2012 Michigan State University Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Michigan State University (MSU), the state's land grant institution, is charged with generating research-based knowledge and educational programming that people can access to make informed decisions to improve their lives. The mission of MSU AgBioResearch -- the university's core research and development arm in agriculture and natural resources -- is to engage in innovative, leading-edge research that combines scientific expertise with an understanding of real-world problems to generate economic prosperity, ensure food safety and security, sustain natural resources and enhance the quality of life in Michigan, the nation and the world. AgBioResearch strives to maintain a balance between basic and applied research and relies heavily on the input of its constituents in identifying research priorities. The accomplishments and discoveries outlined in this report are reflective of the reason why MSU AgBioResearch continues to be one of the most successful entities of its kind.

Michigan State University Extension (MSUE) helps people improve their lives through an educational process that applies knowledge to critical issues, needs and opportunities. One of the hallmarks of MSUE is its willingness and ability to adapt its programming to meet the current needs of Michigan residents, communities and businesses.

Agriculture is Michigan's second largest industry. The state's agrifood system accounts for $91.4 billion in total economic activity (direct, indirect and induced) and more than 600,000 jobs. Michigan has more than 73,000 full-time farmers and farm workers. Food and agriculture account for 22 percent of all jobs in Michigan. The system is likely second only to the manufacturing industry in importance to the state's economy. Michigan also has one of the most diverse agricultural industries in the United States. With more than 200 commodities, the state is second only to California in variety of crops grown. These range from field crops such as corn, wheat and soybeans, a wide range of vegetable crops, ornamental trees and flowering plants, and livestock, honey and fish.

In the sustainability arena, we have adopted the paradigm of 'wicked problems' as a critical conceptual tool to investigate how sustainability can be achieved in both a process and content sense. In the past year, this work has been transformed into the development of a new area of research under the sponsorship of the MetroFoodPlus program, a major university-level project on sustainability related to feeding emerging metropolitan regions around the world. The work is to provide the foundation for the development of the Global Innoversity for MetroFood, an action learning network including Detroit, Mich., the Netherlands, Sao Paulo, Mairobi, Johannesburg, Hyderabad and Singapore. A significant stream of research is expected to emerge over the next several years.

At the same time, Michigan is a state defined, literally, by water. Without the Great Lakes, Michigan's peninsulas and much of the state's agriculture, shipping and tourism offerings wouldn't exist. Further, with the launch of the MSU Global Water Initiative, MSU AgBioResearch and the rest of the university are delving even deeper into water research and positioning themselves as leaders in addressing one of the century's most important challenges - securing a safe and plentiful water supply. Over the past five years, MSU has built a strong research infrastructure rooted in food safety and agricultural development, and these link directly to key issues involving water.

The success and accomplishments of MSU AgBioResearch and MSUE are fueled by close ties with each other, as well as linkages to state agencies, commodity groups and other stakeholders, and outstanding legislative support. Further, reasonable investing for Michigan's success in the past year has resulted in:

Leverage: Every dollar that the federal government invests in MSU AgBioResearch and MSUE

leverages about **$ 9.15** in external contracts, grants and revenues that serve the state's residents. Every federal dollar is leveraged by **$2.47** of state appropriations. Michigan investments in MSU AgBioresearch and MSUE leverage an additional **$100.1 million** in external contracts, grants and other revenues that serve Michigan residents.

Community Benefits: Federal investment extends the reach of MSU AgBioResearch and MSUE that generate as much as **$324.6 million** in benefits to Michigan and the nation. For every federal dollar invested, MSU AgBioResearch and MSUE generate as much as **$18.04** in benefits to the state and nation through educational programs and research.

Benefit/Cost Ratio: When state funds, community benefits and economic stimulus are combined, the estimated benefits to Michigan residents and the nation exceed the initial federal investment **50:1**.

It is important to note that this report reflects only a portion of AgBioResearch and MSUE and not the whole breadth of research and educational initiatives. AgBioResearch's total budget for FY 2012 was **$101.29 million**, with this report representing **$6.43 million** in federal match dollars and equivalent match. MSUE's total budget was **$72.35 million** with this report representing **$8.26 million** federal 3 b&c with **$8.26 million** match.

MSU AgBioResearch 2012 Quick Facts:
129 Hatch-funded researchers representing 64 FTEs
258 active projects
59 patent applications submitted
18 patents received
274 peer-reviewed publications

Key research accomplishments for FY 2012 include:

Setting the stage for children to eat healthier diets -- Childhood obesity rates in the United States have more than tripled in the past three decades. To help address this issue, MSU AgBioResearch scientists have developed a five-topic set of booklets called, "Eat Healthy: Your Kids are Watching! A Parent's Guide to Raising a Healthy Eater," and 24 short video segments to accompany the booklets that feature actual parents talking with their children about food in their homes.

Understanding the importance of milk components to farm profitability -- More than one-third of Midwest dairy farmers experience low milk fat production in their cows at any given moment. MSU AgBioResearch scientists, working to identify ways to increase milk fat yield, discovered that feeding cows a supplement containing 85 percent palmitic acid increased milk fat concentration and yield, as well as the efficiency of feed conversion to milk.

Piecing together the cause of diabetic vision loss -- Diabetic retinopathy is the leading cause of new cases of blindness among Americans ages 20 to 74. Recent research by MSU AgBioResearch scientists has led to a significant discovery -- the inflammation associated with retinopathy is the result of an autoinflammatory feedback cycle, named "inflamm-aging." The team also identified to two proteins responsible -- siah-1 and GAPDH. If these proteins can be prevented from binding, it would create a healthier environment for the retina tissue and prevent blindness altogether.

Monitoring the effects of biomass production on climate -- The Energy Independence and Security Act of 2007 mandates increased use of clean renewable fuels. MSU AgBioResearch scientists are using predictive models to assess the true environmental impacts and benefits of expanded bioenergy plantations and to assist in the sustainable deployment of short-rotation woody biomass crops across the Great Lakes. The most important finding to date is that carbon sequestration and greenhouse gas emissions vary across the landscape -- real world maps would show the best sites for various types of biomass production.

Partnering to defend the nations water resources from nutrient pollution -- Nutrient pollution is one of the country's most widespread and costly environmental issue and, for states in the Great Lakes region, removing phosphorus from water is a matter of particular concern. MSU AgBioResearch scientists are producing media that can retain significant amounts of phosphorus. They are providing engineers with design equations that they need to make use of the product and to know when it needs to be replaced. The next step will focus on how the phosphorus being recovered from the media can be used in other applications.

Reducing mastitis and antibiotic use in dairy cattle -- Mastitis is the most common infectious disease in dairy cattle in North America. To help address this issue a cooperative effort involving the United States and Canada, with support from the USDA and MSU AgBioResearch scientists, offered training sessions and worked with producers in educating employees. This has led to a better understanding of milking procedures and a reduction in mastitis -- Michigan is consistently one of the top states in mastitis control and production of quality milk.

Bridging the gap to protect two of the Earth's greatest resources: soil and water -- Water and soil are two of the most important resources on Earth. Research over the past several decades shows that these critical resources are being compromised by human wastewater treatment and manure disposal practices. MSU AgBioResearch scientists performed pharmaceutical studies that provided the basis to improve best management practices for land application of biosolids and help shape the development of regulations for these emerging contaminants.

Shedding new light on bacterial infections -- Food-borne infections are a major public health concern in the United States. Shiga toxin-producing E. coli (STEC) are the cause of millions of infections every year. MSU AgBioResearch scientists were recently part of a team that discovered that the key to the toxicity of the deadly E. coli outbreak in Germany -- which infected more than 3,800 people and killed 54 -- was its ability to form a biofilm, which allowed it to produce more Shiga toxin. This finding will inform disease prevention practices and ultimately reduce the number of people affected by STEC infections.

Gaining insight into consumer behaviors toward horticultural purchases -- Consumer behavior has always been important for retailers, but with increased climate change, this information has also become critical to horticulturists. Research conducted by MSU AgBioResearch scientists found that purchase odds increase when the price, plant material and other relevant information are packaged together. It was also found that up to half of Americans will search online for information about plants and gardening, and, of those who do search, 19 percent are more likely to make a plant purchase. These findings are essential to horticulture retailers, many of whom operate on less than 10 acres and generate less than $500,000 in revenue.

Advancing biofuels and chemicals from renewable feedstocks -- Ethanol is an alcohol used almost exclusively as a biofuel additive for gasoline. As demand for ethanol increases, MSU AgBioResearch scientists are joining in the effort to help bolster biofuel production by researching butanol. Findings to date have shown that butanol is a highly efficient renewable energy source -- the researchers have been able to get about a 70 percent yield of butanol from ethanol.

Providing tools to help address climate change, prevent environmental harm -- Average summer temperatures in the Midwest are projected to increase by 3 degrees F. over the next few decades and could increase by more than 10 degrees F. by the end of the century. To help address this issue, MSU AgBioResearch scientists have developed predictive models that are being applied to agricultural systems as far away as Senegal, West Africa, where the shortage of food and hunger are major issues. The models produce estimates of a particular crop based on historical and current weather patterns. The technologies developed for Senegal might be able to be applied in Michigan to provide some early warning analysis, especially for intensively managed systems.

Exploring how plants survive freezing temperatures -- The late spring frosts of 2012, which resulted in near devastation to several sectors of Michigan agriculture, underline the importance of learning more about freezing tolerance in plants and, ultimately, determining crops best suited to specific geographical locations. MSU AgBioResearch scientists have recently shown that circadian rhythms prompt a plant's ability to defend against cold weather. This information will allow scientists to design improved crops for food and for the development of plants for the sustainable production of bioenergy.

Making positive changes in Flint with greening projects -- A three-year intervention in two Flint, Mich., neighborhoods to improve their physical surroundings have resulted in increased membership in Code Red, a cell phone network neighborhood watch program, two successful community gatherings in one of the new common areas, and the reestablishment of the local baseball team.

MSU Extension 2012 Quick Facts:

141,229 Unduplicated Adult Participants

Institute for Agriculture and Agribusiness

- 4,917 Business Management
- 44,577 Animal and Plant Production/Environmental Quality
- 591 Bioproducts and Bioenergy

Institute for Children and Youth*

- 7,253 Academic Success
- 4,073 Capacity Building
- 546 Career Education/Work Force Preparation
- 865 Leadership & Civic Engagement

* Additional 20,333 adult volunteers

Institute for Greening Michigan

- 5,996 GM-1: Sustaining Community Prosperity
- 12,086 GM-2: Natural Resources Stewardship
- 4,432 GM-3: Government and Public Policy
- 8,761 GM-4: Community Food Systems

Institute for Health and Nutrition

- 619 HN-1: Disease Prevention and Management
- 2,401 HN-2: Food Safety
- 42,073 HN-3. Nutrition and Physical Activity
- 2,039 HN-4: Social and Emotional Health

176,177 Unduplicated 4-H Youth Participants and 7,329 Children under Five

- 60,160 Animals
- 47,676 Healthy Lifestyles
- 41,065 Environmental Education
- 34,148 Leadership and Personal Development
- 23,611 Plant Science
- 10,960 Biological Science

Key MSU Extension impacts for FY 2012 include:

- $1,736,408,717 Dollars in sales, new or retained
- 645 new farms adopting practices that manage risks
- 681,177 new acres adopting practices that manage risks
- 1,447 new farms adopting technology or tools to manage risks
- 62,961 new acres adopting technology or tools to manage risks
- $1,558,931 Dollars changed due to yield change
- $657,661 Dollars ($) changed due to change in input costs
- 1,717,760 pounds - change in nutrient use in pounds
- 20,052 pounds - change in pesticide use in pounds
- 273,732 tons - change in sediment retained in tons
- 274,000 pounds - change in nutrients retained in pounds (lbs.)
- 5,581 youth (86%) gained the ability to apply science knowledge and problem solving, critical thinking, and decision-making life skills.
- 3,483 youth (98%) could apply life skills learned in their daily lives.
- 4,842 youth (90%) valued and were engaged in cross-cultural experiences.
- 341 adults (65%) kept track of spending and income by creating a personal budget.
- 2,797 adults participated in community natural resource management activities.
- 7,342 youth increased their awareness of human impacts, such as exotic invasive species, habitat damage or non-point source pollution.
- 6,802 youth expressed an interest in ecosystems and ecosystem-based services.
- 234 (72.6%) community decision makers improved their understanding of relevant laws and the practical impacts of those laws on their boards
- 255 people aspired to make changes in their food growing and consumption habits such as patronizing farmers' markets and growing/buying more local and regional food.
- 130 decision makers gained knowledge of the roles food councils can play in their community.
- 1,469 adults adopted healthy eating practices by reporting an increase in fruits consumption during a typical day
- 1,611 adults adopted healthy eating practices by reporting an increase in vegetable consumption during a typical day
- 1,648 adults adopted healthy eating practices based on recommended amount with regards to age, sex, and level of physical activity
- 526 youth (70%) increased their ability to respond to one's own social-emotional needs and the social-emotional needs of others
- 223 youth (30%) decreased involvement with unhealthy/abusive behaviors/relationships

eXtension Impact

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

For further examples of impacts, see the Integrated Legislative Annual Report at:
http://www.agbioresearch.msu.edu/rfp/Legislative-Report-2012-v2-4.pdf

Total Actual Amount of professional FTEs/SYs for this State

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	140.0	0.0	72.0	0.0
Actual	178.8	0.0	64.0	0.0

II. Merit Review Process

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

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

2. Brief Explanation

Because Michigan's agricultural and natural resources are in a constant state of transition, MSU AgBioResearch priorities and MSU Extension educational goals must remain fluid and flexible.

Research goals are continually evaluated for relevance and impact at local state and regional levels. Strategic priority areas address the research priorities of the Michigan agriculture and natural resources industries, but are also linked to national and global goals and new initiatives. Through strategic planning with MSU AgBioResearch-affiliated colleges, MSU Extension staff and key stakeholder groups, priority areas are reviewed annually. This process involves industry experts, university faculty members, MSU Extension and AgBioResearch advisory council members and research center advisory committee members, as well as scientific review by peers (local, national and international).

MSU Extension uses several continuous processes that assist in setting priorities and evaluating program goals and plans. At the local level, the interested public, local government officials, advisory group members and industry experts are involved in their broader stakeholder processes as well as the review of individual educator plans. These goals and plans are also reviewed by state leaders and industry experts for quality and relevance and by the MSU AgBioResearch and MSU Extension directors, who not only evaluate them, but use them in their regional and statewide presentations to describe future plans.

Jointly, MSU AgBioResearch and MSU Extension address issues of concern in local communities with research and teaching by using a network of citizen advisory groups at the local and state levels. 13 District Extension councils identify and prioritize issues, seek collaborations and resources, and communicate to others the importance of MSU Extension educational programming. Citizen Advisory Councils help establish research priorities at the 13 outlying MSU AgBioResearch Centers and on-campus facilities. The MSU Extension and MSU AgBioResearch Council serves as a liaison among district councils, research center advisory groups and state agencies and organizations.

III. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Survey of selected individuals from the general public
- Other (Conferences and meetings)

Brief explanation.

A variety of strategies and approaches were used in the past year to encourage stakeholder participation for a number of key activities and undertakings:

MSU Extension just completed a major restructuring effort in 2011-2012. The effort was underpinned by commitments to reducing administrative overhead, maintaining organizational agility, and responsiveness, accountability to stakeholders, and continued emphasis on focused, effective educational programming across the state. Throughout this process, MSU Extension staff participation was encouraged by publishing weekly newsletters form the MSU Extension director to share information on the progress of the restructure and to solicit staff feedback; using the MSU Extension portal to post information and collect feedback from staff; and holding five town hall meetings and five meetings with local stakeholders at various locations across the state to discuss the restructuring plan and solicit staff input to guide the plan and identify and develop four new institutes within the MSU Extension framework:

- Preparing Michigan's Children and Youth for the Future
- Enhance Michigan's First Green Industry: Agriculture and Agribusiness
- Improve Health and Nutrition for Michigan Residents
- Greening Michigan: Leveraging Natural and Human Assets for Prosperity

Thirteen District Advisory groups were established to help in collecting local stakeholder input and assist in the development of priorities.

Further, numerous individual meetings were held with staff, stakeholder advisory groups and the MSU AgBioResearch/MSU Extension State Council related to the development of MSU Extension institute areas and what they should be. Meetings were also held with the Michigan Association of Counties, the Michigan Townships Association and state legislators.

Following the establishment of the four institutes, a statewide needs assessment -- Advance Michigan -- was undertaken to seek input and direction from staff, internal and external stakeholders, and the general public on what the programmatic priorities should be within each of the institutes. Survey results were used to guide logic models for specific priorities in each institute and a statewide plan of work that will continue into 2015. In addition, MSUE and MSU AgBioResearch continued to strengthen its collaboration with the North Central Region to identify common issues among stakeholder input, pool resources and improve multi-state efforts.

On the research side of the aisle, MSU AgBioResearch and MSU Extension have been continuing to develop the framework for a new, inclusive, industry supported partnership. This Michigan Agriculture and Food Strategic Growth Partnership -- which came about as a result of the 2011 Governor's Summit on Production Agriculture and the Summit for Food Processors, and included input from the agriculture industry and state government -- has developed a plan based on the Governor's five-year challenge to create a stronger and even more vibrant agriculture. The partnership is meeting that challenge with a commitment to a comprehensive review in year four to evaluate the accomplishments during its first three years.

One of its key first-year outcomes was the establishment of the MSU Center for Strategic Growth in Food and Agriculture. This entity, which will combine the strengths of the MSU Product Center and the Center for Economic Analysis, will promote the strategic growth in Michigan's key agricultural commodity, food processing and manufacturing sectors. The partnership's activities will include:

- Establishing baseline metrics for and effectively monitor the contributions of MSUE and MSU AgBioResearch to each key agriculture sector.
- Maintain regularly updated market opportunity assessments for each key sector.
- Create and facilitate a series of strategic working groups for each key sector including MSU, government, industry, and societal organization representatives.
- Maintain effective capacity to respond to quick-turnaround assessments and analyses needed by government and industry sectors.
- Translate the research outputs of MSU AgBioResearch into strategic recommendations for Michigan-based food and agricultural firms.

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.

With a mission to engage in innovative, leading-edge research that combines scientific expertise with practical experience to generate economic prosperity, sustain natural resources and enhance the quality of life in Michigan, the nation and the world, MSU AgBioResearch has an extremely broad and long list of stakeholders and partners -- representatives in the agricultural, food, natural resources and bioeconomy industries and their constituent companies, organizations, farms and businesses; and with other public sector partners from federal, state and local governmental organizations and other universities. In reality, every Michigan citizen is both an AgBioResearch and an MSU Extension stakeholder!

Using the methods checked above, the emphasis is on keeping up-to-date on key internal and external stakeholders (e.g., agricultural producers, commodity groups, food processors and the tourism, fisheries and forestry industries), legislative contacts and the interested public, and using a blend of traditional and online platforms to reach individuals and groups and collect input from them.

The Advance Michigan statewide online issues identification process that was completed in the Fall of 2011, the previous Strengthening Michigan's Economy comprehensive survey before it, and other ongoing outreach efforts offer multiple ways for people in various roles and locations to

help identify the issues and opportunities for MSU AgBioResearch priorities and MSU Extension educational programming in the years ahead.

Community-based discussions in all Michigan counties, involving local advisory committees, the MSU Extension/AgBioResearch councils and others are held to discern what issues and opportunities stakeholders believe should be addressed related to research and programming. Citizen focus groups are also used to identify issues and opportunities in Michigan and assign a priority ranking to each. Community groups, commodity and producer groups and other state and local partners are periodically asked what issues and opportunities should be explored and addressed.

Faculty member focus groups, with representatives from Michigan colleges and units, are held as needed to glean faculty member perceptions on emerging Michigan issues and opportunities and to identify ways that MSU science projects and/or initiatives might address them. MSU faculty members and MSU AgBioResearch/MSU Extension staff surveys are used as needed to develop a better understanding of the university's ability to respond to issues identified in faculty focus groups.

County teams, including AgBioResearch Center managers, synthesize and prioritize content-specific program and research needs identified by the various councils and advisory committees.

Working groups within each institute synthesize and prioritize content-specific program and research needs generated from the input of their advisory bodies and develop programs to meet these needs as well as methods for evaluating their impacts. Needs are fine-tuned as additional input is received.

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

1. Methods for collecting Stakeholder Input

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

Brief explanation.

Stakeholder input provides the foundation for the research and educational programs developed by MSU AgBioResearch and MSU Extension. Stakeholders help decide the future direction for MSU AgBioResearch through programs such as Project GREEEN, the Animal Agriculture Initiative and commodity advisory teams. There are extensive conversations and visits that also take place throughout the year with local, state and federal officials, and commodity group and industry representatives from the agricultural, natural resources and renewable energy industries.

For MSU Extension, town hall meetings, individual meetings, feedback via email, blogs and surveys and new formed District Advisory groups are all being used to inform the newly restructured MSU Extension, including the priorities that should be set under each of the four new institutes.

More specifically, the past two years was spent collecting input from county commissioners. A series of meetings was held with commissioners across the state. A task force was then set up to help determine how the partnership could work. The task force met and then sent a mailing (that also included a url to a website with additional information) to all county commissioners, inviting

them to participate in several webinars to discuss the Memorandum of Agreement that was being put together to formalize the partnership. A survey was also sent out to all commissioners, laying out three scenarios on how to approach the partnership. Survey participants were asked which of the options they preferred and how they thought it could be implemented to ensure that the right costs are allocated to the counties and to MSU Extension. Based on this feedback, changes were made. The MOU (Memorandum of Understanding) was executed in FY 2012 in 80 counties.

For MSU AgBioResearch, multiple meetings were held with commodity groups, legislators and key stakeholders representing the key agrcultural sectors as work continued with the consolidation of management and operations for various research centers and units. In addition to these traditional, long-standing venues, an ad hoc committee comprised of faculty members and commodity group stakeholders was established to conduct a comprehensive review of MSU AgBioResearch Centers and to provide recommendations on how to best move forward in implementing needed changes.

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.

Due to stakeholder input, AgBioResearch has focused more sharply on renewable energy and biobased products that can help boost the Michigan economy, including fuels, chemicals, neutraceuticals and food products; the environment; land use issues; and biotechnology. Water research and food safety are also issues that are receiving increased attention and funding resources, as evidenced by the recent launches of the MetroFoodPlus Initiative and the MSU Global Water Inititative. From an operational perspective, MSU AgBioResearch has used stakeholder input to guide its decision making process around the consolidation and restructuring of its 13 AgBioResearch Centers and various on-campus units.

MSU Extension utilized the stakeholder input in forming the four institutes and the 16 work groups that guide them. The input has been useful in setting priorities and focusing more with less resources.

Brief Explanation of what you learned from your Stakeholders

Things AgBioResearch learned from its stakeholders:

- Genetic research needs to be a critical area of focus.
- Food safety and security and a safe and secure water supply are critical priority areas for research activities.
- It's critical that research activities and MSU stay current and include newer technologies. The organization needs to continue to build and maintain strong partnerships both internally and externally. It's going to take the efforts of all of us, working together, to be successful.
- Solutions and innovations that come from MSU AgBioResearch will be even more critical in the future for MSU, Michigan, the nation and the world.

Things MSU Extension learned from its stakeholders:

Based on input from the restructuring process and other stakeholder input, MSUE will base their efforts around four key topic areas:

- Agriculture and Agribusiness -- Increasing the viability of Michigan agriculture and agribusinesses will ensure a safe, affordable food supply for Michigan residents while maintaining or increasing farm profitability and contributing to job growth.
- Children and Youth -- Statewide project focus areas will address issues related to academic success, science, leadership and civic engagement, career and workforce preparation and capacity building for youth skill development.
- Health and Nutrition -- Increasing productivity and reducing healthcare costs will give Michigan residents tools to embrace healthy living. A healthy population is a sound financial investment. A new workgroup, called Social and Emotional Health will focus on teaching youth skills to address bullying, alternatives to anger and safe dating.
- Greening Michigan -- The MSU Extension Greening Michigan Institute will work with individuals, private and public sector leaders and others under the auspices of workgroups that are committed to strengthening community food systems; community prosperity; financial, housing and energy resources; and natural resources appreciation and stewardship.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
8866825	0	6436878	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8262116	0	7048214	0
Actual Matching	8262116	0	6435430	0
Actual All Other	0	0	28654893	0
Total Actual Expended	16524232	0	42138537	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	4216765	0	0	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Human Health, Environment, Family, Youth, Society and Community
2	Soil, Water and Natural Resources
3	Plant Sciences
4	Economics, Marketing and Policy
5	Animal Production and Protection
6	Global Food Security and Hunger
7	Climate Change
8	Sustainable Energy
9	Childhood Obesity
10	Food Safety
11	Food and Non-Food Quality, Nutrition, Engineering and Processing

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Human Health, Environment, Family, Youth, Society and Community

☑ 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	10%		8%	
702	Requirements and Function of Nutrients and Other Food Components	0%		4%	
703	Nutrition Education and Behavior	10%		3%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	0%		8%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		5%	
721	Insects and Other Pests Affecting Humans	0%		2%	
723	Hazards to Human Health and Safety	5%		12%	
724	Healthy Lifestyle	20%		12%	
801	Individual and Family Resource Management	5%		0%	
802	Human Development and Family Well-Being	20%		10%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%		10%	
805	Community Institutions, Health, and Social Services	0%		18%	
806	Youth Development	30%		8%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	49.9	0.0	10.0	0.0

Actual Paid Professional	99.6	0.0	11.0	0.0
Actual Volunteer	117.3	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**
4346439	0	1127714	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
4346439	0	1029669	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4584783	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

• Determine the relationship between family lifestyle factors, education, environmental influences and physical activity on general health and well-being, especially related to obesity, cancer, diabetes and chronic disease risk.
• Identify the nutritional determinants of allergic immune disorders.
• Increase understanding about how environmental pollutants, especially ozone and endocrine disruptors affect human health.
• Analyze the relationships among social support, public policy and family characteristics and how they affect the function and well-being of families.
• Increase understanding and develop more effective environmental management systems, practices and protocols related to natural and social systems.
• Develop better models for the human health and human services sectors.

Educational programs to:

• Teach how to choose healthful food, physically active lifestyles and behaviors consistent with dietary guidelines.
• Teach consumers to keep their food safe by offering programs on food safety, home food preservation and healthy, hygienic food-handling practices.
• Teach people living with chronic medical conditions to manage their condition effectively.
• Teach financial literacy and prepare individuals to manage their finances in anticipation of retirement.
• Teach caregivers and parents how to prepare children for school.
• Increase access to affordable, high-quality childcare.
• Prepare communities for the health care, housing and transportation needs of seniors.
• Educate citizens and public officials about funding methods, service provision and intergovernmental cooperation.
• Provide counties and municipalities with technical assistance related to intergovernmental contracting, consolidating services and financial and strategic planning.
• Assist government officials in leadership, conflict management, communication and engaging the public in policy development.

- Prepare youth with knowledge and skills needed for life and employment.
- Enhance the physical, social, emotional and cognitive health and well-being of youth.

2. Brief description of the target audience

Michigan private citizens, state agencies, farmers, food processors, commodity groups and agricultural industry representatives are targets of research programs. Individuals of all ages and life stages are targeted for healthy lifestyle and food-safety education programs. Human development and family well-being programs target parents and caregivers of preschool children, people living with chronic medical conditions and senior citizens. Community institutions, health and social services programs target citizens and public/government officials. Youth age 9 to 18 are targets of youth development programs.

3. How was eXtension used?

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

Ask an Expert statistics were analyzed for our program areas and found for Human Health, Environment, Family, Youth, Society and Community there were 39 staff paid by formula funds (13 fte). A few examples were:

Question: I am concerned about the lack of a substantial "whoosh" of air when canned goods are opened. Now I learn that Ball, Kerr, and other lids are no longer made by the old companies. I have to question the safety of these new lids. For example, my canned applesauce has a discoloration in the top portion of the sauce. The lid appears to be sealed, but there is a minimum amount of air entering the jar upon opening. I have not become sick from these products, bu t I do discard that top portion. In the past I preferred the old Kerr lids, and I have canned for the over fifty years of my married life. I do prefer to can green beans, but most other foods can be frozen. Are others having problems with these lids?

Answer: It is wise to be concerned about the safety of canned goods, so I am glad you asked this question! Though you may not find the "whoosh" you are used to with canned goods, the lids have been found to be safe through tests, generally done by research-based institutions (like Universities). The discoloration on the top of your applesauce is not necessarily a sign of spoilage. Some ways to try and prevent this are to make sure all air bubbles are removed before sealing the jars, using the recommended headspace (1/2 inch for applesauce), and checking for minerals (like iron, copper, or zinc) in your cooking pot or in the water. About fifteen years ago there was a bit of a problem with canning lids, as some manufacturers changed their sealing compound. But I have not heard this general concern (about lids) since then. Thank you for contacting eXtension! And congratulations on your 50 years of married life and food preservation!

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9328	27984	15012	30024

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

Patent Applications Submitted

Year: 2012

Actual: 7

Patents listed

MICL01680 - Value-added Products for Improving Human, Animal and Plant Health - 61/598,843, 2/14/2012; 13/468,712, 5/10/2012; 13/460,781, 4/30/2012. MICL02017 - Evaluation Specificity and Structure/Function of Taxol Biosynthesis - PCT/US2012/042951, 6/18/2012. MICL02214 - Molecular mechanisms of Cytoplasmic Incompatibility in Mosquitoes - 61/625,881, 4/18/2012; 61/617.155, 3/29/2012 and PCT/US2012/029048, 3/14/2012.
MICL02107 --

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	1	47	48

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on human health, environment, family, youth, society and community.

Year	Actual
2012	44

Output #2

Output Measure

- Number of adult participants trained in healthy lifestyles.

Year	Actual
2012	4872

Output #3

Output Measure

- Number of youth participants trained in healthy lifestyles.

Year	Actual
2012	6823

Output #4

Output Measure

- Number of adult participants trained in human development and family well-being.

Year	Actual
2012	1499

Output #5

Output Measure

- Number of youth participants trained in human development and family well-being.

Year	Actual
2012	1809

Output #6

Output Measure

- Number of adult participants trained in youth development.

Year	Actual
2012	2130

Output #7

Output Measure

- Number of youth participants trained in youth development.

Year	Actual
2012	6380

Output #8

Output Measure

- Number of adult participants trained in family resource management.

Year	Actual
2012	827

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to determine the relationship between family meals/lifestyle factors, education/food choices, general healthand environmental influences, physical activity and general health.
2	Number of research programs to understand how environmental pollutants, especially ozone and endocrine disruptors, affect human health.
3	Number of research programs to develop better models for the human health and human services sector.
4	Number of adult participants with increased knowledge about healthy lifestyles.
5	Number of youth participants with increased knowledge about healthy lifestyles.
6	Number of adult participants with increased knowledge of human development and family well-being.
7	Number of youth participants with increased knowledge of human development and family well-being.
8	Number of adult participants with increased knowledge of youth development.
9	Number of youth participants with increased knowledge of youth development.
10	Number of research programs to develop more effective environmental/natural resources management systems.
11	Number of adult participants with increased knowledge of family resource management.
12	Number of research programs that study the function of nutrients and other components related to human health.

Outcome #1

1. Outcome Measures

Number of research programs to determine the relationship between family meals/lifestyle factors, education/food choices, general healthand environmental influences, physical activity and general health.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	18

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overweight people are at serious risk for cardiovascular disease, diabetes and some forms of cancer, and the risk is lifelong. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity reports that overweight adolescents have a 70 percent chance of becoming overweight or obese adults, and this risk increases to 80 percent if a parent is overweight or obese. Further, obesity associated coronary heart disease is now the No. 1 cause of mortality in the United States. Parents can significantly improve the health of their children by initiating family lifestyle changes in activity and eating behavior.

What has been done
Research to: generate information to make it easier for citizens to eat healthier and be more physically active; determine the effects of food marketing on children's dietary behavior; determine the role of inflammation in the development of diabetic retinopathy; determine the role of diet, obesity and inflammation on colon cancer risk; determine the effect of calorie restriction on the body's innate immune response to influenza; and develop effective prevention and intervention methods for E. coli-related illnesses.

Results
A five-topic set of booklets, "Eat Healthy: Your Kids are Watching! A Parent's Guide to Raising a Healthy Eater," were produced. Twenty-four short video segments, which feature actual parents with their children talking about food in their homes, were created to accompany the booklets.

Research on diabetic retinopathy resulted in the discovery that the inflammation associated with retinopathy is the result of an autoinflammatory feedback cycle. Further, two proteins that enhance retinal inflammation were identified, creating the possibility of finding a way to keep

these two proteins from binding, ultimately creating a healthier environment for retina tissue and preventing blindness altogether.

Research on Shiga-producing E. coli (STEC) has demonstrated that bacterial cells can increase their toxicity through the use of biofilms. With this information, scientists are now working on mutant strains in an effort to prevent the bacterium from forming a biofilm, potentially decreasing the likelihood of more severe disease.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
802	Human Development and Family Well-Being
806	Youth Development

Outcome #2

1. Outcome Measures

Number of research programs to understand how environmental pollutants, especially ozone and endocrine disruptors, affect human health.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michigan residents are exceptionally vulnerable due to chronic exposure to complex mixtures of endocrine disruptors that include legacy environmental contaminants within the Great Lakes basin (e.g., dioxin, PCBs, DDT), numerous pesticides and herbicides from the diverse and intense agricultural activities within the state, and the broad range of industrial activities that contribute to the overall pollution burden.

What has been done
Research to: comprehensively assess the toxicity of endocrine disruptors to determine the health risks of this contaminant to human health and wildlife in Michigan; study chronic respiratory diseases caused by air pollutants to better understand how nasal tissues and cells may respond

to inhaled toxicants;determine why some species of birds are more likely to support infectious agents than others; and to evaluate pesticide use and mitigate pesticide misuse to reduce environmental and human risk.

Results
Scientists studying a condition known as cardiometabolic syndrome (CMS), which increases the risks of cardiovascular disease and diabetes, found that mice fed a high-fructose diet (pervasive in today's human diet) begin showing CMS symptoms after a few weeks. When those same mice are exposed to air pollutants, they develop a condition known as insulin resistance, believed to be the underlying physiological cause of CMS, demonstrating a link between the health effects of CMS and air pollution.

Research performed in 2012 has further established that HIF1 and HIF2-mediated signaling (transcription factors that control, in part, the response to hypoxia) impacts asthma pathology and suggests that these HIFs may represent new asthma susceptibility factors that could lead to an efficacious means to prevent asthma in premature infants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
723	Hazards to Human Health and Safety
805	Community Institutions, Health, and Social Services

Outcome #3

1. Outcome Measures

Number of research programs to develop better models for the human health and human services sector.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Healthy, vital communities with active citizenry are better equipped to address the challenges facing many of today's families. Whether the issue is economic development, youth aging, family

dynamics, demographics or rural and urban security, better models for the human health and human services sector are critical to human development and overall well-being.

What has been done
Research to: develop healthcare packaging that is easier to access, particularly for aging consumers and people with disabilities; develop models for preventive and early intervention strategies for children living with a family member with a serious illness;examine the relationship between the number of foster home placements for youth and the number of community connections as emancipated adults;examine the relationships between emotion-related socialization behaviors and infants', toddlers' and preschoolers self-regulation and social-emotional competencies; and to develop models and family-based interventions that advance the well-being of National Guard soldiers and their families post-deployment to a combat zone.

Results
Research on front-of-package (FOP) nutritional labeling has shown that a traffic light system to convey nutritional content shows great promise in consumer responsiveness and product understanding. These FOP systems display certain components of a product, such as sugar, fat and salt -- often associated with health conditions such as diabetes, heart disease and hypertension. Green lights suggest foods low in these components, while amber denotes moderate levels and red indicates high amounts. State-of the-art technology is used to observe how people respond to the labeling. A similar system using different facial expressions (smiling, straight mouth, frown) is also being studied.

Research to help military families deal with stress shows that families that do best have strong support systems, the ability to communicate well in times of stress and anxiety, satisfying jobs and access to trusted external resources. Findings are also being used by policymakers at the local and national levels and in reintegration efforts.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Number of adult participants with increased knowledge about healthy lifestyles.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	4287

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"The current lifestyles of most adults and children include too little physical activity and unhealthy diets. These two behaviors have contributed to the current epidemic of overweight and obesity in Michigan" (Healthy Michigan 2010, p.54) and places individuals at a greater risk for heart disease, diabetes, and other chronic diseases including cancer and arthritis. (Ogden et al., 2006; Ogden et al., 2008)

Michigan is a state continuing to struggle with high unemployment, high poverty rates and high obesity rates. While the national unemployment rate is at 9.8%, according to the October 2010 report from the Bureau of Labor Statistics, Michigan's unemployment rate remains slightly below 13%.

A point often overlooked is that many of those included in these statistics are new to poverty and may need significant assistance in navigating the food security system, as well as planning, preparing and budgeting low-cost meals. The loss of health insurance that accompanies unemployment makes disease prevention through good nutrition an even more important aspect of the EFNEP program in Michigan.

We also know that unemployment and under-employment is a factor in growing obesity rates. Michigan has the 10th highest rate of adult obesity (29.4%) and the 41st highest childhood obesity rate (12.4%) in the nation (CDC). A report in the American Journal of Clinical Nutrition (January, 2004) stated that the highest rates of obesity occur among groups with the highest poverty and the least education. Poverty and food insecurity are associated with lower food expenditures, low fruit and vegetable consumption, and lower-quality diets. Though spending a lower percent of income on food, Americans are consuming more sugars and fats contributing to the growing obesity rate.

What has been done
MSU Extension provides nutrition education in all 83 counties of Michigan through a variety of programs and funding sources (numbers here reflect approximately 10% of participants in this area). One example is Cooking Matters where the program empowers families at risk of hunger with the skills, knowledge and confidence to make healthy and affordable meals. With the help of volunteer culinary and MSU Extension nutrition staff, low income course participants learn how to select nutritious and low-cost ingredients and prepare them in ways that provide the best nourishment possible to their family.

Results
Findings from the evaluation of Cooking Matters found:

Positive change in Healthy Behaviors:

-84% reported an improvement in the frequency of thinking about healthy food choices.
-63% reported a decrease in the frequency of adding salt when preparing or eating foods.
-91% reported an improvement in the frequency of using Nutrition Facts on the food label to make food choices.
-38% reported an improvement in the frequency with which their families eat something within two hours of waking up.
-74% reported an improvement in the frequency of eating at least 2 cups of fruits a day.
-73% reported an improvement in the frequency of eating at least 2.5 cups of vegetables a day.
-69% reported an improvement in the frequency of making meals that include at least 3 food groups.
-65% reported an improvement in the frequency of getting at least 30 minutes of moderate physical activity each day.
-50% reported an improvement in the frequency of cooking meals for their family instead of buying take-out or already prepared foods.

Change in food safety behaviors:

-44% reported a decrease in the frequency of letting foods sit out for more than 2 hours.
-35% reported a decrease in the frequency of thawing frozen foods by leaving them out at room temperature.

Change in Resource management behaviors:

-78% reported an improvement in the frequency of planning meals ahead of time.
-75% reported an improvement in the frequency of comparing prices before they buy food.
-49% reported a decrease in the frequency of running out of food before they get money to buy more.
-63% reported an improvement in the frequency of shopping with a grocery list.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Number of youth participants with increased knowledge about healthy lifestyles.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6277

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity is a major contributor to chronic diseases, such as cardiovascular disease, cancer and diabetes. Michigan is currently ranked as the 10th most obese state in the U.S. In 2010, 31.7% of adults in Michigan were considered obese compared to 27.5% of U.S. adults. Clearly, focusing on early education to children and youth can make a significant difference on healthy eating and physical exercise.

What has been done
Show Me Nutrition is a comprehensive nutrition curriculum that teaches youths from preschool through junior high how to have a healthy lifestyle. The curriculum supports Missouri's Show Me Educational Standards (adapted from the National Health Standards) and supports grade level expectations for math and communication arts, where appropriate. Several important health themes are taught in each grade level, such as nutrition, food safety, physical activity, media influence and body image, and the grade levels are designed for continuity. Age-appropriate content, activities and handouts make learning about healthy eating fun for students at all grade levels. The preschool through fifth grade curricula include family newsletters that help family members and caregivers support learning at each grade level. Each curriculum includes handouts to reinforce lesson content with families and caregivers. During the last year the Curriculum has been updated and revised to reflect the 2010 Dietary Guidelines for Americans and to incorporate USDA?s MyPlate.

Results
During the last fiscal year we reached nearly 52,395 children and youth in 82 of 83 counties in Michigan through one time presentations and a series of lessons. Note that only a portion was counted above due to funding lines. Males and females were equally reached in our programming in series. Nutrition education was offered based on child?s developmental stage. Results of the MSU Extension program evaluation reflects that Show Me Nutrition is an effective

curriculum for improving children's knowledge and healthy behaviors. Results found:
School teachers reported that they have observed improvement in children?s healthy behaviors:

88% reported children being more aware of the importance of healthy nutrition.

93% reported that children are more willing to try new foods.

86% reported that children improved hand washing.

59% reported that children increased physical activity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

Outcome #6

1. Outcome Measures

Number of adult participants with increased knowledge of human development and family well-being.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1349

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Understanding the long-term value of academic success, leads one to study the factors that contribute to this state for children and youth. There are many different theories. The broad stroke factors that can affect school performance include socioeconomic status, parenting, amount of time spent with other children, quality and quantity of time spent away from primary caregivers, degree of physical and mental health, and effects of peer relations. Of course other factors such as presence of motivational teachers, parental expectations, reading at appropriate grade levels, and having their nutritional needs met may also be of influence.

Young children who are read to daily are more likely to develop emergent literacy skills; however, a 2007 report issued by the US Department of Health and Human services indicated that 16% of ages one to five were read to less than three days a week. Research shows that young children who develop emergent literacy skills prior to entering kindergarten are better prepared to learn to read and those children who are proficient readers by fourth grade. Furthermore youth who are not proficient readers by 4th grade are 68% more likely to drop out of high school and 5-8 times more likely to be incarcerated. A 2009 Annie E. Casey Foundation analysis of data from the NAEP found that 67% of all 4th grade students were below proficient in reading and 33% were below basic skill level and unfortunately 75% of students who are poor readers in 3rd grade will remain poor readers never overcoming that gap.

Noting that the literature review indicates the possession of basic life skills such as verbal and non-verbal communication skills, ability to work cooperatively, a sense of responsibility and respect, community involvement, decision making and problem solving are predictors not only of academic success but of success in the community and work force as well, preparing parents and other adults to help youth embrace those skills is an important step in growing Michigan?s future by helping to prepare children and youth to thrive and contribute in a complex and changing world. Research conducted by the Search Institute indicates that youth that have a higher number of developmental assets are significantly more likely to succeed in school, value diversity and maintain good health. The study also found that youth with greater developmental assets are significantly less likely to use illegal drugs, be sexually active, or be either a victim or perpetrator of violence. (Search Institute, 1998).

What has been done
It is apparent that Michigan State University Extension can promote academic success by:

equipping parents and other adults significant in the lives of young children with the knowledge and skills preparing children to enter school socially, emotional and physically healthy and safe and ready to learn over their life span; helping youth to develop and practice life skills which will enable them to be successful academically and in future careers; and exposing youth to a variety of science experiences designed to enhance their science literacy.

The Michigan State University Extension Children & Youth Institute's Academic Success work group developed early childhood programs that work with both parents and children to improve academic success through improving parent-child interactions, better understanding of child development stages and needs, and helping the child to be ready for school. The goal of the program is for Michigan children and youth will demonstrate readiness for and engagement in K-12 education and possess the skills needed to be successful lifelong learners and ultimately a diverse population will be prepared to thrive and contribute in a complex and changing world.

Results
90.8% of the children were engaged in emergent literacy activities that prepared them for school.

92.6% of children were socially, emotional, and physically safe.

53.5% of participating adults indicated a change in knowledge regarding their ability to help young children 0-5 learn by using the protective factors survey.

95% of the adults increased their knowledge of how to prepare their children for school.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Number of youth participants with increased knowledge of human development and family well-being.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1628

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Several research studies, also supported by research conducted by the Search Institute, identified significant positive outcomes for youth who have developed life skills preparing them to be academically successful. These adolescents are more likely to delay participation in sexual activity (Schvanevelt, Miller & Berry, 2001); display higher self-esteem (Filozof, Albertin, & Jones, 1998); experience lower levels of depression and anxiety (Cicchetti & Toth, 1998, Liem, Dillion, & Gore, 2001); are less likely to abuse alcohol and to exhibit socially deviant behavior (Kasen, Cohen, & Brook, 1998); and are less likely to use and abuse substances (Hallfores et al., 2002).

What has been done
MSUE Programs in the Children and Youth Institute provide community-based, regional and statewide educational experiences to diverse audiences of children, youth, and the parents and adults that support them resulting in the development of assets that help children and youth thrive and contribute in a complex and changing world.

Results
Examples of evaluation results in life skills found:

97.7%of the youth gained the ability to apply the use of life skills gained through participation in 4-H.

90.1%of the youth applied life skills that they had learned in their daily lives.

98.4%of the youth valued and were engaged in cross-cultural experiences.

96.8%of the youth understood their own culture and the cultures of others.

99.5% of children were socially, emotional, and physically safe.

99.5% of the participating adults indicated the ability to apply life skills education into their youth development programs and activities.

99.5% of the adult participants could identify the connection between 4-H participation, life skills development, and academic success.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
802	Human Development and Family Well-Being
806	Youth Development

Outcome #8

1. Outcome Measures

Number of adult participants with increased knowledge of youth development.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1917

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2012, Michigan 4-H Youth Development involved more than 20,000 adults in providing fun, hands-on learning opportunities to more than 176,000 Michigan young people. 4-H also provided volunteer training opportunities to foster and support positive youth development. It is critical that volunteers have a strong knowledge of youth development.

What has been done
Trainings have been conducted to further develop adult volunteers' knowledge of youth development (especially new volunteers), as well as create safe environments for young people to learn, have fun and develop socially, and ensure that the adults we entrust to work with young people only have the best interests of youth at heart. The Michigan State University Extension Volunteer Selection Process is a tool used to recruit and orient volunteers who will be involved with young people for long-term, overnight or extended involvement. Adult volunteers is a tremendous asset to be cultivated, nurtured and utilized.

Results
Results of evaluations of approximately 528 adult volunteers found:

98.0%of the adults indicated the ability to apply life skills education into their youth development programs and activities.

92.3%of the adults indicated the ability to apply knowledge to engage youth in experiential, inquiry based science learning.

98.0%of the adults who increased their knowledge and skills in science content areas.

98.0%of the adults indicated increased confidence in their ability to engage youth in experiential, inquiry based science learning.

94.8%of the volunteers incorporated appropriate 4-H Guiding Principles into their programming.

94.3%of the adults that learned how to teach youth entrepreneurial concepts.

95.5%of the adults integrated financial literacy education into their programming.

98.7%of the adults supported youth in applying global and cultural competencies.

99.1%of the adults that gained understanding of youth global and cultural competencies.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Number of youth participants with increased knowledge of youth development.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6061

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michigan State University Extension Children and Youth Institute, through its 4-H program, strives to provide opportunities for youth (ages 5-19) to increase their leadership skills, build their cultural competencies, engage in the world around them as active citizens and learn that their voice and actions can make a difference. Our Vision Statement: Youth engage in making the world a better place. They utilize skills to lead in a globally interdependent and multicultural world. As citizens, they respond to shared local and global priorities through leadership, civic engagement and service. They understand and respect their own culture and the culture of others.

Leadership and Civic Engagement: A democracy is only as strong as the citizens that make it up and strength comes from having the knowledge, skills and attitudes to work for a common good. Research shows that changing demographics and lifestyle patterns diminish residents? willingness and ability to participate as leaders and volunteers. (Strengthening Michigan?s Economy Report, 2007). Young people need leadership and citizenship education to be prepared to fully participate in society as adults (Strengthening Michigan?s Economy Report, 2007, p. 23). Sixty-seven percent of Michigan residents surveyed indicate ?helping youth develop leadership, citizenship and other life skills? is a high priority. Fifty-five percent indicate ?involving youth and adults as active partners in decisions that affect the community? is a high priority. (Strengthening Michigan?s Economy Report, 2007, p. 22).?For more than a century, the 4-H program? has engaged young people to strengthen decision-making, communication, teamwork, problem solving, and critical thinking skills.? (National Citizenship Mission Mandate) Research confirms that 4-H members in grades 5-9 are more likely to make contributions in their communities than non 4-H members (Lerner et al, 2009). National 4-H Council defines the concepts and skills necessary for leadership to include communication, conflict management, decision-making, facilitation, planning, goal setting, problem solving, inclusion, diversity, and self-confidence (National 4-H Council, 2010). The Leadership and Civic Engagement work group has identified additional skills and concepts important to leadership including: character, creativity, citizenship,

and ethics.

What has been done
Trainings have been conducted to further develop youth leadership and civic engagement skills.

Results
Evaluation results from approximately 1512 youth found:

72.3%of the youth civically engaged as volunteers, decision makers, and community leaders.

97.8%of the youth that demonstrated the skills necessary for leadership.

72.3%of the youth engaged in authentic decision making partnerships.

98.0%of the youth gained knowledge and skills necessary for leadership.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Number of research programs to develop more effective environmental/natural resources management systems.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The need to develop economically and environmentally sound approaches to address environmental and natural resources challenges is increasingly important. Policies, practices and science-based knowledge must constantly evolve to promote stewardship and sustainability in light of new opportunities for increased productivity, resource-saving technologies and threats to biodiversity. Research is needed to ensure that practices and policies have a strong, science-based foundation.

What has been done
Research to: better understand community capacity in the management and decision making around natural resources, especially water and sanitation; better understand public benefits for policy development in recreation and tourism resource management; identify sustainable ways to enhance human well-being while reducing stresses on the environment; and to better understand the current spread, historical distribution and future disease risk of Lyme disease to inform effective citizen-focused information campaigns.

Results
A three-year intervention in two Flint, Mich., neighborhoods to improve their physical surroundings and measure the social impacts of landscape maintenance has resulted in an increase in membership in Code Red, a cell phone network neighborhood watch program, two successful community gatherings in one of the new common areas,and the reestablishment of the local baseball team.

Researchers focused on strengthening and sustaining Michigan's tourism industry were selected to prepare the 2012-2017 Michigan Tourism Strategic Plan. Preparation of the plan included the researcher's data, a series of industry surveys and 12, four-hour stakeholder workshops throughout the state (with a total participation in excess of 500 people). The plan has subsequently been approved and is being used to direct Michigan tourism industry over the next five years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
723	Hazards to Human Health and Safety
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #11

1. Outcome Measures

Number of adult participants with increased knowledge of family resource management.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	620

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The current national economic crisis in personal finance, housing and home foreclosure have placed unprecedented hardship on Michigan residents resulting in the need for personal financial education.

What has been done
MSUE developed and implemented programs to address financial literacy to improve the capability of Michigan residents to manage credit and financial resources and make financial decisions as well as reduce housing foreclosures and abandonment.

Results
Evaluation results for adults found:

65.1%of the participants kept track of spending and income by creating a personal budget.
68.6%of the participants saved money regularly by spending less than is earned.
68.2%of the participants obtained, reviewed and corrected personal credit report.
73.2%of the participants reported bills were paid on time.
61.6%of the participants paid down debt and adopted behavior changes that improved their credit score.
66.3%of the participants planned for retirement.
54.7%of the participants utilized a checklist for completing the steps in the home buying process.
54.7%of the participants calculated a reasonable housing cost based on the household budget.
58.3%of the participants decided to purchase a home.
34.0%of the participants reviewed and compared utility bills.
77.9%of the participants identified SMART financial goals.
74.7%of the participants increased their awareness of income, saving and spending through tracking.
70.4%of the participants learnned to review all bills and/or financial institution statements for accuracy.
51.4%of the participants increased their knowledge of home ownership financial requirements.
46.6%of the participants increased their knowledge in predatory lending.

Evaluation of 100 Youth trained in financial literacy (not included in adult numbers above but new area for evaluation) found:
87.5%of the youth became financially literate.
84.8%of the youth applied sound financial practices.
78.3%of the youth increased thier knowledge of financial concepts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
806	Youth Development

Outcome #12

1. Outcome Measures

Number of research programs that study the function of nutrients and other components related to human health.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Ase we head into the second decade of the new millennium, paradigms of an unfolding nutrition transition in many countries; and uncontrolled obesity epidemic gripping America; global malnutrition; prolonged food insecurity in many low-income countries; and changes to prevent childhood stunting compel us to more fully understand the developmental (nutritional) origins of health and chronic disease that dominate the global public health nutrition agenda. By studying how individual food components are digested, absorbed, metabolized and utilized - and their effects on genes, cells and organs - the whole person can be understood. Deliberate manipulation of these food interactions can lead to improved health.

What has been done
Research to: identify more effective, efficient and greener, plant-based processes to produce pharmaceuticals; and to determine the effect of selected nutrients and food components on the development of allergic airway diseases.

Results
Research focused on nutritional determinants of allergic immune disorders has found that Vitamin E (in the form of yT), in a rodent model, can protect from and reverse allergic inflammatory processes of the lung by inhibiting the enzyme COX2, which is a key inflammatory pathway. Scientists are also exploring a possible connection between yT consumption during pregnancy and the incidence of allergic airway disease in children. Initial findings showed that pregnant mice

with deficient vitamin E had more pups with worse asthma. On the basis of these findings, researchers believe that setting a recommended daily amount of yT might be beneficial.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The ongoing economic challenges being faced by Michigan -- including the recent federal funding sequestration process -- continue to affect this planned program area. Consequences have included fewer new hires, delaying the award of new financial obligations, reducing levels of continued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants.Although overall research FTEs only decreased by one -- from 65 FTEs to 64 FTEs this past year, we are down from 77.1 FTEs just two years ago. Attrition and faculty departures also continue to have an impact on program outcomes.

We also opted in this year's annual reporting to revert back to our original 6 planned program areas for ease of reporting and better integration of research and Extension efforts. This has, once again, resulted in some instances in skewed results for some planned programs and outcome measures.This should be rectified after this year's reporting cycle.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and whether continuation funding and/or new dollars are appropriate and necessary as funds

are available.

That said, the most notable qualitative research impacts realized in this program were:

- Research evaluating the key contributing factors to diabetic retinopathy resulted in the discovery that the inflammation associated with retinopathy is the result of an autoinflammatory feedback cycle. Further, two proteins that enhance retinal inflammation were identified, creating the possibility of finding a way to keep these two proteins from binding, ultimately creating a healthier environment for retina tissue and potentially preventing blindness altogether.
- A three-year intervention in two Flint, Mich., neighborhoods to improve their physical surrounding and measure the social impacts of landscape maintenance has resulted in an increase in membership in Code Red, a cell phone network neighborhood watch program, two successful community gatherings in one of the new common areas, and the reestablishment of the local baseball team.
- A long-term evaluation of the best way to improve management frameworks for lakes has resulted in the development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers with a framework that more fully views lakes as complex systems coupled with human systems.
- A multi-year research project to evaluate water use and efficiencies, especially during drought conditions, has resulted in a revolutionary new water-saving membrane that dramatically increased corn and vegetable production on test farms. The subsurface water retention technology (SWRT) process uses contoured, engineered films, strategically placed at various depths below a plant's root zone to retain soil water. SWRT-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.

Other Examples Of MSUE Evaluation Results Not Previously Reported For This Area:

Social/Emotional Work Group from Health and Nutrition Institute

<u>Summary of impact.</u>

Issue (who cares and why)?

Caring for the social and emotional health* of young people - the social, mental, psychological and spiritual aspects of their well-being - is one of the most important contributions that adults who live with them, work with them or work on their behalf can make to their positive development. The social and emotional development of children and youth, as well as their healthy physical development, can be significantly compromised by the presence of violence in their lives. Included within the violence that affects young people is "youth violence," defined as the intentional use of physical force or power by one young person against another, and which can cause physical and psychological harm that spans a range of severity from murder, rape and assault to dating violence, bullying, verbal aggression and relational/psychological aggression (Haegerich & Dahlberg, 2011).

What has been done?

MSU Extension has an important role to play in addressing issues of adolescent aggression and violence through community-based education programs for adolescents and the adults who care for and work with them. The overarching goal of the efforts of the Social and Emotional Health area is for youth (and the adults in their lives) to learn to foster healthy relationships - and to live, learn and grow in safe, affirming, fair and inclusive environments free from violence, abuse, bullying and harassment. This will take place through educational opportunities with adolescents, parents and caregivers, and professional staff and volunteers in both nonformal educational settings (4-H, Boys and Girls Clubs, Scouts, Y's, afterschool programs, adjudicated youth groups, camps, faith-based groups, etc.) and in school settings.

Results/Impact? Evaluation of approximately 1,000 youth found:

- 70.2% of the youth improved their ability to respond to one's own social-emotional needs and the social-emotional needs of others
- 42.3% of the youth decreased involvement with unhealthy/abusive behaviors/relationships
- 55.6% of the youth learned about the impacts of healthy and unhealthy relationships on individuals and settings
- 49.0% gained knowledge about ways to foster safe and fair relationships and settings

Consumer Education Regarding Agriculture - Agriculture and Agriculture Business Institute (Evaluation of approximately 675 respondents from 2012)

<u>Summary of impact.</u>

Issue (who cares and why)?

Children and adults are farther removed from agriculture and knowing where their food comes from. They need to have a basic knowledge of agriculture and understand where their food comes from and that it is safe and nutritious for them. Educating consumers about modern agriculture and how farmers care for their animals, for the environment and how they produce safe and wholesome food is critical to helping them support Michigan agriculture.

What has been done?

Eight Breakfast on the Farm educational programs were conducted in 2012, A total of 21 programs have been held since Breakfast on the Farm started in 2009 and 40,865 people have participated in these events. In 2012 a total of 18,293 attendees participated. Particiipants were asked to complete a survey at the end of their tour.

Results/Impact?

This program was an integrated partnership with educators (field staff) and researchers (campus specialists) providing leadership for the evaluation component. The results found:

- 42.7% of the eleven-hundred and thirty-six 2012 BOTF participants who were surveyed on the dairy farms had not visited a working dairy farm prior to this visit, in at least the past 20 years.
- 90% agreed or strongly agreed that as a result of the BOTF visit their confidence in Michigan dairy products increased.
- 89% agreed or strongly agreed that the visit increased the likelihood that they will purchase Michigan dairy products.
- 85% agreed or strongly agreed that their trust in milk as a safe food increased.
- 89% agreed or strongly agreed that their trust in dairy farmers as a source of information about food production has increased.
- 90% stated they would talk to others about what they learned at Breakfast on the Farm
- At the completion of the farm visit there was a 20% increase in their trust that farmers will do the right thing in caring for their environment.
- At the completion of the farm visit there was a 20% increase in their trust that farmers will do the right thing in their treatment of food producing animals.
- At the completion of the farm visit there was a 17% increase in their trust that farmers will do the right thing to safe guard milk.
- At the completion of the farm visit where was a 20% increase in their trust that farmers will do the right thing in providing good housing for their animals.

Community Food Systems - Greening Michigan Institute's Community Prosp

<u>Summary of impact.</u>

Issue (who cares and why)?

The need for this program is based on:

"Residents of areas in all 83 Michigan counties, both urban and rural, have limited access to full service grocery stores and healthy food. Racial and ethnic minorities are particularly vulnerable to diet-related disease, and low income minority communities have been excluded from meaningful entrepreneurial and job opportunities in the food system. Youth obesity is increasing, and the life expectancy of the next generation is predicted to drop rather than rise. Every day people go hungry, and numbers of people without enough to eat have increased with Michigan's economic downturn." Source: Michigan Good Food Charter 2010.

Against these challenges, Michigan also has many assets including the second most diverse agriculture in the United States and abundant natural resources including being surrounded

by one-fifth of the world's fresh surface water, diverse and high quality soils, and increasing capacity for season-extension techniques in agriculture. Michigan also has capacity in available human capital that can be trained in occupations that support and contribute to the food system.

"Consumer demand for fresh, or minimally processed, healthy, farm-direct food is changing market conditions. Interest in home and community gardening has skyrocketed. Parents, students and community members are calling for farm-fresh foods in school cafeterias, and some school districts are responding to these demands. Likewise, institutions are finding ways to purchase from farmers in their region. A new cohort of young farmers is emerging in Michigan. Immigrants and farm workers have agricultural skills and knowledge and often a desire to start new farms. Michigan communities are embracing urban agriculture. Several recent legislative actions have supported these activities, and further actions could pave the way for more good food." Source: Michigan Good Food Charter 2010.

What has been done?

MSU Extension is uniquely qualified to address these challenges by mobilizing stakeholders and building upon these assets to catalyze change in Michigan's food system. The work group has worked at multiple levels that include farmers, businesses, retailers, government officials and consumers to improve community food systems.

Results/Impact?

From approximately 400 surveys, results found:

62.0% of the people reported an increased awareness of the connectedness of food, personal health, the environment and the economy.
69.7% of the people could describe what makes up a community-based food system, the importance of connectedness of the different sectors and food system issues.
44.6% of the people could describe that "good food" is healthy, green, fair, and affordable.
47.9% of the people increased their awareness of the Michigan Good Food Charter.
40.2% of the people increased their understanding of key food system terms such as food desert, food shed, food insecurity, food access, etc.
69.7% of the people were aspired to make changes in their food growing and consumption habits such as patronizing farmers' markets and growing/buying more local and regional food.
92.0% of the food council members that gain knowledge needed to effectively serve.

Key Items of Evaluation

Key research results include:

- The discovery that the inflammation associated with diabetic retinopathy is the result of an autoinflammatory feedback cycle. Further, two proteins that enhance retinal inflammation were also identified, creating the possibility of finding a way to keep these two proteins from binding, ultimately creating a healthier environment for retina tissue and potentially preventing blindness altogether.
- A three-year intervention in two Flint, Mich., neighborhoods to improve their physical surrounding and measure the social impacts of landscape maintenance has resulted in an increase in membership in Code Red, a cell phone network neighborhood watch program, two successful community gatherings in one of the new common areas, and the reestablishment of the local baseball team.
- Research focused on developing management frameworks for lakes has resulted in the development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers with a framework that more fully views lakes as complex systems coupled with human systems.
- MSU researchers dramatically increased corn and vegetable production on test farms using revolutionary new water-saving membranes. The subsurface water retention technology (SWRT) process uses contoured, engineered films, strategically placed at various depths below a plant's root zone to retain soil water. SWRT-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.

Results from MSUE Institute Workteams relevant to this area:

Agriculture and Agribusiness Institute

- Breakfast on the Farm educational programs had 18,293 attendees in 2012 (see specific impacts described above).

Children and Youth Institute

- 176,177 children/youth participated in 4-H in 2012 (see specific impacts described above)
- 7,091 pre-school children were readied for academic success
- 6,380 youth volunteers contributed to programming and experiential learning
- 20,340 adult volunteers contributed to programming and experiential learning

Health and Nutrition Institute

- 47,674 youth were trained in healthy lifestyles
- 47313 adults were educated in nutrition and health
- 81 youth and 671 adults trained in Alternatives to Anger

Greening Michigan Institute

- 10 producers developed new strategies for local food production and distribution.
- 8,761 adiult participants gained knowledge regarding community food systems
- 5,996 adult participants learned about sustaining community prosperity

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Soil, Water and Natural 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
101	Appraisal of Soil Resources	1%		15%	
102	Soil, Plant, Water, Nutrient Relationships	20%		12%	
111	Conservation and Efficient Use of Water	11%		12%	
112	Watershed Protection and Management	15%		10%	
123	Management and Sustainability of Forest Resources	7%		5%	
131	Alternative Uses of Land	15%		6%	
132	Weather and Climate	4%		10%	
133	Pollution Prevention and Mitigation	10%		12%	
134	Outdoor Recreation	1%		1%	
135	Aquatic and Terrestrial Wildlife	1%		12%	
216	Integrated Pest Management Systems	5%		5%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	17.3	0.0	8.0	0.0
Actual Paid Professional	10.2	0.0	11.0	0.0
Actual Volunteer	10.0	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**
467841	0	1268679	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
467841	0	1158377	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5157881	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs and Extension activities to:

• Develop new land use models for Michigan communities.
• Offer education to planners, elected officials and citizens on how these new models will reduce sprawl and ensure that the desirable outcomes will become reality.
• Create new remediation strategies to clean up polluted soil and water. These strategies will be environmentally friendly, economically feasible and easy to implement with proper training.
• Discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.
• Develop a user-friendly computer program for nutrient management for Michigan crop and livestock producers to improve the management of fertilizer and manure nutrients on cropland to protect water resources and boost crop productivity.
• Develop management techniques for potato and vegetable growers that includes cover crops.
• Develop new nitrogen application recommendations for turf managers.
• Develop a management system for Michigan inland lakes that does not involve sampling the lakes.
• Develop Total Maximum Daily Load (TMDL) assessment tools for evaluation of Michigan watersheds.
• Determine how wildlife responds to ecosystem management decisions in forest and agricultural systems
• •Develop fish population/community computer models for species important to Michigan. These models will be used to evaluate different fishery management strategies.
• Develop web-based tools and models for natural resources managers so knowledge can be shared quickly and easily.
• Develop computer models to assess how habitat management affects species important to Michigan, including white-tailed deer, salmon, trout and perch.
• Promote and support value-added processing of forest products, including wood products, biofuels, maple syrup and other nontimber products.
• Identify, prevent and control exotic invasive pests and diseases of forests.
• Conduct educational programs to help farmers improve nutrient management and other practices to maintain and improve quality of groundwater and surface water.
• Conduct educational programs with riparians and lake users to enhance their understanding of watershed management and inland lakes water quality issues.
• Work with state agencies and local communities to encourage protection of community groundwater supplies through wellhead protection programs.
• Educate and train health officials, consultants, engineers and riparians to improve onsite and decentralized wastewater treatment and design.

2. Brief description of the target audience

Michigan farmers, natural resource managers, private citizens, agriculture and natural resources industry representatives, state agencies, riparians and foresters.

3. How was eXtension used?

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

Ask an Expert statistics were analyzed for our program areas and found for Soil, Water and Natural Resources there were 8 staff paid by formula funds (1 fte). A few examples were:

Question: I live in Michigan, Allegan county, Otsego township. I have 5 acres of wooded land, very large trees, with a thick canopy. Over the last couple of years, more so this year, I have noticed a ground cover type of vine spreading very quickly. It is so thick on the ground it is choking out the woodland flowers and other plants. The plant has a sticky feel, and will attach to anything. It's more like Velcro, and has a rough texture. It will pull from the ground with little effort, but the large quantity is a concern. I am looking for some direction as to the correct method to remove it, and what to do to prevent it. Thanks, Mike

Answer: Mike, my friend, your question led me on a merry chase only to end up in my front yard. Your problem is my problem: one Sweet Woodruff sold in nurseries under that name. It also is from the genus: Galium and Synonym of Asperula orderata (Asperula [many leaved] and ordorata {scented}. It is a very popular plant sold as a coverup for many other shrubs that leave the surrounding soil areas barren looking. Once it is planted - Look OUT! My efforts have been ongoing for about 10 years now in just a smallish plot. I'm sitting at my computer with three of the subject plants feeling their texture and knowing they are going into the garbage when i'm done with this message. Glyphosate (Roundup) may work with it but you have to be very careful of surrounding shrubs and trees, especially the younger ones of each variety. Because it does pull up very readily it can be controlled in smaller areas physically (sometimes) however I'm not sure that one person could control this critter by himself in large acreage such as what you have in Otsego. You could perhaps put a bounty of one or two cents per plant with a local scouting troup to get rid of some of it. (This is done out east with Garlic Mustard with some success) Hopefully this indentity will help you eradicate a pest from your environment. If nothing else you could dig up the plants and sell them to the public that wants them. Thank you for using the Ask an Expert System.

Question: I recently had MSU do a soil test to figure out exactly why my soil is so inadequate at producing quality grass. My soil test number is #L46EL4. My name is Ed Gall. Please reference my soil test results so that you can best address my questions - thanks! One question I have is if I choose the starter fertlizer option (option #1), how many times per year, and at what seasonal times, should I apply the starter? Also, you recommend compost since my organic matter is only 1.4% Is there an efficient way to spread compost? I have over an acre, so spreading it by hand is not a great option. Thanks for your time!!

Answer: You would use the starter fertilizer and work into the soil if grass has not gone in yet. If you work the starter fertilizer into the soil you can use 8 pounds per 1000 square feet of the 18-24-12 and this would meet the needs for both the phosphorus and potassium for the season. If the lawn has already gone in, use half this amount, 4 pounds per 1000 sq. ft. Space applications about 4 to 5 weeks apart. Two

applications this year is enough for this summer. Next year begin using a common lawn fertilizer like 29-3-3 or similar product. How often you apply is based on type of grass and available water. Kentucky bluegrass lawns benefit from 3-4 application per season. See the following schedule: http://ohioline.osu.edu/hyg-fact/1000/1191.html Low maintenance grasses like fescue only need 1-3 applications per season. If you have a lawn mixed with different grasses do not exceed the 3 application per season. Avoid fertilizing in the heat of mid summer and when grass is going dormant in October. A fertilizer application can be applied after lawn goes dormant in the fall. Do not fertilize a drought stressed lawn! Compost can be spread with a lawn spreader but it would be best if the site that produced the compost passed it through a screen first to remove larger particles.

Question: my arborvite is turning brown. See attached. Will I lose it ?

Answer: From the amount of browning on your plant I am going to assume that is dead, however you can make some small checks to see if disease or insects did the deed on your plant or as mentioned below mzybe the soi became too acidic from the concrete and mortar that has leached into the soil since you planted the Arb. You did not mention the type of arborvitae that you had planted. I am going to assume they were either eastern arborvitae (Thuja occidentalis) or western arborvitae (Thuja plicata) These are the two species that are recommended for Michigan however there are others that do fairly well in the midwest, namely the Holmstrup or Techny varieties. Arbs like full sun and soil of average fertility that is well drained. They do best when given protection from the wind especially in the winter. If a plant is in the correct location it is less likely to develop problems. If your site is not appropriate for Arbs then it is best to select another plant that will do well in your conditions. I am concerned about the proximity of the tree to the brick and concrete wall very near it. Concrete can reduce the amount of water that is getting to the roots of the plant. I would suggest that you have a soil test before finding another variety to plant and then fertilize according to the recommendations of that test. You can get a soil test by contacting your local MSU extension office. Some local nurseries offer The Don't Guess - Test program in the spring. You can pick up an MSU soil test kit from a participating nursery. On the form for the soil test indicate that you want to grow arborvitae. Arbs usually have few problems if sited correctly. Probably the most common problem is winter browning. This website offers some information about winter browning. http://urbanext.illinois.edu/focus/winterinjury.cfm Leaf miner is an insect that causes damage that can resemble that of winter browning. Observe the new plants regularly. At the first signs of browning hold the branch tips to the light and look for small caterpillars feeding inside. If you see caterpillars prune and destroy the infested branches before June. Other potential problems include bagworm, heart rot, blight, canker and spider mites but these are not frequent when the plants are properly sited. Some of these problems are mentioned in the above website. It is always important to check your plants regularly for any signs of disease or insect damage. Problems are much easier to manage if caught early. If you notice a problem it is important to get a correct diagnosis before treating the problem. I hope this information was helpful. Thank you for using the Ask an Expert system.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9498	28494	10266	20532

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

Patent Applications Submitted

Year:	2012
Actual:	2

Patents listed

MICL01884 - Soil Aggregate Porosity Contributions to Carbon Sequestration - PCT/US2011/056173, 10/31/2011. MICL02155 - Study on Epidemiology, Microbial Community and Management of Soilborne Diseases - 61/640,024, 4/30/2012.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	1	46	47

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on soil, water and natural resources.

Year	Actual
2012	45

Output #2

Output Measure

- Number of adult participants trained in soil, plant, water and nutrient relationships.

Year	Actual
2012	2830

Output #3

Output Measure

- Number of adult participants trained in watershed protection and management.

Year	Actual
2012	3021

Output #4

Output Measure

- Number of youth participants trained in watershed protection and management.

Year	Actual
2012	10266

Output #5

Output Measure

- Number of adult participants trained in management and sustainability of forest resources.

Year	Actual
2012	625

Output #6

Output Measure

- Number of adult participants trained in alternative uses of land.

Year	Actual
2012	3022

Output #7

Output Measure

- Number of youth participants trained in alternative uses of land.
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.
2	Number of adult participants with increased knowledge of watershed protection and management.
3	Number of youth participants with increased knowledge of watershed protection and management.
4	Number of adult participants with increased knowledge in management and sustainability of forest resources.
5	Number of research programs to determine how wildlife responds to ecosystem management decisions in natural resource and agricultural systems.
6	Number of adult participants with increased knowledge of alternative uses of land.
7	Number of adult participants with increased knowledge of soil, plant, water and nutrient relationships.
8	Number of research programs that deal with fish population dynamics and the management of Great Lakes fisheries.
9	Number of research programs that deal with the security, stewardship and management of Michigan's water resources.
10	Number of research programs that analyze key soil characteristics to better assess their agricultural and environmental contribution, including crop yield.
11	Number of research programs that explore the occurrence, transport and fate/effect of organic contaminants, chemicals, pesticides, pharmaceuticals and particulates in soils.
12	Number of research programs to develop new land use models for Michigan communities.

Outcome #1

1. Outcome Measures

Number of research programs to discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soils constitute a huge reservoir of microbes, whose activities have a profound impact on crop productivity, soil fertility and biogeochemistry. However, knowledge of the composition, organization and fluctuations of indigenous microbial populations in soil ecosystems is scarce, even though metabolism of such microbes drives many ecosystem level processes.

What has been done
Research to: understand temporal and spatial control of gene expression during development of soil bacteria; determine how well the most promising candidate strains of cereal-adapted rhizobia perform as superior biofertilizer innoculants for rice and wheat when scaled up to full-size farmer plots; investigate novel cultivation strategies and cultivation-independent techniques to advance our understanding of microbes and microbial communities in soils; and develop new technologies to control soilborne diseases.

Results
Research to increase knowledge of beneficial plant-microbe interactions of agricultural importance has resulted in the development of Center for Microbial Ecology Image Analysis System (CMEIAS) software ? free image analysis software designed to strengthen microscopy-based approaches for understanding microbial ecology. The system includes custom plug-ins for the host programs and interactive semi-automatic image editing and analysis of microbial abundance, luminosity and morphological diversity.

Researchers have successfully characterized the soil that is suppressive to potato common scab and established a program for fundamental soil-borne disease study. The research has also resulted in the discovery of a group of biological agents for disease control of potato, including Bacillus amyloliquefaciens.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships

Outcome #2

1. Outcome Measures

Number of adult participants with increased knowledge of watershed protection and management.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2658

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With 41 of Michigan's 83 counties bordering on the Great Lakes or connecting waters. Michigan?s coastal communities provide vital economic, social, and recreational opportunities for millions of residents and visitors. Near-record low Great Lakes water levels, the increased number and intensity of regional storms, and other natural and human hazards are putting more people and property at risk with major implications for human safety and the economic and environmental health of coastal communities. To accommodate more people and activity, and to balance growing demands on coastal resources, we must develop new policies, institutional capacities, and management approaches to guide the preservation and use of Great Lakes resources.

It is essential that Michigan residents of coastal communities understand these risks and learn what they can do to reduce their vulnerability and respond quickly and effectively when events occur. the Great Lakes Education Program engages a diverse and growing coastal population in applying the best available scientific knowledge, and uses its extension and education capabilities to support the development of resilient communities that are economically and socially inclusive, supported by diverse and vibrant economies, and function within the carrying capacity of their ecosystems.

What has been done
Since 1991, the Great Lakes Education Program has introduced more than 92,000 K-12 students through the help of teachers and adult volunteers to teach about the unique features of the Great

Lakes through a combination of classroom learning and hands-on experience. The program is designed to stimulate interest in the Great Lakes and help students and adults understand their role in protecting these vital freshwater resources.

Winner of both the John A. Hannah Award for MSU Extension Program Excellence and a National 4-H Program of Distinction Award, the Great Lakes Education Program is seen as a leader in vessel-based education. The program was developed as a collaborative effort between Michigan State University Extension, Michigan Sea Grant, the Huron-Clinton Metroparks, the National Oceanic and Atmospheric Administration, and a host of K-12 teachers and education specialists. It has served as a national model for implementing effective vessel-based education, as when in 2001, Texas Sea Grant used the Great Lakes Education Program as the developmental model for its Floating Classroom Program.

Results
The Great Lakes Education Program (GLEP) has documented program outcomes through university research and seasonal assessments. Michigan State University, research conducted through the Department of Fisheries & Wildlife, found a highly significant increase in Great Lakes knowledge on the part of students, and a significant increase in girls? positive attitudes toward the Great Lakes. A second MSU study found participants effectively shared knowledge learned with family members and friends, and the parents of participants scored significantly higher on the Great Lakes behavior intentions scale than parents of non-participants.
Annual seasonal evaluations of the program are conducted with GLEP teachers and adult chaperones. Teacher evaluations have shown that their participation results in a high incidence of increased Great Lakes subject matter used in the classroom. Teachers also report the GLEP curriculum provides excellent support for addressing Michigan?s Grade Level Content Expectations and Great Lakes Literacy principles. The 2012 teacher evaluations found that following GLEP participation, 90 percent of the students had greater responsibility for the Great Lakes; 64 percent included more Great Lakes science content in their classroom; 30 percent visited the Great Lakes more often; and 20 percent involved their students in new Great Lakes stewardship activities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
806	Youth Development

Outcome #3

1. Outcome Measures

Number of youth participants with increased knowledge of watershed protection and management.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	9034

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
It is critical to get youth involved as early as possible in nature, understanding the environment, enjoying nature and becoming advocates for protecting our delicate ecosystem.

What has been done
One example in this area is where MSUE worked with several school systems to provide experiential learning opportunities around watershed protection. For example, MSUE worked with Sanborn Elementary students of Alpena Public Schools to use science and technology to study impacts of aquatic invasive species in their local Thunder Bay River Watershed. Rogers City Middle School students monitordc water quality and the health of local Trout River. Alcona High School Environmental Science students partnered with the Northeast Michigan Council of Governments (NEMCOG) to study and develop a management plan for their local Black River Watershed.

Results
Qualitative evaluation of these experiences found that they provided amazing hands-on learning experiences for students and bring them into the community as valued partners addressing important environmental stewardship issues. Through their projects, students fostered a better understanding of the social, economic, and environmental importance of Michigan?s water resources, and that their watersheds, the Great Lakes and people are interconnected. Educationally, these projects reflected wonderful case studies of applied principles and best practices of place-based education where youth, through their learning, engage in environmental stewardship leadership activities that enhance and provide community enhancement values.

These projects also illustrate community partners investing in youth learning and in trade benefiting from youth leadership. The Michigan Sea Grant, 4-H Youth programs, NOAA Thunder Bay National Marine Sanctuary, and many other water-interested partners in northeast Michigan directly supported these projects through the 4-H20 and NOAA B-WET water quality education programming in northeast Michigan. Collectively, these schools, community partners, and youth-led projects reflect a growing community or shared interest in water science education and watershed stewardship activities. These partners are networking and fostering school-community partnerships, sharing ideas and resources, and collaborating among their diverse water-related projects and activities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
806	Youth Development

Outcome #4

1. Outcome Measures

Number of adult participants with increased knowledge in management and sustainability of forest resources.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	519

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The most recent statistics about Michigan?s forest resource reveal that there are over 20 million acres of forest land in the state. Of this vast resource, over 40% of this forest acreage is owned by non-corporate and individual forest landowners. In addition, there is currently more than 440,000 family forest or private landowners in Michigan by most estimates. Consequently, this is a sizeable financial asset in Michigan (i.e. just considering the value of the land and timber alone) that is under control by private entities. But these same forest statistics also provide another startling fact about private forest owners. A large proportion of these owners are aging fast with over 39% of forest owners being 69 years of age or older. Therefore, as our society continues to age (e.g. the aging baby boomers) many landowners have begun to wonder what will happen to their beloved forest land after they are deceased. Thus, a shift in land ownership from one generation to the next will occur very soon as these current owners pass on.

What has been done
The MSUE Ties to the Land program is a broad overview of the interpersonal, financial and legal issues involved in successfully planning a transfer of forest property from one generation to the next. It is designed to inform landowners of what they need to consider and plan for in this transition process. The Ties to the Land program is a DVD-driven curriculum developed by Oregon State University that is coupled with interactive discussion and planning activities. The MSUE version has been adapted for Michigan. Additional resource materials as well as a panel of local professionals are incorporated into the Michigan program to offer general advice on

estate planning to participants.

Results
A one-year follow-up survey was recently conducted of 40 participants in late 2010 Ties to the Land programs in Saginaw, Escanaba and Quinnesec.

Results found that participants have taken action as a result of participating in the Ties to the land program. Highlights include:

83 percent of respondents indicated that they have used the Ties to the Land resource workbook, with 100 percent finding it somewhat or very useful.
72 percent of respondents indicated that they discussed goals for their property within the last year, an additional 22 percent said that they intend to within the next 6-12 months.
44 percent have taken steps to increase family involvement in the property, with 17 percent indicating that they intend to within the next 6-12 months.
39 percent have explored options for a legal structure for estate planning purposes, and 28 percent said that they intend to within the next 6-12 months.

There are still significant barriers to succession planning for forest families:

61 percent haven?t figured out fairness issues
47 percent indicated that lack of time prevents them from progressing on succession planning
44 percent said that their heirs are too dispersed
38 percent indicated that one or more heirs are disinterested
35 percent have difficulty finding qualifies advisors

Many participants commented about the difference the Ties to the Land Program planning process made their family and how they see the future of their property. One participant commented that the program clarified differences in viewpoints and future goals for ownership. another participant commented that the program was the starting gun for taking action to preserve our forest [and] added the human element to our thought process.

Participants in this survey represented 11,828 forest acres.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #5

1. Outcome Measures

Number of research programs to determine how wildlife responds to ecosystem management decisions in natural resource and agricultural systems.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A better understanding of wildlife-habitat relationships as influenced by natural and human wildlife habitat disturbances is needed in order to make more effective natural resources management decisions to sustain biodiversity and conserve wildlife populations, communities and habitat.

What has been done
Research to: understand the mechanisms of wildlife dynamics on landscape mosaics; develop a better understanding of wildlife-habitat relationships as influenced by natural and managed wildlife habitat disturbances; and uncover systematically informative morphological and molecular characteristics related to arthropods in order to revise classifications and test evolutionary hypotheses.

Results
Researchers have developed an elk survey methodology and model to estimate the population size in Michigan. This technique allows researchers to estimate the population size with a 95 percent confidence interval and uses a sightability model.

Research to understand the influences that farm management practices may have on the spread (and control) of bovine tuberculosis in free-ranging while-tailed deer suggests that the efficiency and effectiveness of a trap/test/cull management effort could be improved by vaccinating test-negative animals, should a vaccine be approved for free-ranging deer.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife

Outcome #6

1. Outcome Measures

Number of adult participants with increased knowledge of alternative uses of land.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2659

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The need for this program is based on:

Many Michigan communities were unprepared for the transition from the old economy to the new economy and, as a result are currently in the process of developing relevant communities that are better situated to compete and thrive in the 21st Century.
High turnaround rates of locally elected and appointed officials have created an ongoing need for training programs addressing the fundamentals of local government, including basics of governance, finance, planning and zoning.
Many Michigan communities have appointed officials without adequate training in local governance and finance, planning, and zoning. Without these fundamental skills, many appointed and elected officials are not at the point where they can fully benefit from training on more advanced concepts that inform key policy issues in Michigan.
Local officials, community leaders, and general citizens have a need for greater awareness of government operations, budget, and land use decision makers? roles and responsibilities. Importantly, increased knowledge and awareness of these issues can lead to the development of more livable communities, the protection and conservation of natural resources, and better overall governmental and land use decisions throughout Michigan.

What has been done
MSUE's Greening Michigan Institute Workgroup Government and Public Policy conducted a a series of trainings that focused on government officials and a set of trainings (called Citizen Planner and Firewise) that included the general public.

Results
Evaluation of the training for public officials found:

82.1% board members reported improved use of data and relevant information to inform their decision making

72.6% of the participants improved their understanding of relevant laws and the practical impacts of those laws on their boards

84.2% of the participants increased knowledge of their board?s structure, functions and duties, and/or operational best practices

60.5% of the participants increased their knowledge of citizen input processes and /or methods to implement those practices

74.0% of the participants could identify and locate resources for quality information and/or apply that information to the solution of problems

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

Outcome #7

1. Outcome Measures

Number of adult participants with increased knowledge of soil, plant, water and nutrient relationships.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2179

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example in this area is regarding corn residue. The quantity and quality of corn residue has increased in recent years impeding the performance of no-till planting equipment, increasing tire wear and reducing soil warming and drying in the spring. This has led to an increase in the number of acres that are tilled prior to planting soybeans increasing production costs and the potential for soil erosion. Soybean producers have a vested interest in reducing production costs and preserving their soil resources. Non-farmers benefit from improved water quality when

erosion is reduced or prevented.

What has been done
Planned, promoted, conducted and evaluated a high-profile educational program addressing one of the most current and relevant issues facing Michigan Soybean producers. We identified and invited two of the best Extension resources in the U.S to present at the program. Applied for and secured a grant from the Michigan Soybean promotion Committee to pay for the program. The program entitled, "Options for Manageing Corn Residue Prior to Planting Soybeans" was held at the MSU Pavilion.

Results
Designed, distributed, collected and summarized and evaluation to measure the program?s educational and financial impacts.

More than 130 soybean producers and agribusiness agronomists participated in the program. Evaluation results found:

39% of the participants said they were more likely to make long-term changes to their current corn residue management practices as a result of the information they learned at the program

77% indicated that they planned to leave more corn residue on the soil surface prior to planting soybeans

48% planned to use the information they learned at the program to change their residue management practices

37% expected these changes to earn or save them additional money.

The average amount of additional money saved was $11.31 per acre.

Changes effected 5,865 acres with the total projected financial impact of the program to be $66,312.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #8

1. Outcome Measures

Number of research programs that deal with fish population dynamics and the management of Great Lakes fisheries.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Urban, industrial and agricultural development have caused remarkable changes in the lakes' flora and fauna and fauna associated habitats over the past 200 years. Today, the lakes have aquatic communities that are structurally and functionally volatile and exhibit rapid changes in species number and abundance. Successful fish management of the Great Lakes is now actively focused on the lakes as ecosystems.

What has been done
Research to: investigate areas of uncertainty for Great Lakes fishery management, particularly sea lamprey control and salmon stocking; determine how fish population dynamics are affected by the physical, chemical and biological environment; investigate how human activities bring about changes in aquatic habitats; and develop models capable of predicting response of fish to habitat alteration.

Results
In research evaluating the ecological significance of lake trout refuges, scientists found that relative abundance higher inside the refuges and increased at a greater rate than outside the refuge as expected. However, annual means in lake whitefish were surprisingly higher in areas outside of the refuges, while the rate of increase in relative abundance was higher in the refuge. These findings highlight the potential significance of refuges for enhancing populations of various species and will be important in informing future Great Lakes fisheries management and research.

A new, regional database characterizing locations of freshwater mussels in Michigan has been developed. While researchers have historically just considered fishes to assess landscape effects on aquatic environments, considering mussel response to landscape influences adds richer information and enhances the understanding of the broader responses of aquatic communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife

Outcome #9

1. Outcome Measures

Number of research programs that deal with the security, stewardship and management of Michigan's water resources.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With growing concern about the connection between health and the marine environment, there is a corresponding emphasis on large freshwater lake ecosystems and human health. The Great Lakes serve as a highway for international maritime commerce and support a $1 billion per year recreational and commercial fishing industry. They also supply drinking water for more than 15 million people. Holding about 20 percent of the world's fresh surface water, the degradation of the Great Lakes ecosystem through chemical and biological contamination presents an enormous challenge for the future.

What has been done
Research to: enhance the current water resources management structure through the ecosystems approach, development of a system to help create sustainable water resource management, understand how anthropogenic actions can affect food web structure and function, address critical questions that have relevance to specific problems in Michigan inland lake and Great Lakes integrity; help develop dynamic, interactive computer interfaces in resource-based recreation management; construct and evaluate a knowledge management system in resource-based recreation management; develop a landscape-based ecosystem management framework that integrates landscape ecology with natural resource policy and management; determine why sport fish populations, fish assemblages and lake food webs, and their response to perturbation vary among lakes; determine if pheromones can be used to control sea lamprey in streams, with a view to developing a viable new control strategy; and to improve design of engineered phytoecosystems for treatment of wastewaters and stormwaters.

Results
Research focused on developing management frameworks for lakes has resulted in the development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers

with a framework that more fully views lakes as complex systems coupled with human systems.

Research initiated to quantify the carbon storage potential of 12 landscape systems (three of which were duplicated on roof platforms in green roof media) with increasing levels of complexity, ranging from sedum to woody shrubs over the course of three years showed that landscape systems containing more woody structures had higher content than other landscape systems. Carbon storage on the green roofs ranged from 68 kg m2 for a mixture of herbaceous perennials and grasses, down to 7 kg m2 for a typical sedum-based extensive green roof.

Networked Neighborhoods for Eco-Conservation Online (NECO) is a web-based tool that helps link individuals in the Great Lakes region to map and share green practices was developed ? www.iwr.msu.edu/neco. This, in combination with other tools and models are being integrated into a process that will result in a series of physical and digital maps that are web accessible and interactive. The system will assist landowners and technicians in identifying and addressing critical areas related to soluble phosphorus and sediment delivery.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #10

1. Outcome Measures

Number of research programs that analyze key soil characteristics to better assess their agricultural and environmental contribution, including crop yield.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Understanding the variability of soil and landscape properties and their effect on crop yield is a critical component of site-specific agricultural and environmental management systems. This

includes factors such as nitrogen management, soil absorption and environmental interactions.

What has been done
Research to: study herbivore suppression of cyanobacteria and total phytoplankton biomass; effectiveness of nitrogen rates on soil quality and plant nutrition; study the characteristics of high content soil blends used in athletic fields and golf putting greens and how the properties of these soils change with time and use; and to explore diversification with cover crops to enhance nutrient cycling efficiency and rhizosphere traits for resilient, productive row crop systems.

Results
While much of the nation?s crops withered under last year?s punishing drought, MSU researchers dramatically increased corn and vegetable production on test farms using revolutionary new water-saving membranes. The subsurface water retention technology (SWRT) process uses contoured, engineered films, strategically placed at various depths below a plant?s root zone to retain soil water. SWRT-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.

Researchers have documented that inland lakes in Michigan that have been invaded by zebra mussels have higher levels of algae that produce a toxin that can be harmful to humans and animals. Findings show that lakes that are home to zebra mussels have, on average, three times higher levels of a species of blue-green algae known as Microcystis. There have been documented cases in which animals, including cattle and dogs, died after drinking water with high levels of microcystins. The toxin is also believed to be responsible for liver damage in humans.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation

Outcome #11

1. Outcome Measures

Number of research programs that explore the occurrence, transport and fate/effect of organic contaminants, chemicals, pesticides, pharmaceuticals and particulates in soils.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michigan's 37 million acres of land support the plants and animals that provide our shelter, food and fiber. The land provides us with minerals and foods for our industry and our businesses. At the same time, human activities are generating and releasing large amounts of pollutants -- including pesticides, antibiotics and dioxins, and other industrial emissions -- that may end up in the soil. Research to investigate the fate and effect of these pollutants is critical to sustaining soil viability and health, and minimizing consequences to human health.

What has been done
Research to: investigate the transport of a group of engineered nanomaterials in the soil and water environments and develop an understanding of their interactions with other elements; evaluate the occurrence and human health risks of historic pesticide contamination of agricultural soils; understand the mechanisms by which chronic estrogen exposure brings about reproductive failure; determine the mechanistic functions and contributions of soil humus and clays to the immobilization of pesticides and POPs found in soils; evaluate the occurrence of antibiotics in animal farms and their mobility; and to control and convert rural waste to resources.

Results
Scientists seeking to address ways to recover phosphorus from wastewater have developed a media that can retain significant amounts of phosphorus. They are working with MetaMateria Technologies in Columbus, Ohio, to create a cost-effective material and to develop design equations that will provide the information engineers need to make use of the product and to know when it needs to be replaced.

Research over the past several decades shows that soil and water are being compromised by human wastewater treatment and disposal practices. Results obtained from recent pharmaceutical studies provide the basis to improve best management practices for land application of biosolids and will help shape the development of regulations for emerging contaminants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
132	Weather and Climate
133	Pollution Prevention and Mitigation
216	Integrated Pest Management Systems

Outcome #12

1. Outcome Measures

Number of research programs to develop new land use models for Michigan communities.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
What we do to our land is intimately tied to our drinking water quality, wildlife habitat, potential for flooding, our recreational open space and tourism, and many other quality of life issues. For example, urbanization of the rural landscape is claiming some of the country's richest farmland and creating challenges for areas where rural and urban interests collide. Some recipients indicate the, by 2020, farmers will only have enough land to meet the nation's domestic food needs.

What has been done
Research to: better understand how regional and continental processes affect local processes; increase management capacities among agencies to better integrate biological and human dimensions of management in dealing with wicked problems, such as wildlife health; and to help develop sustainable agro-ecosystems that protect public health, environmental quality and promote efficient and profitable resource use.

Results
Research to provide tools to help address climate change and prevent environmental harm has resulted in the development of predictive models that are being applied to agricultural systems as far away as Senegal, West Africa, where the shortage of food and hunger are major issues. The models predict what the agricultural production would be and how the weather will affect the cropping systems, providing some early warning analysis to agricultural producers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
131	Alternative Uses of Land

132 Weather and Climate

135 Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The ongoing economic challenges being faced by Michigan -- including the recent federal funding sequestration process -- continue to affect this planned program area. Consequences have included fewer new hires, delaying the award of new financial obligations, reducing levels of continued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants.Although overall research FTEs only decreased by one -- from 65 FTEs to 64 FTEs this past year, we are down from 77.1 FTEs just two years ago. Attrition and faculty departures also continue to have an impact on program outcomes.

The extreme weather conditions during last year's growing season also delayed or greatly diminished some of the research projects being conducted at our various research centers both on- and off-campus, particularly related to plant research around food and biofuel crops.

We also opted in this year's annual reporting to revert back to our original 6 planned program areas for ease of reporting and better integration of research and Extension efforts. This has, once again, resulted in some instances in skewed results for some planned programs and outcome measures.This should be rectified after this year's reporting cycle.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and whether continuation funding and/or new dollars are appropriate and necessary as funds

are available.

That said, the most notable qualitative impacts realized in this program were:

- An exploration of the tools to assist resource managers in managing Michigan's elk population led to the development of an elk survey methodology and model to estimate the animal's population size. This has allowed researchers to estimate the population size with a 95 percent confidence interval.
- An evaluation of approaches to the development of management frameworks for lakes has resulted in the development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers with a framework that more fully views lakes as complex systems coupled with human systems.
- Following more than a decade of research and evaluation, AgBioResearch scientists dramatically increased corn and vegetable production on test farms using revolutionary new water-saving membranes. The subsurface water retention technology (SWRT) process-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.
- Scientists who have created a media that can retain signifcant amounts of phosphorus are working with MataMeteria Technologies in Columbus, Ohio, to evaluate and develop design equations that will provide the information that engineers need to make use of the product and to know when it needs to be replaced.

Evaluation Results Not Previously Reported for this Area:

Soybean Harvest Equipment Field Day and PLot Tour

Issue (who cares and why)?

Past research has shown that preventable soybean harvest losses of 4 to 5% (2 to 2.5 bushels/acre) are common in normal years. However, the dry weather in 2012 created two conditions that could significantly increase harvest losses. The plants were short and excessive spider mite feeding caused the pods to be brittle increasing shatter losses. Michigan soybean producers could net an additional $30 to $40 per acre by learning and implementinginformation about measuring and reducing soybean harvest losses.

What has been done?

The MSUE Soybean educator worked with the Michigan Soybean Checkoff to plan, promote, conduct and evaluate a Soybean Harvest Equipment Field Day and Plot Tour in Jonesville on September 20, 2012.

Results/Impact?

- Developed a follow-up evaluation and mailed it to 120 participants of the 2012 Soybean Harvest Equipment Field Day and Plot Tour.
- Compiled and summarized the survey results.
- 38% (46) of the participants returned surveys
- 86% said that they utilized the information they learned about measuring and

preventing harvest losses on their farms during the 2012 harvest.

- 74% said they **actually** earned additional money by implementing the new information they learned at the field day.
- The average amount of additional income was $16.66 per acre applied to 9,999 acres, producing an **actual** financial impact of $166,624 in 2012 alone.
- The participants also provided specific changes they made and listed soybean topics they wanted to learn more about.

Promoting the Use of Enviroweather

Issue (who cares and why)?

Critical weather information for farmers can have a tremendous impact on both productivity and the environment.

What has been done?

During 2012 MSUE promoted the use of Enviroweather among small fruit growers to guide their Integrated Pest Management activities in order to optimize the effectiveness of their pest control actions and reduce the runoff of pesticides into bodies of water or leaching into ground waters.

These uses were related to consulting the Cranberry Fruit Worm phenology model for timing fruit worm control actions and the use of fruit rot predictive models to manage the risk of infections for mummy berry and anthracnose in blueberries. Also, growers used Enviroweather to obtain weather information for IPM decision making.

Results/Impact?

67 new users that impacted 3,695 acres.

Unwanted and Outdated Pesticides

Issue (who cares and why)?

Unwanted and outdated pesticides stored on farm pose a great risk to groundwater and surface water contamination.

What has been done?

The Michigan Clean Sweep program helps protect the state's natural resources by pesticide pollution prevention. This program offers farmers the opportunity to safely and voluntarily dispose outdated, unused or unwanted pesticides without any cost.

Results/Impact?

The Eaton County Clean Sweep program was held as part of the annual Eaton County Fall Conservation Tour in Sunfield, MI on September 6, 2012. It was jointly sponsored by

the Ionia and Eaton County Conservation Districts, Crop Production Services and MSU Extension.

At this year's event, 42 farmers submitted 6,588 pounds of pesticides. Some of the most common materials collected were atrazine, glyphosate and chlordane. A small amount of DDT was also collected. By submitting these chemicals to proper authorities for disposal, farmers clearly eliminated a high risk for groundwater contamination. This program has gained in popularity every year because famers do not have to submit tedious paperwork or authenticity of products at the point of disposal. No fees are charged.

Key Items of Evaluation

Key research results include:

- The development of an elk survey methodology and model to estimate the animal's population size in Michigan has allowed researchers to estimate the population size with a 95 percent confidence interval and uses a sightability model.
- The development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers with a framework that more fully views lakes as complex systems coupled with human systems.
- Dramatically increased corn and vegetable production on test farms through the use of revolutionary new water-saving membranes. The subsurface water retention technology (SWRT) process-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.
- A media that can retain significant amounts of phosphorus has been developed as a tool to help recover phosphorus from wastewater. Scientists are working with MataMeteria Technologies in Columbus, Ohio, to create a cost-effective material and to develop design equations that will provide the information engineers need to make use of the product and to know when it needs to be replaced.

Results from MSUE Institute Workteams relevant to this area:

<u>Agriculture and Agribusiness Institute</u>

- 1,717,760 lbs. -change in nutrient use in pounds
- 20,052 lbs. -change in pesticide use in pounds
- 273,732 tons Change in sediment retained
- 274,000 lbs. Change in nutrients retained in pounds
- 895 lbs. of active ingredients -change away from broad spectrum products
- 9,752 soil test with 6,460 from farms and 3,292 from households

<u>Children and Youth Institute</u>

- 10,953 youth trained in biological science
- 41,051 youth educated on environmental education/earth sciences
- 2,058 youth report an increase in science knowledge, problem solving, critical thinking, and decision making skills
- 519 adults who increase knowledge and skills in science content areas to teach children and youth;
- 112 adults indicate increased confidence in their ability to engage youth in

experiential, inquiry based science learning.

Evaluations from the Children and Youth Institute's Academic Success Workgroup found in 2012:

- 97.6% of the youth participating in programs reported an increase in science knowledge, problem solving, critical thinking, and decision making skills
- 82.0% of participating youth indicating the ability to apply science knowledge and problem solving, critical thinking, and decision-making life skills.

Greening Michigan Institute

- 12,086 adults trained in natural resource stewardship
- 4,432 adults trained in government and public policy regarding land use and community development

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Plant Sciences

☑ 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%		17%	
202	Plant Genetic Resources	6%		9%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	7%		10%	
204	Plant Product Quality and Utility (Preharvest)	5%		5%	
205	Plant Management Systems	28%		16%	
206	Basic Plant Biology	3%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	3%		8%	
212	Pathogens and Nematodes Affecting Plants	15%		11%	
215	Biological Control of Pests Affecting Plants	3%		5%	
216	Integrated Pest Management Systems	20%		9%	
806	Youth Development	5%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	16.3	0.0	16.0	0.0
Actual Paid Professional	30.1	0.0	19.0	0.0
Actual Volunteer	10.0	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**
1464770	0	2114464	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1464770	0	1930629	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	8596468	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

• Develop improved varieties of dry beans, tart and sweet cherries, potatoes, wheat, rice, soybeans, oats, barley, canola, turfgrass, apples, strawberries, blueberries, floriculture crops, chestnuts, vegetable crops, and conifers for Michigan growers.
• Continue to identify genes and genetic pathways that control plant response to environmental stresses and develop techniques to insert these pathways into at-risk plants.
• Identify and isolate novel genes, markers and genetic pathways that can benefit crops important to Michigan agriculture through higher yields, improved quality, and better insect and disease resistance.
• Identify and isolate novel genes, enzymes and other phytochemicals that may have benefits for human health and determine how these beneficial compounds can be made available to people.
• Develop integrated management strategies and provide education programs for producers of fruit, field, vegetable, floriculture, Christmas tree and forestry crops that use the lowest possible inputs of resources and improve yield and quality, while minimizing environmental effects, such as leaching and run-off.
• Develop cultural, management and insect and disease control strategies for crops that meet USDA certified organic standards so Michigan growers can take advantage of this growing market, if they choose to do so.
• Continue to develop biological controls for pest insects and diseases to minimize effects on the environment.
• Continue variety trials for crops important to Michigan, including wheat, corn, soybeans and forages.

Extension actitivities to:

• Conduct educational programs to help farm producers control weeds and more effectively manage high-cost fertilizer inputs while optimizing crop production.
• Develop plant disease prediction models.
• Conduct educational programs to help plant producers control disease caused by pathogens and nematodes and teach integrated pest management methods.
• Provide green industry professionals and homeowners with scientifically sound information to enable them to safely and effectively manage their turf, landscapes and gardens, improving efficiency of resources and controlling pests, while reducing pesticide and fertilizer use.
• Train Native American adults in sustainable agriculture.

2. Brief description of the target audience

Michigan growers (traditional and organic), commodity groups, agriculture and natural resources industry representatives (including herbicide, pesticide and insecticide suppliers), green industry/landscape/turf professionals, state agricultural agencies, Native American growers and the interested public.

3. How was eXtension used?

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

Ask an Expert statistics were analyzed for our program areas and found for Plant Sciences there were 13 staff paid by formula funds (5 fte). A few examples were:

Question: Hello, We have beautiful old Arborvitae trees that range from heights of 10 - 20 feet. We have placed our soaker hoses in a straight line near the outer edges of the trees. Should we have more soaker hoses placed near these trees? Should they be placed with two hoses going straight on each side of the tree? Should they weave around the trees or have a circle or two around each tree? Regarding watering, should this be done only once per week if we've had a good rain or should they be watered more? Our beds sit above our lawn. How long should we keep the hose on? Thank You, Mary

Answer: When it comes to watering, there are no hard and fast answers. It depends on what type of soil you have, how hot it is and how much rain you are getting. It depends on how the trees look. The trees need to have water that goes all the way around each tree and you won't know unless your stick fingers in the soil and check. The moisture needs to be in the soil at least 12 inches deep. You are going to determine if the trees have enough water if it is not raining. You want damp, not wet or soggy soil. You want to see one inch of water a week in the rain gauge and then you don't have to water until the soil is dry in the top three inches or so. Trees should be mulched with 3 inches of woodchips. Keep the trunks dry and clean to the ground. But evergreens can have damage and not show it for as much as six months so that's why it is critical to keep up on moisture. If the tree is turning brown, the damage is done.

Question: what variety of blueberry is best to plant in houghton and do you need more than one variety for pollination?

Answer: I am not sure where you will buy them but here are the varieties we recommend in northern Michigan. Highbush Blueray, Bluetta and Patriot, and half-high Northblue and Chippewa. You do not need another variety to pollinate, but if you have more than one variety you will get more fruit and it will be larger.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4785	14355	5903	11806

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

Patent Applications Submitted

Year: 2012

Actual: 28

Patents listed

MICL02179 - A Proteomics Study of Self-Incompatibility in Sweet Cherry - PCT/US2011/045044, 7/22/2011; 2011280960, 7/22/2011; 11746700.1, 7/22/2011; 61/576,515, 12/16/2011; PCT/US2011/044981, 7/22/2011; 201181001, 7/22/2011; 1174699.5, 7/22/2011. MICL01533 - Genetic Engineering of Oilseed Crops - 13/519,660, 6/28/2012. MICLO1654 - Genetic Improvement of Bean - PCT/US2011/047050, 8/09/2011. MICL01810 - Genetic Improvement of Strawberries and Blueberries - 2011/3174, 12/27/2011; BLU030, 12/12/2011. MICL01814 - Applied Behavioral Ecology of Insects - PCT/US2011/043038, 7/6/2011; 31-2013, 7/6/2011. MICL01832 -Management of Turfgrass Diseases - 13/472,213, 5/15/2012. MICL01940 - Regulation of Metabolism in Developing Seeds of Arabidopsis - 13/350,287, 1/13/2012; PCT/US2011/054881, 10/5/2011.MICL01986 - Tree Fruit IPM - 13/526,214, 6/18/2012. MICL02133 - Molecular-Genetic Analysis of Disease Resistance Signaling - 61/608,747, 3/9/2012. MICL02141 - Molecular Insights into Geobacter Films - 61/558,091, 11/10/2011; 61,530,708, 9/2/2011; 13/221,495, 8/30/2011; 13/221,459, 8/30/2011. MICL02166 - Chemical Catalysis and Processing for Advanced Biofuels and Biochemicals - 61/607,057, 3/6/2012; 61/568,726, 12/9/2011; 13/183,114, 7/14/2011. MICL02172 - Genetic and Genomic Approaches for Studying Fruit Ripening in Solanaceae - 61/505,004, 7/6/2011; PCT/US2011/052607, 9/21/2011.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	1	82	83

V(F). State Defined Outputs

Output Target

<u>Output #1</u>

Output Measure

- Number of research projects on plant sciences.

Year	Actual
2012	78

Output #2

Output Measure

- Number of adult participants trained in plant management systems.

Year	Actual
2012	3630

Output #3

Output Measure

- Number of youth participants trained in plant management systems.

Year	Actual
2012	5903

Output #4

Output Measure

- Number of adult participants trained in pathogens and nematodes affecting plants.

Year	Actual
2012	403

Output #5

Output Measure

- Number of adult participants trained in integrated pest management (IPM).

Year	Actual
2012	752

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of youth participants with increased knowledge of plant management systems.
2	Number of adult participants with increased knowledge of pathogens and nematodes affecting plants.
3	Number of adult participants with increased knowledge of integrated pest management (IPM).
4	Number of research programs to develop insect and disease control and/or cultural and management strategies for organic crops.
5	Number of research programs to develop biological controls for pest insects and diseases to minimize any effects on the environment.
6	Number of research programs to develop integrated management strategies for fruit, field, vegetable, floriculture and forestry crops that use the lowest amounts of nutrients possible and improve yield and quality.
7	Number of research programs to identify and isolate novel genes, markers and genetic pathways that can benefit crops important to Michigan agriculture through higher yields, improved quality, and better insect and disease resistance.
8	Number of research programs to identify genes and genetic pathways that control plant response to environmental stresses and develop techniques to insert these pathways into at-risk plants.
9	Number of research programs to develop improved varieties of economically important crops for Michigan and the region.
10	Number of adult participants with increased knowledge of plant management systems.
11	Number of research programs to develop weed control methodologies, protocols and practices.
12	Number of research programs to develop controls for pathogens and nematodes affecting plants.
13	Number of research programs to develop production protocols and environmental and cultural strategies for the floriculture/nursery industry.
14	Number of research programs to develop more effective post-harvest protocols and practices to minimize loss and enhance quality.

Outcome #1

1. Outcome Measures

Number of youth participants with increased knowledge of plant management systems.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5018

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Residents of areas in all 83 Michigan counties, both urban and rural, have limited access to full service grocery stores and healthy food. Racial and ethnic minorities are particularly vulnerable to diet-related disease, and low income minority communities have been excluded from meaningful entrepreneurial and job opportunities in the food system. Youth obesity is increasing, and the life expectancy of the next generation is predicted to drop rather than rise. Every day people go hungry, and numbers of people without enough to eat have increased with Michigan's economic downturn.? Source: Michigan Good Food Charter 2010. The Healthy Food Financing Initiative (HFFI) Working Group considers a food desert as a low-income census tract where a substantial number or share of residents has low access to a supermarket or large grocery store. Furthermore, to qualify as a food desert tract, at least 33 percent of the tract's population or a minimum of 500 people in the tract must have low access to a supermarket or large grocery store. (USDA Economic Research Service Food Desert Locator Map definition of a ?food desert? http://www.ers.usda.gov/data-products/food-desert-locator/documentation.aspx).

What has been done
Plant science and gardening programs were offered to over 1,000 youth across Wayne county including at Bulman Elementary School in Redford, 4-H Community Center in Detroit, A.L. Holmes Public School in Detroit, and in several Downriver communities. These programs are designed to encourage fitness, healthy eating habits and can serve as community service projects.

Results
Of the 400 participants who were invited to share their school progress records to see if learning life skills in gardening could transfer to skills in completing tasks like homework assignments and testing skills, about 74% presented documented improved grades at the end of the school year and 70% reported improved test scores in reading and comprehension.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
806	Youth Development

Outcome #2

1. Outcome Measures

Number of adult participants with increased knowledge of pathogens and nematodes affecting plants.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	367

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Unseasonable warm weather in late winter caused fruit trees in northwest Michigan to break dormancy and subsequently exposed to crop to a number of damaging frosts and freezes that devastated the 2012 tree fruit crop.

What has been done
One example is a set of twenty-two, on-farm integrated pest management sessions held in northwest Michigan during the spring of 2012 and focused on helping growers cope with crop losses.

Results
A total of 403 participants were recorded over the 8 week period (some were repeat participants as information changes each week). Season long attendance (including repeat attendees) totaled 54 in Antrim County, 57 in Benzie County, 214 in Leelanau County, and 78 in Grand Traverse County.

Participants were surveyed to determine the adoption of new practices or use of technologies based on the information presented at sessions or developed by Specialists on campus. Forty-three participants responded to the survey and represented 1,286 acres of apple and 5,355 acres of cherry production. Respondents reported land holdings in Grand Traverse (9), Leelanau (20),

Benzie (9), Manistee (3) and Antrim (4) counties. Forty-two respondents identified themselves as growers; one indicated that he was retired.

Ninety percent of respondents (representing 6,446 acres of tree fruit production and 37 farms) reported using scouting to detect pests and time treatments based on MSU recommendations. Seventy-eight percent of respondents (representing 6,143 acres of tree fruit production and 32 farms) use Enviroweather pest or disease modeling to accurately time treatment applications with 28% referring to the site daily, 47% weekly, and 25% intermittently. Twenty-nine percent of respondents with apples reported using reduced risk pesticides and 53% were able to delay pesticides based on early MSU recommendations, allowing for application saving. 68% of respondents with cherry (representing 3,336 acres of cherry land) reported utilizing a non-bearing chlorothalonil program to save on fungicide costs.

The Special Local Need (SLN) label for Bravo Weather Stik for use after schuckplit (secured by the MSU Tree Fruit Pathology Lab and Trevor Nichols Research and Extension Center in collaboration with the Michigan Cherry Committee) was utilized on the equivalent of 694 acres of tart cherry in northwest Michigan. The SLN label reduced growers? fungicide costs and delayed decision-making to allow growers to more accurately assess the crop size before moving to a non-bearing program in unharvestable blocks.

Based on MSU recommendations northwest Michigan growers will reduce their use of fertilizers by a total of 108,350 lbs and pesticide use by 13,350 lbs during 2012.

Based on reductions or modifications in pesticide and fertilizer applications, and a reduction in mowing based on MSU recommendations the total input saving reported totaled $502,976.73 for northwest Michigan growers who responded to the survey.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

<u>Outcome #3</u>

1. Outcome Measures

Number of adult participants with increased knowledge of integrated pest management (IPM).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	698

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Michigan agribusiness professionals are in need of 2013 MSU seed, weed, fertilizer and pesticide recommendations for year-end bulk pesticide and fertilizer purchasing and sales decisions. They also need this information for tax purposes.

With rising production costs, it is important that farmers and agribusiness professionals consider all production and risk management options and remain up to date on the latest MSU recommendations. With favorable grain prices, the industry is expanding and farmers are making new investments on land, equipment and new technology.

Another concern for the industry in the potential new threats, such as weeds and insects.

What has been done
One example, MSUE conducted an annual crop and pest Management update for Michigan agribusiness. It was held at the MSU Pavilion at the end of December It was offered to agribusiness professionals, mostly pesticide sales and services, commercial seed companies, crop consultants, and retail sales. Participants needing pesticide recertification credits before the end of the year to earn MAEAP, CCA and MDA credits.

Results
Three hundred and twenty participants from 44 counties attended the 2012 Integrated Crop and Pest Management Update on December 14.

Eighty percent of participants indicated that their 2013 production practices would change as a result of educational information received at this event.

This change in production practices will impact 115,412 acres in 2013. The net economic gain in terms of increased revenue or added savings that would potentially result from changing to new practices would be $1,477,273.

Attendees who attended the previous year were asked about the impact of that event.

They indicated that the 2012 recommendations were implemented on 105,750 acres of cropland that resulted in a financial gain of $1,004,625.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems

Outcome #4

1. Outcome Measures

Number of research programs to develop insect and disease control and/or cultural and management strategies for organic crops.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
American organic farmers represent only 1 percent of total U.S. farms, with 14,540 farms out of 2.2 million, and 4.1 million acres of land out of 922 million, with organic farms in all 50 states. Despite their smaller numbers, the sector grew by 8 percent in 2010, dramatically outpacing the food industry as a whole which grew at less than 1 percent in 2010. Overall, the industry has grown from $3.6 billion in 1997 to $29 billion in 2010, demonstrating that the organic sector will continue to play a contributing role in revitalizing America's economy through diversity in agriculture. Given this, research to help these producers increase production and marketing efficiences and control pests with methods that conform to organic standards is critical.

What has been done
Research to: optimize the production and use of thermophilic compost and vermicompost as important tools for organic and sustainable production and management of vegetable transplants and high tunnels for year round vegetable production and marketing on rural and urban farms; and to develop a methodology for quantifying multi-trophic crop/pest beneficial interactions.

Results
Research using repetitive cultivation (vs. a herbicide strip) for managing weeds in conventional orchards has shown that, by treating weeds like a cover crop, nitrogen becomes more available to the trees than when using a herbicide strip. The weeds serve as a catch for carbon and other nutrients instead of having a dead zone created by herbicides. This finding has application for both conventional and organic orchard floor management.

4. Associated Knowledge Areas

KA Code	Knowledge Area

205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #5

1. Outcome Measures

Number of research programs to develop biological controls for pest insects and diseases to minimize any effects on the environment.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Biological control is the use of living organisms to suppress pest populations, making them less damaging than they would be otherwise. Biological control can be used against all types of pests, such as vertebrates, plant pathogens, weeds and insects. Insects that were of little economic importance can become damaging pests. When a non-toxic control method is used, natural enemies are more likely to survive and reduce the numbers and damage of potential pest species.

What has been done
Research to: develop and deliver Integrated Pest Management strategies for insects in Michigan vegetable crops; develop stable, sustainable management strategies for vegetable insect pests; determine the effectiveness of currently registered and experimental products for control of insect pests in small fruit crops; improve control of moth pests by pheromone disruption; increase knowledge about mode of actions or effects of pests and diseases on honey bees to achieve better control and to gain increased honey production and more effective pollination of agricultural crops; and to develop biological and cultural tactics based on vegetation management.

Results
Research on pest management in Michigan fruit crops resulted in the validation of two degree day models for key moth pests, one in blueberry and the other in grape. The models are being widely used for timing, monitoring and control activities. In 2012, these models performed well in

combination with reduced-risk IGR or diamide insecticides. Delivery of the models through the MSU enviroweather website and through training of Extension educators and growers has supported this.
Further research on the effect of verroa mites on honey bees foraging and survival found that bees with mixed infections foraged earlier than either control bees or those with pure infections and that bees with mixed infections had lower survival than bees in other treatment categories. These data indicate that the effects of nosema infection may be dependent on co-infection and other factors. These findings will help in the development of a novel method for verroa mite control.
Investigations of asparagus miner management in asparagus included the development of a degree-day model, baits to trap and manage adult miner populations and an insecticide trial to determine the efficacy of different compounds against larvae. Through this combination, a 50 percent reduction in asparagus miner infested stems was achieved.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

Number of research programs to develop integrated management strategies for fruit, field, vegetable, floriculture and forestry crops that use the lowest amounts of nutrients possible and improve yield and quality.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers' livelihoods depend on production systems that are healthy and sustainable --

environmentally, ecologically and economically. Farmers in Michigan grow a diversity of crops second only to California, a state almost three times the size of Michigan. This world-class diversity necessitates a unique mixture of research and Extension programs to meet the needs of the state's growers, who produce more than 200 commercially grown commodities.

What has been done
Research to: identify and characterize phloem-associated lipids and lipid-binding proteins and identify their role in plant development and pathogen defense response; optimize protocols for honeycrisp storage in air and in controlled atmospheres; utilize and integrate physiological, genetic and horticultural approaches for understanding and improving Great Lakes region high value fruit production; decrease reliance on conventional crop protection practices by using low environmental impact fungicides in combination with host resistance; and to improve row crop nitrogen management to optimize economic returns and reduce environmental impacts.

Results
Research results in the 2012 bean breeding program included a yield of 40 cwt/acres of cranberry beans and many lines with resistance to common bacterial blight in kidney bean and cranberry bean trials. Rust is becoming an increasing threat to navy, black and small red bean producers in Michigan. Scientists have identified resistance to the emerging race in 22:2 in new navy, black and small red bean lines.

Work on the volatiles released from filamentous fungi, such as Aspergillus, which grows on stored grain has been published and may be helpful in the development of detection technologies.

Research on potato common scab has resulted in the discovery of a group of innovative biological agents for disease control. One of the bacterial strains shows strong antimicrobial activity against several important soil-borne pathogens, such as Streptomyces scabies. Ninety percent of the time, the research team?s isolate was stronger in disease control than the commercial one. Further, it not only suppressed the disease but also promoted plant growth.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology

Outcome #7

1. Outcome Measures

Number of research programs to identify and isolate novel genes, markers and genetic pathways that can benefit crops important to Michigan agriculture through higher yields, improved quality, and better insect and disease resistance.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	22

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As the world population increases and the demand for food and fuel relies more heavily on agricultural products, efficient methods of plant transformation will be required. Although conventional breeding will fulfill a part of this need, these techniques are limited to the gene pool of the species involved. In contrast, the tools of genetic engineering significantly expand the resources that can be used for variety improvement. Further, current transformation techniques are not applicable to all plant species.

What has been done
Research to: identify molecular markers for traits that are important in highbush blueberries; identify high-yielding oat, barley and canola cultivars for Michigan; provide guidance on disease control and crop health to the Christmas tree and chestnut industries; determine the biochemical mechanisms involved in turfgrass disease control; develop production methods to increase net returns to Michigan berry producers; elucidate molecular and biochemical mechanisms of plant resistance to arthropod herbivores; determination of how to better control for fungal and bacterial diseases of plants; and to develop improved analytical methods for the profiling of metabolites to assist in comprehensive measurements of biomarkers related to plant and animal health.

Results
In research to develop improved potato varieties under MSU?s SolCAP project, exotic germplasm has been identified that will enhance varietal breeding efforts; a new set of genetic markers (8,300) called SNPs, has been developed; and genetic engineering allowing scientists to introduce new genes to improve varieties and advance germplasm for traits such as insect resistance, late blight and PVY resistance, lower reducing sugar, and nitrogen use efficiency.

Two new blueberry varieties ? Calypso and Osorno -- were released to help extend Michigan?s blueberry season and enhance blueberry quality. Calypso ripens in mid-season and its overall fruit quality is far superior to current cultivars. Osorno is also a mid-season variety that has larger fruit and a better overall quality than earlier varieties, such as Aurora, Draper and Liberty.

Two new aphid-resistant soybean germplasms were released to the soybean industry in 2012. In addition, two food-grade soybean varieties were released, and one was licensed to a seed company.

Providing data and research tools to plant breeders and biologists that enable genomic-based plant breeding will be essential to improved agriculture in the 21st century. Using rice as the

foundation species, scientists have provided annotation for Poaceae species to permit cross-species analysis and data-mining, thereby providing a computational resource for Poaceae researchers to data-mine their species of interest, the majority of which lack robust annotation and research tools.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
206	Basic Plant Biology

Outcome #8

1. Outcome Measures

Number of research programs to identify genes and genetic pathways that control plant response to environmental stresses and develop techniques to insert these pathways into at-risk plants.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research on plant resistance to environmental stress is essential to sustainable agriculture. Determining how to develop or enhance resistance is a critical research area. Before plant varieties that are insect- or disease-resistant can be developed, scientists have to find a source of plant resistance and then determine how to cross-breed plants or isolate the responsible genes and then move them from one plant to another.

What has been done
Research to: better understand disease resistance signaling in plants; determine foliage thresholds based on the assimilation and storage of carbon; improve the efficiency of crop production through increased understanding of the genetics controlling plant growth and development; determine the effects of stress on plant metabolism; and to understand the genetic mechanism by which plants tolerate environmental stresses.

Results
Research has recently shown that circadian rhythms prompt a plant's ability to defend against cold weather. This information will allow scientists to design improved crops for food and for the development of plants for the sustainable production of bioenergy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology

Outcome #9

1. Outcome Measures

Number of research programs to develop improved varieties of economically important crops for Michigan and the region.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	17

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agriculture is Michigan's No. 2 industry. The state's agrifood system accounts for $71.3 billion in total economic activity and 600,000 jobs. Michigan is also one of the most diverse agricultural industries in the United States, growing more than 200 commodities. As the world population increases and demand for food and fuel relies more heavily on agricultural products, efficient methods of plant transformation will be required. Developing improved crop varieties is critical to sustaining an economically viable agriculture industry.

What has been done
Research to: identify the genes critical for the replication and repair of chloroplast DNA; understand the patterns of evolution of flora forms that contributes to the reproduction and persistence of Michigan plants; increase the environmental and economic sustainability of small fruit production through management of diseases in Michigan; understand the central plant

metabolism and transport in plant systems well enough to rationally manage and engineer them for human benefit; develop a data-driven protocol for culture of juice grape cultivars as well as fruit plant canopies and management systems that fit into these advances to achieve maximum efficiency; and to discover genes that are co-expressed with genes known for amino acid biosynthetic and catabolic enzymes.

Results

Field studies testing the impact of alternative cultural practices on asparagus performance in a replant situation and examining the potential to integrate brassica cover crops into asparagus crops showed limited yield benefits with soil amendments, especially in fields that were fumigated prior to asparagus planting. However, sowing brassica cover crops in the second half of August into asparagus fields showed great potential for improving yield. The use of transplants as a substitute for one-year-old crowns showed the greatest benefit to asparagus yield.

Research to understand how plants receive and respond to stress has found compelling evidence that PM-CW adhesion is required for the activation of defense signaling in plants following infection by phytopathogenic bacteria and that the plant hormone abscisic acid (ABA) plays a role in mediating the drought response phenotype in andr-1 mutant plants, which are highly susceptible to ABA-dependent drought stress.

An MSU scientist has identified a chromosome region in cherry that contains a gene(s) that controls cherry leaf spot (CLS) resistance, especially for tart cherries. This discovery will allow for the breeding of this resistance into commercial tart cherry cultivars. Further. The resistance is such that no sprays for CLS would be required as the leaves on the resistance selections do not yellow and do not fall off.

Research focused on developing reactions pathways for fuels and chemicals over the past year have identified biofuel compositions that reduce both particulate (soot) and nitrogen oxide (NOx) emissions from diesel engines. This is unusual, as NOx and soot emissions are usually a tradeoff, lowering one at the expense of the other. In addition, researchers have identified a universal chemical reaction rate constant for esterification reactions. This is an important generalization for what has been, until now a type of reaction that requires careful study.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology

Outcome #10

1. Outcome Measures

Number of adult participants with increased knowledge of plant management systems.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5193

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example in this area, is the ability to select the right variety of sugarbeets for the right field that is imperative for success for the farmers. Different diseases and pest issues are different in every field. By selecting the right variety-yields and profit can be increased significantly.

What has been done
MSUE educators conducted a series of 5 Sugarbeet Variety selection meetings in 2012.

Results
Based on growers that attended these meetings they indicated by attending the meetings yields increased by 3 tons per acre and quality improved by 1/2%. When asked what they thought the projected impact per acre would be on average, they reported $178 dollars per acre. These growers represented 33,453 acres that would be about 5.9 Million dollars increase in revenue. In conjunction with that 99% of the growers indicated that they are better able to select the right variety after attending this seminar.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #11

1. Outcome Measures

Number of research programs to develop weed control methodologies, protocols and practices.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Weed control is an essential part of all crop production systems. Weeds reduce yields by competing with crops for water, nutrients and sunlight. Weeds may also reduce profits by hindering harvest operations, lowering crop quality and producing chemicals harmful to crop plants. Weeds left uncontrolled may harbor insects and diseases and produce seed or rootstocks that infest fields and affect future crops. Weeds are a major source of yield loss for growers in Michigan and in the North Central Region. It is estimated that losses due to weeds left uncontrolled exceed $7.5 billion in the United States.

What has been done
Research to: help define management strategies that address shifts in weed populations; understand the degree to which weeds affect crop establishment and production in traditional and emerging cropping systems; identify effective practices for weed control in annual and perennial horticultural crops; determine the mode of action and basis for selectivity and fate of new or potentially new herbicides for weed control in Michigan; and identify the fundamental factors in cultural and chemical weed control, weed composition and weed life cycles.

Results
Pre-emergence herbicides were applied in Nov. 2011 and April 2012 to 6-year-old dwarf apple trees. Glyphosate at 1.35 pounds per acre was added to all treatments to kill emerged weeds. No injury to apple trees was apparent from any treatment. Fall applied flumioxazin at .383 pounds per acre suppressed most weeds into July.

Manganese (Mn) containing water conditioners have been developed and marketed to help growers alleiviate Mn deficiency symptoms in glyphosate-resistant soybean and to meet the water conditioning requirement for glyphosate without sacrificing weed control.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems

Outcome #12

1. Outcome Measures

Number of research programs to develop controls for pathogens and nematodes affecting plants.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nematodes are among the parasites that attack numerous economically important plants, substantially reducing their yield potential by destroying their root system. Pathogen epidemics are a constant problem for agriculture and are known to influence natural ecosystems, especially when alien pathogens successfully invade new areas.

What has been done
Research to: examine methods and problems associated with controlling disease in agriculture; gain a strategic understanding of the complexity of nematode problems and necessary disciplinary interactions; develop new, safer methods of insect control by using baculovirus biotechnology to either improve the insecticidal properties of baculoviruses or as a tool for designing safer chemical insecticides; to develop, assess and deliver effective IPM programs in cherry, apple, peach and some row crop conventional and organic commodities in the Upper Midwest; and to employ ecological and evolutionary perspectives to understand the dynamics of plant disease

Results
Research investigating how to best manage nematodes as part of a soil ecosystem demonstrated that microbial and organismal community structures vary by soil group, landscape and region, suggesting that one-size-fits-all approaches to managing soil-driven problems need to be reconsidered.

During the past year, more than 820 alerts related to IPM and ICM management and measurement systems, especially related to invasive species, were sent out via email, websites, commodity meeting oral reports, TV and radio interviews, etc., to cherry, apple, peach and some row crop growers in the upper Midwest to help them develop effective and adaptive IPM programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #13

1. Outcome Measures

Number of research programs to develop production protocols and environmental and cultural strategies for the floriculture/nursery industry.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The wholesale value of floriculture crops produced in Michigan is more than $400 million annually. Michigan's 625 commercial floriculture companies showed an estimated value of $402.7 million, with over half of them reporting wholesale sales of more than $100,000. Total greenhouse cover is about 50 million square feet, with an additional 3,600+ acres of open ground for floriculture production. Research in this area is critical to keeping this industry viable and profitable.

What has been done
Research to: improve control over quality loss in horticultural produce; evaluate turfgrass species and mixes for their adaptation to athletic field turf and to assess the effects of cultural practices;

improve the environmental sustainability of the Michigan landscape tree industry by optimizing water and nutrient inputs and determining the utility and potential impacts of organic fertilizers; investigate nitrogen fate in turfgrass; evaluate several perennial semi-aquatic or aquatic plants for use in the phytoremediation of nursery runoff water; and to develop protocols that growers and retailers can use to produce and profitably sell perennials as new floriculture crops while enhancing sustainability.

Results
Research to develop more efficient greenhouse lighting strategies and technologies demonstrated that, with petunias, limited LD lighting to periods of photoperiod sensitivity can promote flowering while potentially reducing lighting costs and undesirable stem extension.

Research investigating the water and nutrient budgets for shade trees and conifers found that a soilless substrate consisting of 80 percent composted pine bark and 20 percent peat moss optimized water and nutrient inputs for these two nursery crops.

Research findings on production efficiency for American marigolds, geranium, gerbera, osteospermum and snapdragon in glass-glazed greenhouse compartments are being used to estimate the net profit per pot and per square meter week for each species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #14

1. Outcome Measures

Number of research programs to develop more effective post-harvest protocols and practices to minimize loss and enhance quality.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers and food sellers have been concerned about losses since agriculture began. Yet the problem of how much food is lost after harvest to processing, spoilage, insects and rodents or to other factors takes on greater importance as world food demand grows. Cutting postharvest losses could add a sizable quantity to the global food supply and reduce the need to intensify production in the future. Estimates of total postharvest food loss are controversial and range widely, generally from about 10 percent to as high as 40 percent.

What has been done
Research to: Improve orchard and vineyard postharvest technologies and postharvest recovery of sugars and pectic polysaccharides from plants.

Results
A micro-irrigation overhead system to apply chemicals such as pesticides, growth regulators and chemical dyes was developed. Known as the Solid set Canopy Delivery System, the infrastructure was established in four Michigan orchard plots and was operated in October 2012 for growers, Extension educators and the public to demonstrate its effectiveness.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The ongoing economic challenges being faced by Michigan -- including the recent federal funding sequestration process -- continue to affect this planned program area. Consequences have included fewer new hires, delaying the award of new financial obligations, reducing levels of continued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants.Although overall research FTEs only decreased by one -- from 65 FTEs to 64 FTEs this past year, we are down from 77.1 FTEs just two years ago. Attrition and faculty departures also continue to have an impact on program outcomes.

The extreme weather conditions during last year's growing season also delayed or greatly diminished some of the research projects being conducted at our various research centers both on- and off-campus, particularly related to plant research around food and

biofuel crops.

We also opted in this year's annual reporting to revert back to our original 6 planned program areas for ease of reporting and better integration of research and Extension efforts. This has, once again, resulted in some instances in skewed results for some planned programs and outcome measures.This should be rectified after this year's reporting cycle.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and whether continuation funding and/or new dollars are appropriate and necessary as funds are available.

That said, the most notable qualitative impacts realized in this program were:

- Investigations of asparagus miner managment resulted in the development of a degree-day model, baits to trap and manage adult miner populations and an insecticide trial to determine the efficacy of different compounds against larvae. Evaluation of trials showed that, through this combination, a 50 percent reduction in asparagus miner infested stems was achieved.
- An evaluation of consumer preferences and the provision of an extended growing season for blueberries informed the development of two new blueberry varieties in 2012 - Calypso and Osorno. Calypso ripens in mid-season and its overall fruit quality is far superior to current cultivars. Osorno is also a mid-season variety that has larger fruit and a better overall quality than earlier varieties, such as Aurora, Draper and Liberty.
- Following substantial research and evaluation of numerous cherry rootstocks, an MSU scientist has identified a chromosome region in cherry that contains a gene(s) that controls cherry leaf spot (CLS) resistance, especially for tart cherries. This discovery will allow for the breeding of this resistance into commercial tart cherry cultivars. Further, the resistance is such that no sprays for CLS will be required as the leaves on the resistance selections do not yellow and do not fall off.

Other Examples Of MSUE Evaluation Results Not Previously Reported For This Area:

Master Gardener College

<u>Summary of impact.</u>

Issue (who cares and why)?

Michigan is the 2nd most diverse agricultural industry in the nation with a unique climate and resource base that provides for both food, feed and horticultural industries

from growing to processing. That same uniqueness also provides a tourism and manufacturing industry that must coexist with a socially aware population for environmental quality, safe and nutritious foods and economic prosperity.

Agriculture has become the fastest growing sector of the state's economy. MSU Extension needs to ensure a thriving knowledge base to be competitive in local, state, national and international markets that in turn, creates a thriving local economy for all residents.

Our resources are our greatest attribute. Air, water and soil quality must be sustained while fruit, vegetable, crop, livestock and ornamental industries remain efficient in yields, quality and input costs. Preservation, conservation and energy efficiencies must maintain social acceptability while the production and processing segments remain economically viable.

What has been done?

MSUE conducted Master Gardener College that included four, day-long educational tours that included stops to greenhouses, garden centers, and specialty nurseries and farms to address the needs described above.

Results/Impact?

Participants in the Master Gardener College program reported (119 respondents) that they would change their gardening practices that will enhance:

- 55% - **Water conservation** (reduce water usage, reduce lawn area, mow higher, mulch, use rain gage or moisture sensor before watering)
- 41% - **Water preservation** (water harvesting, rain barrels, rain gardens)
- 45% - **Proper fertilizer use** (best timing, reduced phosphorus use, slow-release sources)
- 42% - **Reduced pesticide use** (mulch leaves into turf, mulch garden to reduce weeks, select disease resistance plants)
- 58% - Proper plant selection (to reduce water use, right plant right place, to reduce pesticide and fertilizer need)
- 45% - Food gardening (growing fruits and vegetables)
- 39% - Reducing yard waste (recycling grass clippings, composting, mulching leaves into turf)

Evaluation specifically related to "Responsible Gardening to Protect the Environment" water quality session:

% of respondents who reported planned behavior changes:

- 60%- Test soil prior to fertilizing lawn/garden areas
- 53%- Address stormwater issues on my property by installing a rain garden, rain barrel, utlizing pervious pavement or pathways, etc.

- 53%- Apply no-P lawn fertilizer to my lawn, unless a soil test shows a need or I fall into one of the defined exemptioins for use as specified byt he MI Fertilizer Law.
- 73%- Avoid applying fertilizer on frozen or saturated soil.
- 53%- Practice proper setback distances from surface water as defined in the MI Fert. Law.
- 60%- Develop buffer strip utlizing native plants on my prpoerty adjacent to lakes, rivers or streams.
- 73%- Look for fertilizer that contains water-soluable forsm of nitrogen to feed plants slowly over time instead of all at once, reducing the risk of excess fertilizers moving off site and ending up in nearby waterways.
- 80%- Keep fertilizer and grass clippings off impervious surfaces to prevent them from washing into stormdrains and nearby waterways.
- 67%-Maintain lawn at hight of cut of at least 3 inches or taller.
- 53%- Create a no-mow zone around surface water.
- 53%- Address areas of lawn/garden with exposed soil by using vegetation to anchor soil in place in order to keep soil from wshing off-site into nearby waterways, carrying with it unnecessary nutrients.
- 27%- Use the Home-A-Syst to identify lawn/garden practices which may be negatively impacting my watershed.
- 100% of respondents indicated that this session was very relevant or somewhat relevant for addressing their personal gardening needs.
- 100% of respondents indicated the session was very relevant or somewhat relevant for addressing their volunteer outreach needs.

FRUIT CROP LOSS RESPONSE FOR 2012

Summary of impact.

Issue (who cares and why)?

The 2012 growing season started with record breaking warm temperatures in March, which forced fruit flower bud development along much earlier than normal. This was followed by a series of freeze events in April that resulted in a nearly complete crop loss in all of our tree fruit grown on the nearly 400 fruit farms in east Michigan. This was a series of events that took most of the fruit from the major fruit production areas east of the Mississippi River. This was the worst freeze event since 1945 for area growers.

What has been done?

MSUE responded by shifting the planned programming for fruit growers dramatically for the remainder of the season to help them adjust to such a significant disaster.

Results

Changes in programming included different pest management scouting and recommendations, fertility and weed management practices. I feel that I responded to this very different growing season quickly and concisely with appropriate and timely information, grower meetings, crop reports, MSUE News articles. This event also resulted in a flood of requests from elected officials, media, and agency representatives to MSUE.

Christmas Tree

Summary of impact.

Issue (who cares and why)?

Quality foliage determines the saleability of Christmas trees. Insects and diseases can cause significant damage to the foliage in any given year.

What has been done?

MSUE responded by helping growers on their management plans to control Douglas-fir Needle midge, hemlock scale, pine needle scale and pine tortoise scale. This included helping them scout their fields to determine when the insects were active, look at spray coverage and evaluate effectiveness of their spray programs.

Results

Evalution surveys from these growers reported that because of these efforts they were able to harvest trees that would have been un-salable due to damage from these pest. They valued this at $1,021,200 gain to their operations.

Key Items of Evaluation

Key research results for this area include:

- The development of a asparagus minor management strategy that includes a degree-day model, baits to trap and manage adult miner populations, and an insecticide trial to determine the efficacy of different compounds against larvae. Through this combination, a 50 percent reduction in asparagus miner infested stems was achieved.
- The release of two new blueberry varieties - Calypso and Osorno -- to help extend Michigan's blueberry season and enhance blueberry quality. Calypso ripens in mid-season and its overall fruit quality is far superior to current cultivars. Osorno is also a mid-season variety that has larger fruit and a better overall quality than earlier varieties, such as Aurora, Draper and Liberty.
- The identification of a chromosome region in cherry that contains a gene(s) that controls cherry leaf spot (CLS) resistance, especially for tart cherries. This discovery will allow for the breeding of this resistance into commercial tart cherry cultivars. Further, the resistance is such that no sprays for CLS will be required as the leaves on the resistance selections do not yellow and do not fall off.
- Manganese (Mn) containing water conditioners have been developed and marketed to help growers alleiviate Mn deficiency symptoms in glyphosate-resistant soybean and to meet the water conditioning requirement for glyphosate without sacrificing weed control.
- The development of a micro-irrigation overhead system to apply chemicals such as pesticides, growth regulators and chemical dyes. Known as the Solid set Canopy Delivery System, the infrastructure was established in four Michigan orchard plots and was operated in October 2012 for growers, Extension educators and the public to demonstrate its effectiveness.

Results from MSUE Institute Workteams relevant to this area:

Agriculture and Agribusiness Institute

- 645 new farms adopting practices that manage risks
- 681,177 new acres adopting practices that manage risks
- 1,447 new farms adopting technology or tools to manage risks
- 62,961 new acres adopting technology or tools to manage risks
- 37 new retailers displaying information about their food supply
- 1,002 new farms adopting practices to increase yield, improve quality, or decrease inputs
- 249,823 new acres adopting practices to increase yield, improve quality, or decrease inputs
- 246 new farms adopting tools or technology to increase yield, improve quality, or decrease inputs
- 84,061 new acres adopting tools or technology to increase yield, improve quality, or decrease inputs
- 3,631,822 Dollars ($) gained
- 401,536,531 Dollars ($) saved or protected
- 1,666,138,132 Product protected (mass in pounds)
- 4,006 Product protected (mass in acres)

Children and Youth Institute

- 23,611 youth educated on plant science
- 41,065 youth educated on environmental education/earth sciences
- 10,960 youth trained in biological sciences
- 14,225 youth trrained in Ag in the Classroom

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Economics, Marketing and Policy

☑ 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	25%		20%	
602	Business Management, Finance, and Taxation	22%		12%	
603	Market Economics	20%		8%	
604	Marketing and Distribution Practices	5%		5%	
605	Natural Resource and Environmental Economics	5%		14%	
606	International Trade and Development	0%		11%	
608	Community Resource Planning and Development	15%		10%	
609	Economic Theory and Methods	0%		9%	
610	Domestic Policy Analysis	3%		6%	
611	Foreign Policy and Programs	0%		5%	
806	Youth Development	5%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	18.2	0.0	4.0	0.0
Actual Paid Professional	20.7	0.0	7.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1125175	0	775304	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1125175	0	707897	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3152038	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

- Identify current and emerging key public policy issues on trade, environmental, agricultural and food issues important to Michigan and analyze responses.
- Conduct research and education to improve the operations, business and financial management skills of Michigan producers so they can make decisions that are more sound financially and environmentally.
- Evaluate the competitiveness and marketing strategies of Michigan farm markets, greenhouses and other green industry retailers.
- Develop a framework to understand and analyze domestic and international trade policies and assess their impact on Michigan.
- Evaluate how Michigan citizens use the Internet when searching for information about a vacation destination or planning a vacation.
- Determine rationale for farmland preservation choices and how changes will affect the Michigan tax base.
- Develop models to estimate the demand for and value of recreational fisheries and wildlife resources.
- Identify and evaluate the policy, technology and marketing issues faced by Michigan organic growers and develop responses.

Extension program activities to:

- Teach financial management skills, business organization, estate planning, management information systems, strategic management, alternative sustainable production and marketing systems to agriculture and natural resources producers and businesses.
- Assist agencies, organizations, local governmental units and individuals in pursuing a cultural economic development strategy.
- Offer business retention and expansion support.
- Help people recognize, understand and appreciate multicultural differences.
- Provide entrepreneurship education to a broad audience, including individuals, business owners, youth and communities.
- Offer communities consultative, diagnostic and educational assistance in planning and zoning to meet community land use goals.

2. Brief description of the target audience

Agriculture and natural resources producers and industry representatives; tourism industry representatives; state agency representatives; private citizens; school administrators; local, state and

federal elected officials and policymakers.

3. How was eXtension used?

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

Ask an Expert statistics were analyzed for our program areas and found for Economics, Marketing and Policy there were 19 staff paid by formula funds (4 fte). A few examples were:

Question: Can a Council person serve on the PC as chairman when no other member agrees to take the position?

Anwswer: A village or city planning commission shall have 5, 7, or 9 members (MCL 125.3815(2)). They have three year staggered terms, except the ex officio(s) members (MCL 125.3815(2)). Each member is to represent important segments of the city or village . . . . (MCL 125.3815(3)) Members shall be qualified electors, (with some exceptions . . . . (MCL 125.3815(4))

And in a City or Village the ex officio can be:

1. Chief administrative official [e.g., Village Manager], if any, or

2. Person designated by the chief administrative official, if any, or

3. Chief elected official [e.g., village president], or

4. One or more members of the legislative body [e.g., village council], or

5. Any combination of #1 - #4. So long at not more than 1/3 of the total membership of the planning commission are ex officio members, and not prohibited by [village or city] charter, if any. (MCL 125.3815(5))

Elected officer, employee, of the local unit of government [e.g., village or city] is not eligible to be a member of the planning commission (MCL 125.3815(5))

Ex officio have full voting powers, etc. on a planning commission.

The city or village ordinance creating the planning commission should have this detail spelled out: Statute presents a range of options so that a village one can choose to have none, one, or up to 1/3 of the total membership as ex officio members. One of the purposes of the city/village ordinance creating the planning commission is to make that policy decision, so that the Planning Commission Ordinance specifies if, and how many ex officio members shall be on the planning commission, whom they are and how appointed. The idea is that composition of membership of a planning commission does not arbitrarily change from time to time, but is a constant.

So the answer to your question for your local government should be found in the Planning Commission Ordinance which should set up the membership with the mandatory directive "shall" to specify which is being done in that local government. If it does not, or if it just reiterates statutory language, then that would

be a bigger problem that needs to be addressed. Also another option that should be specified in the planning ordinance would be whom the ex officio member(s) would be among the choices 1-5 given above (MCL 125.3815(5)). Again the Planning Commission Ordinance ought to specify whom with the mandatory directive "shall." If it does not, or if it just reiterates statutory language, then that would be a bigger problem.

Michigan Association of Planning's (MAP) best practice guidelines suggests that there should be an ex officio member(s), so that those with the fiscal purse strings are sitting on the planning commission (for CIP coordination, plan implementation coordination, etc.).

Question: If one of the use mentioned in the title are issued, does it go with the land forever

Answer: Zoning administrative decisions and zoning permits (such as special land use, planned unit developments handled like a special use, zoning permit, variance, site plan review) are issued to the parcel of land, and run with that land forever.

Other zoning decisions (such as zoning amendment, conditional zoning amendment, rezoning) are changes to the zoning ordinance, and not specific to a single parcel of land. Those types of legislative decisions can be changed by additional zoning amendments, conditional zoning amendments, and rezonings.

Nonconformites is a "status" (which is a land use established legally when it was first created, but due to zoning amendment, etc., becomes a type of land use which could not be established today. That status runs with the land, but it can be changed by (1) an amemdment which again makes it legal, or (2) the owner of the parcel voluntarally stops the nonconformity (it can not be stated up again), or (3) the local government buys the nonconformity from the parcel owner.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5483	16449	168	300

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

Year: 2012
Actual: 8

Patents listed
MICL02184 - Regional Biomass Processing Centers for Sustainable Biofuels and Animal Feeds - 13/458,830, 4/27/2012; 13,202,011, 8/17/2011; 61,641666, 5/2/2012; 61,606,139, 3/2/2012; 61/547,569, 10/14/2011; 61/623,408, 4/12/2012; 61/640,536, 4/30/2012. MICL02249 - Microbial Processes for Bioproducts and Biofuels Production - 61/531,304, 9/6/2011.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	1	30	31

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on economics, marketing and policy.

Year	Actual
2012	29

Output #2

Output Measure

- Number of adult participants trained in economics of agricultural production and farm management.

Year	Actual
2012	1229

Output #3

Output Measure

- Number of adult participants trained in business management, finance and taxation.
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of adult participants trained in natural resource and environmental economics.

Year	Actual
2012	2797

Output #5

Output Measure

- Number of adult participants trained in community resource planning and development.

Year	Actual
2012	1527

Output #6

Output Measure

- Number of youth participants trained in entrepreneurial skills

Year	Actual
2012	178

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of adult participants with increased knowledge in economics of agricultural production and farm management.
2	Number of adult participants with increased knowledge in business management, finance and taxation.
3	Number of adult participants with increased knowledge in natural resource and environmental economics.
4	Number of adult participants with increased knowledge in community resource planning and development.
5	Number of research programs to identify current and emerging key public policy issues on trade, environmental, agricultural and food issues important to Michigan and analyze responses.
6	Number of research programs to improve the operations, business and financial management skills for Michigan producers so they can make decisions that are more sound financially and environmentally.
7	Number of research programs to evaluate the competitiveness and marketing strategies and human resources management practices of Michigan farm markets, greenhouses and other green industry retailers.
8	Number of research programs to develop a framework to understand and analyze domestic and international trade policies and assess their impact on Michigan.
9	Number of research programs to develop models to estimate the demand for and value of recreational fisheries and wildlife resources.
10	Number of youth that develop an understanding of starting a business

Outcome #1

1. Outcome Measures

Number of adult participants with increased knowledge in economics of agricultural production and farm management.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1020

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Creation of new businesses, especially in the food/agriculture sector, has become important to the economic development of the State. Policy makers, administrators, and economic development personnel support organizations that can help expand this sector.

What has been done
MSUE is a critical partner with the MSU Product Center to develop programs to foster entrepreneurial development in the food, agriculture, and bioeconomy.

Results
From one educator in 2012 there were:

193 Venture start-ups (based on a commencement and continuation of planning for a new business or an expansion for an existing business)

169 Specialized services (including product testing, market analysis, and feasibility studies)

25 venture launches (commencement of economic activity for new or existing businesses through new sales, investment, or employment)

$ 12,004,990 Increased annual sales (cumulative first year sales only)

$ 6,259,448 Value of increased investment

78Jobs created

53Jobs retained

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Number of adult participants with increased knowledge in business management, finance and taxation.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Number of adult participants with increased knowledge in natural resource and environmental economics.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Number of adult participants with increased knowledge in community resource planning and development.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #5

1. Outcome Measures

Number of research programs to identify current and emerging key public policy issues on trade, environmental, agricultural and food issues important to Michigan and analyze responses.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Public policy has taken on considerable importance to the future of agriculture. The farmer's historic struggle was with the forces of nature and the marketplace, and government policy played a minor role. Government policy at all levels now is a major player in agriculture, especially related to agriculture as an important economic asset - the sustainability of a productive agricultural sector balanced with the preservation of environmental quality and the importance of prime farmland with respect to the continued viability of the rural economy and of rural lifestyles.

What has been done
Research to: develop a dynamic model to analyze the long-run impacts of renewable energy development on fossil fuel supply; provide a more comprehensive understanding of tourist preferences for tourism management and development; provide information that can contribute to better design and better use incentive-based conservation; develop rural Latino communities in Michigan; develop environmentally benign bioprocesses to effectively utilize various renewable resources; visually characterize changes in food and agricultural systems examine the implications of sustainability principles for U.S. agriculture; elucidate the role of economics and law on environmental management; develop, extend and apply economic and ecological theory to analyze economic and ecological trade-offs associated with ecological problems; and to better understand what forces spark Michigan food system conflict and how these conflicts can be transformed into opportunities for citizenship.

Results
A database was developed to assess the financial condition of 1,800 units of government in Michigan. The data is being employed to conduct research on the financial outlook for Michigan units of government, factors contributing to financial stress in Michigan units of government, policy alternatives for addressing fiscal stress and consequences of these policy alternatives for stakeholders in the units of government.

A series of decision-support tools were developed to assist farmers deal with market volatility and decisions framed in the context of the 2012 United States drought. Software and papers were made available via university outreach facilitation.

By looking at historical data, including land characteristics, weather data and potential factors that drive farmers to adopt a crop in a local region, AgBioResearch economists have developed sophisticated models to help predict cropping patterns for U.S. agriculture to deal with the warming climate trend. In these models, the availability of irrigation water is critically important in determining what crops are grown.

4. Associated Knowledge Areas

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

605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis

Outcome #6

1. Outcome Measures

Number of research programs to improve the operations, business and financial management skills for Michigan producers so they can make decisions that are more sound financially and environmentally.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research that enhances knowledge and informs risk analysis and management strategies and tactics related to the causes and effects of price, yield, and revenue risk in production agriculture and the costs of alternative strategies is critical to the long-term sustainability of the agrifood industry.

What has been done
Research to: explore, analyze and evaluate the dynamics and economic impact of entrepreneurial activity within the context of MI and global agrifood systems; further the understanding of coupled human and natural systems and sustainability; more broadly develop conceptual and analytically frameworks for understanding, assessing and empirically studying effective innovation in the agriculture, food and natural resource sectors; examine the causes and consequences of Michigan state and local government fiscal challenges; and to discern the relationship between entrepreneurship and the Michigan agrifood sector.

Results
The Michigan local government database management system was enhanced so that local authorities could pull data from the database into an Excel file, which enables them to generate a basic forecast of revenues and expenditures.

Research evaluating alternative configuration of biomass supply chains for future biorefineries

has identified a concept of distributed biomass processing using a network of regional biomass pretreatment centers (RBPC) that feed into a central biorefinery as opposed to the conventional supply chain structure consisting of a single central integrated biorefinery. The RBPC structure has the potential to address many challenges faced by the conventional structure, including issues related to market power, transaction costs of contracting, hold up and food vs. fuel issues.

In research on thermochemical conversion of woody biomass to fuels and chemicals, several different biomass feedstocks wer pyrolyzed using a screw-conveyor reactor at MSU, including poplar and a waste product from an industrial partner. Bio-oil yields in excess of 60 percent, along with biochar yields of 20 percent were observed on a mass basis. Electrocatalysis was then used to stabilize the bio-oil product of pyrolysis and reduce its reactivity and corrosiveness. Pyrolysis followed by electrocatalysis is a novel coupling of these technologies that may enable the decentralization of future bioenergy systems.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Number of research programs to evaluate the competitiveness and marketing strategies and human resources management practices of Michigan farm markets, greenhouses and other green industry retailers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Management of personnel and human resources has changed over the past three decades, partially due to increasing employment legislation, education issues, employee awareness and changes in demographics. As competitors strive to win the war for talent, effective human

resource management is necessary to gain true competitive advantage in the marketplace.

What has been done
Research to: study issues related to the management of human resources and "green" business practices in commercial recreation and tourism; profile and characterize consumers and markets for eco-friendly products.

Results
Recent research on horticultural consumer buying behavior found that purchase odds increase when the price, plant material and other relevant information are packaged together. It was also found that half of Americans will search online for information about plants and gardening and, of those who do search, 19 percent are more likely to make a plant purchase. These findings are essential to horticulture retailers, many of whom operate on less than 10 acres and generate less than $500,000 in revenue.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics
608	Community Resource Planning and Development

Outcome #8

1. Outcome Measures

Number of research programs to develop a framework to understand and analyze domestic and international trade policies and assess their impact on Michigan.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The ability to understand the economic, cultural and political factors of domestic and international trade policies in order to determine the likely changes in these policies and their consequent market is essential to a competitive, sustainable Michigan economy. Research in this arena will

provide information and resources that are critical to Michigan businesses, either directly or indirectly, as the balance of power within the marketplace shifts. As globalization of food industries continues, an assessment of such power requires analysis of world trends and the institutional structures that govern national and international actions.

What has been done
Research to: provide economic analysis of agricultural production technologies and management practices related to the many agricultural enterprises important to Michigan farmers; and better understand the supply chains of various horticultural products.

Results
In research to investigate why farmers aren?t adopting some of the environmentally beneficial row crop practices such as cover crop planting, small grain rotation and reduced fertilizer rates, a survey of 3,000 Michigan farmers and focus group sessions revealed that farmers are well aware of low-put technologies, but they see implementing these practices as adding to their costs. However, large numbers of growers said that they would adopt these practices if provided an incentive. Based on these findings, researchers developed supply curves, which show how much land Michigan farmers would be willing to put into these practices for various levels of payment.

Another survey asking Michigan residents if they would be willing to pay for the kinds of ecosystem services that these changed farm practices would require revealed that they would be willing to pay for reduced numbers of eutrophic lakes and reductions in greenhouse gas emissions. That payment could support potentially 20 to 50 percent of Michigan corn-soybean landing going into low-input practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
606	International Trade and Development
610	Domestic Policy Analysis
611	Foreign Policy and Programs

Outcome #9

1. Outcome Measures

Number of research programs to develop models to estimate the demand for and value of recreational fisheries and wildlife resources.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The natural beauty and outstanding recreational opportunities provided by Michigan draw more than one million visitors a year. Improving ecological conditions and fisheries has the potential to enhance economic and recreational benefits. For this reason, it is important for natural resources and wildlife managers to understand the recreational demands and economic benefits stemming from these important resources in order to wisely protect, sustain and market them.

What has been done
Research to: develop and extend economic models for estimating consumer preferences and the demand for, and value of, recreational fisheries and wildlife resources; and to study issues related to the management of human resources in a commercial recreation and tourism context.

Results
A multi-year survey to determine the demographic profile of Michigan anglers and recreational users has resulted in the collection of comprehensive data on public participation in hunting, fishing, ORV use and camping that is being used by the Michigan Department of Natural Resources to identify ways to get more people involved in outdoor activities and purchasing hunting and fishing licenses, ORV stickers and camping and parking permits to help support and maintain the state?s natural resources. Access to this data not only provides resource managers with a sound basis for decision making, but helps in interactions with interest groups because the decisions are being driven by systematic, representative data collection, not opinions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics
605	Natural Resource and Environmental Economics

Outcome #10

1. Outcome Measures

Number of youth that develop an understanding of starting a business

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	151

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
It is important to provide youth opportunities to learn entrepreneurial skills and how to start a business.

What has been done
One example is a 4-H club in the Upper Peninsula called the "Loop" that was a series of entrepreneurial youth experiences that connected Delta County youth with seven local businesses. The series brought adult entrepreneurs and 4-H youth together to discuss what it takes to run a business.

Results
Ninety one youth participated with 61 youth completing evaluation surveys. Results found:

- 71% of the youth have a better understanding of the realities and barriers of starting their own business
- 66% of the youth were confident that they could start their own business
- 72% of the youth understood the importance of a business plan
- 31% of the youth understood the importance of diversifying their income stream to have a successful business and make a profit.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The ongoing economic challenges being faced by Michigan -- including the recent federal funding sequestration process -- continue to affect this planned program area. Consequences have included fewer new hires, delaying the award of new financial obligations, reducing levels of condinued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants.Although overall research FTEs only decreased by one -- from 65 FTEs to 64 FTEs this past year, we are down from 77.1 FTEs just two years ago. Attrition and faculty departures also continue to have an impact on program outcomes.

The extreme weather conditions during last year's growing season also delayed or greatly diminished some of the research projects being conducted at our various research centers both on- and off-campus, particularly related to plant research around food and biofuel crops.

We also opted in this year's annual reporting to revert back to our original 6 planned program areas for ease of reporting and better integration of research and Extension efforts. This has, once again, resulted in some instances in skewed results for some planned programs and outcome measures.This should be rectified after this year's reporting cycle.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and whether continuation funding and/or new dollars are appropriate and necessary as funds are available.

That said, the most notable qualitative impacts realized in this program were:

- Research conducted by MSU AgBioResearch scientists on consumer behavior related to plant purchases found that purchase odds increase when the price, plant material and other relevant information are packaged together. It was also found that up to half of Americans will search online for information about plants and gardening and, of those, who do search, 19 percent are more likely to make a plant purchase. These findings are essential to horticulture retailers, many of whom operate on less than 10 acres and generate less than $500,000 in revenue.
- In research that evaluated why farmers weren't adopting some of the environmentally beneficial row crop practices such as cover crop planting, small grain rotation and reduced fertilizer rates, a survey of 3,000 Michigan farmers and focus group sessions revealed that farmers are well aware of low-put technologies, but they see implementing these practices as adding to their costs. However, large numbers of growers said that they would adopt these practices if provided an incentive. In a second survey asking Michigan residents if they would be willing to pay for the kinds of ecosystem services that these changed farm practices would require revealed that they would be willing to pay for reduced numbers of eutrophic lakes and reductions in greenhouse gas emissions. That payment could support potentially 20 to 50 percent of Michigan corn-soybean landing going into low-input practices.
- Research evaluating alternative configuration of biomass supply chains for future biorefineries has identified a concept of distributed biomass processing using a network of regional biomass pretreatment centers (RBPC) that feed into a central biorefinery as opposed to the conventional supply chain structure consisting of a single central integrated biorefinery. The RBPC structure has the potential to address many challenges faced by the conventional structure, including issues related to market power, transaction costs of contracting, hold up and food vs. fuel issues.

Other Examples Of MSUE Evaluation Results Not Previously Reported For This Area:

Farm Business Analysis

Issue (who cares and why)?

Health of the Agricultural Industry plays a signifanct roles in the economic health of the state of Michigan. The agricultural industry is a major source of the states overall economy. While other sectors continue to decrease or stay stagnent while the agricultural industry has steadily continued to show growth.

What has been done?

Farm Management educators have continued to work with agricultural producers through group programs and one-on-one consultations to provide education and information on the farm business analysis. Having "good" numbers from the farm allows a producers to have greater knoweldge on what is happening on the farm and how various aspects of the farm play a role in its expenses and revenue generations. This allows the producer to make better management decisions on how to move the farm forward. Note

that this was not reported in the output numbers because of the shift from more formal training with lesson plans to technical assistance and working one on one.

Results/Impact

From sampling 33 farms that have completed a thorough financial analysis these farms have contributed to the economy in the following manner: 1) They produced over $63 Million in sales; There is a combined change in their earned networth of almost $9 Million, and between these 33 farms they have provided 427.9 FTE's.

Michigan Garden Plant Tour 2012

Issue (who cares and why)?

Growers need information on new plants to continue to develop greenhouse businesses.

What has been done?

MSUE conducted Michigan Garden Plant Tour during 2012.

Results/Impact

129 growers reported increased income from new plants they saw at the Michigan Garden Plant Tour.

Over $431,000 in new plant sales for Michigan propagation greenhouses as a direct result of being a host site for the Michigan Garden plant tour based on evaluation summary.

Extrapolated out to the total attendance for the tour it results in potential increased sales of $4.3 million dollars to Michigan based businesses.

Agriculture for Tomorrow in the Upper Peninsula

Issue (who cares and why)?

Farmers and residents of the Upper Peninsula care because they want their industry and individual businesses to prosper.

What has been done?

121 paid participants (farmers and others) attended the full-day, multi-session "Agriculture for Tomorrow" MSUE conference in Escanaba on March 6, 2012

Results/Impact

Results from the conference evaluation found:

77% of the crop and 68% of the livestock respondents reported adopted production practices recommended at the conference. Among these included crop yield increased by 84% and 79% for crop quality as reported by the respondents. Livestock production was increased by 52% and quality increased by 61% for these respondents. 50% of the respondents reported increased net farm income as a result of participation in the

Agriculture for Tomorrow Conference. 28% of the participants used information from the conference to create a new business and 25% used the information to expand their businesses.

Key Items of Evaluation

Key research results in this area are:

- The development of a database to assess the financial condition of 1,800 units of government in Michigan. The data is being employed to conduct research on the financial outlook for Michigan units of government, factors contributing to financial stress in Michigan units of government, policy alternatives for addressing fiscal stress and consequences of these policy alternatives for stakeholders in the units of government.
- The development of supply curves, which show how much land Michigan farmers would be willing to put into environmentally friendly row crop practices such as cover crop planting, small grain rotation and reduced fertilizer rates. Consumers surveyed indicated that they would be willing to pay for reduced numbers of eutrophic lakes and reduction in greenhouse gas emissions - that payment could support potentially 20 to 50 percent of Michigan corn-soybean landing going into low-input practices.
- In experiments with thermochemical conversion of woody biomass to fuels and chemicals, several different biomass feedstocks were pyrolyzed using a screw-conveyor reactor at MSU, including poplar and a waste product from an industrial partner. Bio-oil yields in excess of 60 percent, along with biochar yields of 20 percent were observed on a mass basis. Electrocatalysis was then used to stabilize the bio-oil product of pyrolysis and reduce its reactivity and corrosiveness. Pyrolysis followed by electrocatalysis is a novel coupling of these technologies that may enable the decentralization of future bioenergy systems.
- The identification of a concept of distributed biomass processing using a network of regional biomass pretreatment centers (RBPC) that feed into a central biorefinery as opposed to the conventional supply chain structure consisting of a single central integrated biorefinery. The RBPC structure has the potential to address many challenges faced by the conventional structure, including issues related to market power, transaction costs of contracting, hold up and food vs. fuel issues.

Results from MSUE Institute Workteams relevant to this area:

<u>Agriculture and Agribusiness Institute</u>

- 5,429 jobs retained during this time
- $1,736,408,717 in sales, new or retained
- 45 new business plans created
- 72 new businesses
- 184 new business expansions

<u>Children and Youth Institute</u>

- 71% of the youth participants gained knowledge of entrepreneurial concepts.
- 94% of adult volunteers learned how to teach youth entrepreneurial concepts

Greening Michigan Institute

- 53 new business start-ups including businesses in the green economy [note there is a seperate indicator for new green economy business start-ups as well]
- 40 businesses expanded
- 139 jobs created
- 15 communities involved in CEC-related activities, asset mapping, Business Resource Centers, awards/recognition programs for entrepreneurs and green entrepreneurs, other activities
- 20 new regional economic development collaborations
- 10 regional economic development collaborations strengthened
- 222 community leaders demonstrated increased awareness of the value of entrepreneurship
- 87 community stakeholders reported an increased awareness of individual entrepreneurs, their needs and assets, and possible strategies including strategies related to entrepreneurship in the green economy
- 83 community stakeholders reported an increased awareness of regionalism as a sustainable community prosperity opportunity
- 182 emerging entrepreneurs reported an increase in business knowledge, tools, skills and technical expertise.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Animal Production and Protection

☑ 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
301	Reproductive Performance of Animals	2%		15%	
302	Nutrient Utilization in Animals	5%		13%	
303	Genetic Improvement of Animals	4%		10%	
304	Animal Genome	3%		10%	
305	Animal Physiological Processes	0%		10%	
307	Animal Management Systems	45%		13%	
308	Improved Animal Products (Before Harvest)	0%		1%	
311	Animal Diseases	25%		15%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	1%		2%	
315	Animal Welfare/Well-Being and Protection	1%		11%	
605	Natural Resource and Environmental Economics	4%		0%	
806	Youth Development	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	9.1	0.0	7.0	0.0
Actual Paid Professional	15.1	0.0	10.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
712713	0	1127714	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
712713	0	1029669	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4584783	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

- Understand the processes that control/influence reproduction at the molecular and genetic level.
- Develop and test new cropping, grazing and feeding strategies for food animals.
- Develop and evaluate management/training strategies for race horses to reduce injuries.
- Add to the understanding of various food animal genomes by improving and integrating genetic maps.
- Understanding of the genetic and molecular processes that control/influence the immune system in food animals to create new disease detection and tracking technologies.
- Develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.
- Understanding of the environmental fate and biological effects of vaccines, steroids and other drugs fed to animals.

Extension activities to:

- Assist beef producers with implementing the mandatory electronic identification system and demonstrate methods to use the system to sharpen management skills.
- Provide livestock producers with knowledge and skills to develop and maintain herd-health systems.
- Provide animal industry with up-to-date animal health information.
- Improve farm-specific environmental stewardship related to manure management, including developing whole-farm nutrient management plans, manure value, land use and neighbor relations.

2. Brief description of the target audience

Michigan animal producers, agriculture and natural resources industry representatives, animal pharmaceutical industry, animal welfare organizations, state agency representatives, state and local elected officials and the interested public.

3. How was eXtension used?

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

Ask an Expert statistics were analyzed for our program areas and found for Animal Production and Protection there were 11 staff paid by formula funds (4 fte). A few examples were:

Question: Does the bull determine the length of gestation in a cow or is the cows age and whether or not the bull is calving ease determine the gestation

Anwer: Gestation length varies by age of dam, breed, and sex of the calf. Gestation length ranges from 279 to 287 days. For most breeds, 283 days is common. Cows carrying bull calves tend to have a slightly longer gestation compared to cows carrying heifer calves. First-calf females tend to have a shorter gestation than mature cows, but that may be due to their being bred to calving-ease bulls, and they may be calving easier because they sire calves that are *in utero* for a shorter length of time.Browse related Faqs by tag: beef cattle, gestation Thank you for using eXtension's Ask an Expert function.

Question: How many acres does a 1 cow need for eating?

Answer: 5 acres

Question: I have a 6 yr old QH Gelding. Showing all the signs of ulcers and excess gas. We are treating with the GastroGard, what would be the best hay and grain for this animal. Research of the low carb/sugar leave me lost.

Answer: The best diet for all horse, and especially those with ulcers is a forage based diet (hay and pasture). If addition calories are needed, use a compete feed or a fat supplement.

Question: What is wrong with chickens thats legs are out in front of them and they can't stand?

Answer: There could be a disease issue, a nutrition issue, or perhaps a management issue. However, I don't have enough information to provide guidance on one of these areas. Please provide some additional information on type of chicken, age, feeding program, management program, and anything else you want to share.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1326	2652	15154	30308

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	1	44	45

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on animal production and protection.

Year	Actual
2012	40

Output #2

Output Measure

- Number of adult participants trained in animal management systems.

Year	Actual
2012	663

Output #3

Output Measure

- Number of youth participants trained in animal management systems.

Year	Actual
2012	15154

Output #4

Output Measure

- Number of adult participants trained in animal diseases.
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of adult participants with increased knowledge about animal management systems.
2	Number of youth participants with increased knowledge about animal management systems.
3	Number of adult participants with increased knowledge of animal diseases.
4	Number of research programs to understand the processes that control/influence reproduction at the molecular and genetic level.
5	Number of research programs to add to the understanding of various food animal genomes by improving and integrating genetic maps.
6	Number of research programs to develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.
7	Number of research programs to understand the environmental fate and biological effects of vaccines, steroids and other substances fed to animals.
8	Number of research programs to develop and evaluate management/training strategies for horses to reduce injuries.
9	Number of research programs to add to the understanding of animal behavior and welfare.
10	Number of research programs to test new cropping, grazing and feeding strategies for food animals.

Outcome #1

1. Outcome Measures

Number of adult participants with increased knowledge about animal management systems.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example is for beef producers to help them increase profitability while improving quality of the animal and protecting the environment.

What has been done
MSUE conducted a four-part webinar series called "Opportunities in Beef Production & Marketing"

Results
Thirty five individuals participated in one or more of the webinars in the four-part series held in February and March 2012. An online survey was sent to all participants at the conclusion of the series with two follow-up reminders to those who had not completed the survey. Response rate was 55 percent (n=19).

Participants reported that they planned to use much of the information presented in the series. Ten of the thirteen topics covered in the series received high marks with 90 ? 100 percent of participants reporting that they would use the information in their business or farm operation. Current Cost of Beef Production and Identifying Market Potential & Consumer Demand Trends appeared to be the most useful segments with 100 percent of respondents reporting they planned to use the information from these webinar segments.

A behavior check list assessing potential changes that participants may make in their operations in the next nine months showed that producers are planning significant change. Sixty-one percent plan to expand their existing beef herds and 22 percent plan to begin raising beef that are not currently raising beef. Eleven percent reported they plan to change their production method for producing beef and 17 percent plan to change the type of genetics they are using. Thirty percent

reported they plan to expand direct marketing efforts and 11 percent plan to begin direct marketing.

Twenty eight percent plan to begin marketing a differentiated beef product (ex. grass fed, organic or no added hormones) and 17 percent plan to expand marketing of a differentiated beef product. Eleven percent plan to develop a branded meat product. Half of the respondents reported they plan to write a business plan and 22 percent plan to update their existing business plan.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases

Outcome #2

1. Outcome Measures

Number of youth participants with increased knowledge about animal management systems.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	12123

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
It is critical youth learn about animal management, life skills, and to examine if this is an area that they may wish to pursue a career.

What has been done
One example is where MSUE conducted a 4-H Horse camp where the objectives of the horse camp were to help youth:
-learn horsemanship skills
-increase knowledge and interest in the area of equine science
-increase knowledge of equine project related careers
-learn important life skills such as teamwork, critical thinking, problem solving, decision making

Results

Thirty-nine youth completed evaluation surveys. Results found:

83% increased their knowledge in horse science
66% increased communication skills
75% increased skills in horse management practices
70% increased decision making skills in areas that involve their horse project area.
78% increased problem solving skills that involve their horse project area
75% increased critical thinking skills in areas that involve their horse project area
86% feel more knowledgeable about career opportunities related to the equine project area.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases
806	Youth Development

Outcome #3

1. Outcome Measures

Number of adult participants with increased knowledge of animal diseases.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of research programs to understand the processes that control/influence reproduction at the molecular and genetic level.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Unless you are a strict vegetarian or lactose intolerant, chances are that dairy and beef products make up half of your diet. According to the U.S. Department of Agriculture, almost 40 percent of the average American diet is dairy, and beef makes up 10 percent. This makes these products an integral part of our lifestyle and our economy, this sustained productivity and animal health are critical issues to the cattle industry

What has been done
Research to: understand the impact of animal agriculture on the modern society; develop new methods to improve fertility and reproductive efficiency in livestock; investigate potential effects of exposure to environmental contaminants in humans and animals, with an emphasis on reproductive performance; develop a local/regional pasture-based beef production system encompassing the entire beef production chain; and to assess the impact of Ovsynch on conception rates of lactating dairy cows.

Results
Research on why fertility increases in lactating cows when progesterone is enhanced during the growth of the ovulatory follicle found that it might be possible to significantly lower fertility in heifers by lowering progesterone during growth of the ovulatory follicle.

Research to improve conception rates among dairy cows at a Michigan dairy operation experiencing a 10 to 20 percent first service conception rate found that the application of the newly developed G-6-G protocol increased first service days to 100 days for cows and 120 days for first-calf heifers (vs. 65 to 70 days after calving), and that the conception rate for these cows increased to about 60 percent.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
304	Animal Genome
305	Animal Physiological Processes
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

<u>Outcome #5</u>

1. Outcome Measures

Number of research programs to add to the understanding of various food animal genomes by improving and integrating genetic maps.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Genetic maps are an integral part of several statistical models that are commonly used to find disease genes. A better understanding of these maps will allow for the development of increasingly accurate models that will provide researchers and producers with reliable estimates in a practical amount of time and will greatly enhance disease prevention and treatment efforts.

What has been done
Research to: develop methods for producers and consultants to evaluate dairy herd performance and assess trends for herd life and culling rates;develop a new set of tools and reagents to study autologous cell therapy using a new large animal model; and to develop and adapt staistical and computational methods to link phenotypic variation to genomic variation.

Results
DNA and phenotype records from a resource population of Duroc sires and Pietrain dams (pigs), along with DNA and phenotypes from a Landrace x Yorkshire population that had been exposed to a halothane challenge test were used to evaluate corticotropin-releasing hormone receptor 2 (CRHR2) as a potential candidate gene affecting stress response, carcass merit and meat quality traits. Several meat quality traits, including pH and drip loss exhibited a significant association with the CRHR2 genotype.

Significant strides have been made in the identification of next generation probiotics for the treatment of bone health and obesity. First, a recombineering technology in L. reuteri and L. lactis was developed, enabling researchers to perform powerful genetic assays to identify key probiotic features in these organisms. Second, researchers have demonstrated that L. reuteri 6475 has a positive effect on bone health in three different models of osteoporosis in mice.Third, scientists have isolated and cataloged more than 2000 intestinal bacterial isolates from healthy human volunteers to be screened for beneficial properties in obesity, type II diabetes and antibiotic-associated diarrhea.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome

305 Animal Physiological Processes

Outcome #6

1. Outcome Measures

Number of research programs to develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Animal disease in the United States could seriously damage the livestock and poultry industries. For example, eradication of avian influenza in the United States following an outbreak in the mid-1980's resulted in the destruction of 17 million birds and cost taxpayers nearly $65 million. The collective effort and vigilance of researchers, livestock producers, veterinarians and state and local government officials is needed to ensure adequate disease surveillance and to provide the needed resources to prevent, respond and/or eliminate disease outbreaks.

What has been done
Research to: develop new interventions to reduce antimicrobial resistance when treating animals with antimicrobial drugs and to develop a new non-antibiotic treatment for mastitis in dairy cows; determine the contribution of T2SS to biofilm formation in gram-negative human and plant pathogens' better understand parasitic and mutualistic interactions in a bacteria-nematode insect association; collect and screen for bacterial strains with antagonistic properties for food borne pathogens and test their efficacy; and improve immune recognition in order to protect against or eliminate viruses and diseases such as Johne's disease.

Results
A cooperative effort involving the United States and Canada, with support from the USDA and MSU AgBioResearch scientists, offered training sessions and worked with producers in educating employees about mastitis. This has led to a better understanding of milking procedures and a reduction in mastitis through prevention and non-antibiotic treatments. Michigan is consistently one of the top states in mastitis control and production of quality milk.

A Johnes Disease lesion scoring system for cattle has been developed, which will greatly assist scientists studying tissues from infected animals.

2012 marks the sixth year of the Michigan Upper Peninsula Bovine Viral Diarrhea Virus (BVDV) Project. To date, over 60 percent of the Upper Peninsula cattle farms are enrolled in the project. The data collected and research findings coming from this project are not only benefiting producers by reducing economic losses associated with BVDV morbidity and mortality, but consumers are benefiting because of reduced disease incidence, which has both food safety and quality implications. Recent studies have reported out on the potential for detecting BVDV virus by PCR skin samples taken from calves following vaccination with a modified-live BVDV vaccine and the potential association of persistent infection with BVDV on colonization and shedding of shiga-toxin producing E. coli.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #7

1. Outcome Measures

Number of research programs to understand the environmental fate and biological effects of vaccines, steroids and other substances fed to animals.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michiganders are an exceptionally vulnerable population due to their chronic exposure to complex mixtures of endocrine disruptors, which include legacy environmental contaminants (e.g., dioxin, PCBs, DDT) within the Great Lakes basin. A comprehensive molecular and physiological understanding of the interactions that may occur is critical to human health. Also, vaccines,

steroids, antibiotics and other substances are added to animal feed to improve growth rates by controlling parasitic and bacterial diseases. With the recent major expansion in concentrated animal feedlot operations, the potential risks from these operations must be assessed.

What has been done
Research to: achieve a better understanding of the impact of animal agriculture on society by integrating the risks and benefits related to economics, environmental protection and human health; develop multistage hierarchical models to facilitate greater efficiency of inference in general mixed model microarray experiments; and to identify the environmental transformations undergone by animal feed additives and determine their environmental fate.

Results
Outreach efforts to promote better stewardship on antibiotic use on dairy farms in the past year included several workshops on mastitis bacteriology for dairy producers and veterinary practices to help these stakeholders make better therapeutic decisions, and several presentations made to veterinary practitioner and dairy producer groups to highlight the interaction between poor therapeutic decisions and residues in meat and milk.

Research evaluating the effects of feeding farm-raised mink diets containing PCB-contaminated fish from the Upper Hudson River (New York) on adult reproductive performance and kit growth and mortality found that a daily diet composed of less than 10 percent Hudson River fish could provide a dietary concentration of PCBs that resulted in 20 percent kit mortality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
315	Animal Welfare/Well-Being and Protection

Outcome #8

1. Outcome Measures

Number of research programs to develop and evaluate management/training strategies for horses to reduce injuries.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2012	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Due to improvements in nutrition, management and health care, horses are living longer, more useful lives. It's not uncommon to find horses and ponies living well into their 20s and 30s. Although genetics play a determining role in longevity, providing proper care and nutrition plays a key role in horses' health, performance and overall well-being.

What has been done
Research to: investigate ways to manipulate bone density and strength through mechanical loading to help prevent injuries to performance horses and increase the longevity of livestock; identify ways to manipulate the equine diet to optimize skeletal health and improve the overall welfare of horses; and to define the role that EHV-5 plays in the development of spontaneous equine multinodular pulmonary fibrosis.

Results
Information provided through talks and popular press publications provided new material on how to properly feed growing horses, how to feed equine athletes, feeding horses in hot weather, and feeding for soundness. Information was also provided to the science and veterinary communities on topics such as gastric ulcers, whether the incorporation of phytase into equine diets can reduce phosphorus excretion into the environment, and using horses as a model to explore a link between insulin resistance and iron overload disorder in browsing rhinos.

4. Associated Knowledge Areas

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

<u>Outcome #9</u>

1. Outcome Measures

Number of research programs to add to the understanding of animal behavior and welfare.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2012 2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our society has placed increased emphasis on the welfare of research and exhibit animals. U.S. law now requires attending to exercise requirements for dogs and the psychological well-being of non-human primates. Animal welfare without knowledge is impossible. Animal behavior researchers look at the behavior and well-being of animals in lab and field. Good animal welfare requires solid science that informs and directs policies and practices related to disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter.

What has been done
Research to: maintain and improve skeletal health in livestock and companion animals; identify management practices and environmental conditions, particularly for young animals, that allow expression of positive natural behaviors while improving animal welfare in the context of environmentally sustainable production systems; and to examine ethical issues in agriculture.

Results
A wireless body-mounted sensor system to describe behavior, space use and resources use in non-caged laying hens has been developed. Outputs associated with this system include the development of standardized science-based criteria for assessing the well-being of non-caged chickens and an automated monitoring system to be used commercially to monitor the well-being of livestock.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Number of research programs to test new cropping, grazing and feeding strategies for food animals.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As production costs rise, environmental concerns increase and consumer expectations become higher, those involved in the agrifood industry are looking for ways to maximize reproductive and perfomance efficiencies in a way that is economically and environmentally sustainable, and that protects human and animal health.

What has been done
Research to: develop a local/regional pasture-based beef production system encompassing the entire beef production chain; investigate strategies to maximize milk production output and ecosystem functions in grazing dairy systems; mitigate the environmental footprint of animal systems; develop a local/regional pasture-based beef production system encompassing the entire beef production chain; investigate strategies to maximize production output (milk)and ecosystem functions (processes and services) in grazing systems managed under various scenarios for the optimization of automatic milking and pasture systems; better understand the mineral needs of the pig; and to evaluate the effectiveness of mannaniligosaccharides on egg production, egg weight and bird livability of laying hens.

Results
Research to increase the efficiency of protein production and the quality of meat and milk in ruminants through nutritional methods has resulted in the development of a database to quantify relationships among factors that affect dairy feed efficiency. The database is currently being used to determine if there is an optimal level of milk production to maximize feed efficiency. There is currently data from about 5,000 Holstein cows from the United States and Europe, with a goal of collecting data from 8,000 cows.

Research investigating the effects of water iron concentration, valence and source on the drinking water preference of lactating cows found that, upon first exposure to drinking water, lactating dairy cows tolerate concentrations of iron up to 4mg/L without reducing water intake. However, water intake was reduced with 8 mg/L. Preference was not dependent upon iron valence or iron source in the studies. This information will aid in the understanding of potentially negative impacts of some poorer quality natural or polluted waters often relegated to livestock. Being able to effectively treat waters for consumption by cattle while maintaining normal health and production will be crucial to help preserve, or at least conserve, more pristine waters.

Research on how nutrition affects reproduction and feed efficiency found that once cows reach the optimum body condition score for calving, they should be fed less grain and more digestible fiber to direct more energy to milk. Understanding how to feed cows during early and late stages of lactation also affects the efficiency of milk production, a critical consideration for dairy operations.

4. Associated Knowledge Areas

KA Code	Knowledge Area

302	Nutrient Utilization in Animals
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The ongoing economic challenges being faced by Michigan -- including the recent federal funding sequestration process -- continue to affect this planned program area. Consequences have included delaying the award of new financial assistance obligations, reducing levels of continued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants. Although overall research FTEs only decreased by one - from 65 to 64 FTEs this past year - we are down from 77.1 FTEs just two years ago. Attrition, faculty departures and reduced faculty hires also continue to have an impact on program outcomes.

The extreme weather conditions during last year's growing season also delayed or greatly diminished some of the research projects being conducted at our various research centers both on- and off-campus, particularly related to plant research around animal feed and food crops.

We also opted in this year's reporting to revert back to our original 6 planned program areas for ease of reporting and better integration of research and Extension efforts. This has, once again, resulted in skewed results from numbers for this year's projected outcomes. This should be rectified after this year's reporting cycle.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As Hatch dollars are base funding for faculty member salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and whether continuation funding and/or new dollars are appropriate and necessary as funds are available.

That said, the most notable qualitative impacts realized in this program were:

An evaluation of a newly developed protocol, G-6-G, to improve conception rates among dairy cows at a Michigan dairy operation experiencing a 10 to 20 percent first service conception rate found that the use of the protocol increased first service days to 100 days for cows and 120 days for first-calf heifers (vs. 65 to 70 days after calving), and that the conception rate for these cows increased to about 60 percent.

- An evaluation of advances in the identification of next generation probiotics for the treatment of bone health and obesity documented the development a recombineering technology in L. reuteri and L. lactis that enables researchers to perform powerful genetic assays to identify key probiotic features in these organisms, and that L. reuteri 6475 has a positive effect on bone health in three different models of osteoporosis in mice. Scientists have isolated and catalogued more than 2000 intestinal bacterial isolates from healthy human volunteers to be screened for beneficial properties in obesity, type II diabetes and antibiotic-associated diarrhea.
- A 2012 evaluation of the Michigan Upper Peninsula Bovine Viral Diarrhea Project documented that over 60 percent of the Upper Peninsual cattle farms are now enrolled in the project
- Research evaluating the effects of feeding farm-raised mink diets containing PCB-contaminated fish from the Upper Hudson River (New York) on adult reproductive performance and kit growth and mortality found that a daily diet composed of less than 10 percent Hudson River fish could provide a dietary concentration of PCBs that resulted in 20 percent kit mortality.

Examples Of MSUE Evaluation Results Not Previously Reported For This Area:

Adoption of feeding technology results in reduced ammonia emissions from swine grow/finish facilities

Issue (who cares and why)?

Reduced emissions from livestock operations can have a tremendous impact on both the environment and costs.

What has been done?

MSUE conducted training for swine farmers on changing their feeding strategies to reduce ammonia emissions.

Results/Impact?

Evaluation has found that Michigan swine farmers have adopted feeding strategies that reduced ammonia emissions from swine grow/finish facilities. A MSU researcher

reported a 21% reduction in average daily ammonia emissions when grow/finish pigs were fed diets formulated using three synthetic amino acids, (lysine, methionine and threonine) compared to pigs provided diets formulated using lysine, only. Average daily ammonia emissions were reported at 37,136 mg/pig when pigs were fed the lysine diet versus 29,123 mg/pig when pigs were fed diets containing three synthetic amino acids, an average daily reduction of 8,013 mg ammonia on a per head basis.

USDA reports 2,000,000 hogs are marketed from Michigan farms annually. Because farms turn-over their inventory about 2.6 times each year, Michigan's inventory of pigs in the grow-finish phase of production was estimated at 795,000 head. Nutritionists formulating diets for Michigan swine farms estimate that 80%, 636,000 head, of the pigs are currently fed diets formulated with at least three synthetic amino acids compared to just 6 years ago when most farms fed diets containing lysine, only. Based on the state's inventory of grow/finish hogs and the ammonia emission reduction reported by Powers, in Michigan the adoption of this feeding strategy has resulted in an annual reduction of 2,047 tons of ammonia emissions.

Key Items of Evaluation

Key research items from evaluations include:

- A newly developed protocol to improve conception rates among dairy cows resulted in increasing first service days from 65 to 100 and increasing conception rates from 10/20 percent to about 60 percent.
- A recombineering technology in L. reuteri and L. lactis was developed that enables researchers to perform powerful genetic assays to identify key probiotic features in these organisms. A key finding along these lines is that L. reuteri 6475 has a positive effect on bone health in three different models of osteoporosis in mice.
- A Johnes Disease lesion scoring system for cattle has been developed, which will greatly assist scientists studying tissues from infected animals.
- More than 60 percent of Michigan Upper Peninsula cattle farms are now enrolled int the Michigan Upper Peninsula Bovine Viral Diarrhea Project, greatly increasing the ability of producers and veterinarians to reduce and control this economically costly disease.

Results from MSUE Institute Workteams relevant to this area:

<u>Agriculture and Agribusiness Institute</u>

- 1,002 new farms adopting practices to improve quality
- 246 new farms adopting tools or technology to improve quality
- $3,631,822 Dollars gained

<u>Children and Youth Institute</u>

- 60,616 youth trained in animal science
- 10,960 youth educated in biological science
- 14,225 youth educated in Ag in Classroom

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Global Food Security and Hunger

☐ Reporting on this Program

Reason for not reporting

Went back to original six state plans and incorporated old NIFA Prioirities back into these main areas.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	9.1	0.0	8.0	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

• Genetically improve dry beans, rice, soybean, wheat, vegetable crops (e.g., potatoes, tomatoes) and fruits (e.g., strawberries, blueberries, tart and sweet cherries) for yield, pest resistance and food quality.
• Better understand the processes and factors that influence the growth, meat quality and other economically important traits in food animals.
• Increase the efficiency of milk production in dairy cattle
• Identify current and emerging public policy issues on trade, environmental, agricultural and food issues to ensure food access and security to all.
• Develop strategies and approaches that enhance the sustainability of vegetable production systems.
• Identify beneficial plant-microbe interactions and soil properties and their influence on crop yield.

Extension and outreach activities to:

Financial tools instruction such as enterprise analysis, partial budgeting, breakevens, and cost of production (including Annie's Project)

Resources for growers scaling up production to new markets (local through global) to include:

• Applied market demand research (local through global)
• Target market research and education
• Pricing strategies
• Facilitating grower/buyer relationships

Marketing strategies and information on emerging and evolving business practices and market structure throughout the food supply chain

Active market research on the global market for Michigan products, including distribution, tariff and tariff compliance issues, food safety and global standards compliances, and identification of opportunities for Michigan products.

Commodity marketing for commercial production agriculture producers

Provide support to farmers and other land owners in understanding and negotiating contracts, leases and agreements (mineral, right-of-way and wind power).

Labor/ employee management training

Business succession and estate planning training (incl Annie's Project)

Demonstrate food production and distribution model that directly engages producers on a local/regional scale teaming with modest size food processing facilities and large scale institutional and private-industry consumers.

Conduct and publish applied research in support of value added agriculture on local, multi-state and national levels

Risk Management Tools Including Crop Insurance, USDA Programs(Farm Bill) ACRE, SURE
Development of and information sharing related to Agricultural Policy

Support for start-ups, including limited resources and minority farmers and their employees.
Identify local experts to network with new start-ups.

2. Brief description of the target audience

Agricultural producers (crop and livestock), commodity groups, state agency representatives, food chain supply industry representatives, state and federal elected officials and policymakers, national and international policy and standards boards and councils, and the interested public.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	32	0

V(F). State Defined Outputs

Output Target

<u>Output #1</u>

Output Measure

- Number of research programs on global food security and hunger.

Year	Actual
2012	0

Output #2

Output Measure

- Number of producers and processors trained in national and international policy issues that impacts the industry competitiveness.

Year	Actual
2012	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs that deal with the genetic improvement of key agricultural crops related to yield, quality, drought/cold tolerance and pest resistance.
2	Number of research programs to understand the processes and factors that influence growth, meat quality and production efficiencies in food animals.
3	Number of research programs to identify current and emerging key public policy issues on trade, environmental, agricultural and food issues.
4	Number of research programs to develop strategies and methods that enhance sustainability and reduce risk for agricultural systems.
5	Number of producers and processors with improved understanding of national and international policy issues and the impacts on their own firm and industry competitiveness.

Outcome #1

1. Outcome Measures

Number of research programs that deal with the genetic improvement of key agricultural crops related to yield, quality, drought/cold tolerance and pest resistance.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #2

1. Outcome Measures

Number of research programs to understand the processes and factors that influence growth, meat quality and production efficiencies in food animals.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #3

1. Outcome Measures

Number of research programs to identify current and emerging key public policy issues on trade, environmental, agricultural and food issues.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #4

1. Outcome Measures

Number of research programs to develop strategies and methods that enhance sustainability and reduce risk for agricultural systems.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #5

1. Outcome Measures

Number of producers and processors with improved understanding of national and international policy issues and the impacts on their own firm and industry competitiveness.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area

{No Data} null

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Climate Change

☐ Reporting on this Program

Reason for not reporting

Went back to original six state plans and incorporated old NIFA Prioirities back into these main areas.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	2.8	0.0	4.5	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research will be undertaken to: ensure an agricultural system (supported by its surrounding environs) that maintains high productivity in the face of climate change; analyze and identify climate change mitigation strategies and technologies to address greenhouse gas emissions and

other climate-altering factors and activities related to agricultural lands and urban environments; address the effect of climate change on water resources and aquatic and terrestrial life.

Extension and outreach will focus on the establishment of expedient response groups/other means of information sharingstructured to provide information to Michigan food producers on critical information related to production at crucial times that will include for example, in-season training and meetings, timely fruit pest monitoring and reporting, updates on control measures, prediction models, weather reports to assist Michigan fruit growers to produce high-quality and profitable crops.

2. Brief description of the target audience

Target audiences include agricultural producers, natural resource managers, environmental organizations, commodity groups and industry representatives, elected officials and policymakers at all levels, and the interested public.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	17	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on climate change.

Year	Actual
2012	0

Output #2

Output Measure

- Number of producers trained in responding to food production issues resulting in less production and marketing losses

Year	Actual
2012	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to help ensure an agriculture system(and its surrounding environs) that maintains high productivity in the face of climate change.
2	Number of research programs to analyze and identify climate change mitigation strategies and technologies to address greenhouse gas emissions and other climate-altering factors and activities related to agricultural lands and urban environments.
3	Number of research programs that address the effect of climate change on water resources and aquatic life.
4	Number of producers that decrease time taken to respond food production issues resulting in less production and marketing losses.

Outcome #1

1. Outcome Measures

Number of research programs to help ensure an agriculture system(and its surrounding environs) that maintains high productivity in the face of climate change.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #2

1. Outcome Measures

Number of research programs to analyze and identify climate change mitigation strategies and technologies to address greenhouse gas emissions and other climate-altering factors and activities related to agricultural lands and urban environments.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #3

1. Outcome Measures

Number of research programs that address the effect of climate change on water resources and aquatic life.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #4

1. Outcome Measures

Number of producers that decrease time taken to respond food production issues resulting in less production and marketing losses.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Sustainable Energy

☐ Reporting on this Program

Reason for not reporting

Went back to original six state plans and incorporated old NIFA Prioirities back into these main areas.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	2.8	0.0	4.5	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities for this planned program include: developing linkages to connect Michigan industries with the research, education and entrepreneurial activity needed in the basic sciences, engineering, plant science and production agriculture to provide Michigan with a foundation for the

vigorous development of a new biobased economic sector; developing biomass for use for biofuels; developing new biofuel compounds, designing optimum forestry and crops for bioenergy production, developing management practices for bioenergy feedstock production systems; and producing value-added biobased industrial and chemical products.

Extension activities will engage agriculture more fully in development of bioproducts and bioenergy sources that include:

• Development of new bioproducts and markets for bioproducts
• Increased adoption of bioenergy technologies
• Improvement of technology at the farm scale
• Policy development and comprehension

2. Brief description of the target audience

Agriculture and natural resources industry representatives, commodity groups, biofuel/bioenergy producers, biotechnology company representatives, state agencies, elected state and federal officials and other policymakers, entrepreneurs and the interested public.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: {No Data Entered}

Patents listed
{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	18	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs in sustainable energy.

Year	Actual
2012	0

Output #2

Output Measure

- Number of adults trained in sustainable bioenergy crop production.

Year	Actual
2012	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to identify and isolate novel genes, markers, mechanisms and identify genetic pathways that can be used in the development and production of biofuels and other biobased materials and products.
2	Number of research programs to examine and improve efficiencies in bioenergy feedstock production and processing systems.
3	Number of research programs that investigate and/or evaluate the economics of a biobased economy and/or corporate environmental management.
4	Number of participants that increased in their understanding of sustainable bioenergy crop production.

Outcome #1

1. Outcome Measures

Number of research programs to identify and isolate novel genes, markers, mechanisms and identify genetic pathways that can be used in the development and production of biofuels and other biobased materials and products.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #2

1. Outcome Measures

Number of research programs to examine and improve efficiencies in bioenergy feedstock production and processing systems.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #3

1. Outcome Measures

Number of research programs that investigate and/or evaluate the economics of a biobased economy and/or corporate environmental management.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #4

1. Outcome Measures

Number of participants that increased in their understanding of sustainable bioenergy crop production.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Childhood Obesity

☐ Reporting on this Program

Reason for not reporting

Went back to original six state plans and incorporated old NIFA Prioirities back into these main areas.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	5.3	0.0	2.0	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities for this program include:

- Dissemination of science-based information to individuals and families so that they can make

informed decisions about their health and well-being, especially related to obesity and overweight.

• Identification and documentation of environmental and cultural influences on health behaviors contributing to obesity and overweight in children that can be shared with individuals, families and communities to improve health and well-being.

• Development of effective community-based environmental and policy supports for physical activity and healthy eating.

MSU Extension has a long history of collaborations and partnerships through out Michigan and the United States of America, at the national, state, county and local level. In particular, MSUE Nutrition and Physical Activity work team will continue to partner with other states such as Colorado, national associations such as SNE and ASNNA, as well as WIC - Michigan Department of Community Health, the Department of Human Services, Michigan's Food Assistance Program, Michigan Department of Education, Public and Private Schools, Head Start programs, other youth education sites such as YMCA/YWCA, boys and girls clubs, 4-H, parks and recreation site, community fairs, farmers markets, work sites, State Dietetic Association, MiSNAC, community coalitions, medical centers and physicians serving people with limited incomes, community centers, community action agencies, homeless shelters, domestic violence shelters, child abuse prevention programs, libraries, public housing sites, churches, adult rehabilitation centers, food stores, food pantries, and food banks. From these agencies and at these venues, trainings will focus on healthy eating (portions and type of food), physical excercise and social/emotional well-being.

2. Brief description of the target audience

State and community agencies, schools and organizations that deal with healthy eating and physical activity as a pathway to wellness; pediatric caregivers; individual consumers, particularly mothers; food marketers/retailers (especially those targeting children), producers and processors; and other researchers and institutions conducting childhood obesity research.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	6	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs in childhood obesity.

Year	Actual
2012	0

Output #2

Output Measure

- The number of adults trained in controlling food portions.

Year	Actual
2012	0

Output #3

Output Measure

- The number of youth trained in controlling food portions.

Year	Actual
2012	0

Output #4

Output Measure

- The number of youth trained in healthy physical activities.

Year	Actual
2012	0

Output #5

Output Measure

- Number of youth trained in various positive coping skills.

Year	Actual
2012	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs that address obesity and diet quality and dietary attitudes and behavior of children and youth.
2	Number of research programs that address school and community-based supports for physical activity and healthy eating, with a focus on children and youth.
3	Number of research programs that address the association between diet, obesity and disease.
4	Number of adults that increase their knowledge about controlling their food portions that align with the food guidedlines.
5	Number of youth that increase their knowledge about controlling food portions according to the food guidelines.
6	Number of youth that increase their physical activities.
7	Number of youth that increase their positive coping skills.

Outcome #1

1. Outcome Measures

Number of research programs that address obesity and diet quality and dietary attitudes and behavior of children and youth.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #2

1. Outcome Measures

Number of research programs that address school and community-based supports for physical activity and healthy eating, with a focus on children and youth.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #3

1. Outcome Measures

Number of research programs that address the association between diet, obesity and disease.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #4

1. Outcome Measures

Number of adults that increase their knowledge about controlling their food portions that align with the food guidedlines.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #5

1. Outcome Measures

Number of youth that increase their knowledge about controlling food portions according to the food guidelines.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area

{No Data}	null

Outcome #6

1. Outcome Measures

Number of youth that increase their physical activities.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #7

1. Outcome Measures

Number of youth that increase their positive coping skills.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Food Safety

☐ Reporting on this Program

Reason for not reporting

Went back to original six state plans and incorporated old NIFA Prioirities back into these main areas.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	5.3	0.0	8.0	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities in this planned program seek to to: ensure the microbial safety of foods; develop effective biosensors, RFID tags and other technologies for track, trace and security issues; develop sustainable packaging systems to enhance food quality and shelf life; enhance the economic and

nutritional value of food products through post-harvest and food processing technologies; identify and control/eliminate the causes of microbial resistance to contaminants; and improve the diagnosis and prevention of known and emerging infectious diseases of livestock and poultry.

MSU Extension will focus it's activities in this area on helping producers improve the quality of food delivered to markets and address food safety issues, education will be provided to food handlers in restaurants on food safety issues, training the public on cooking temperatures and storage, and training to youth regarding hygiene.

2. Brief description of the target audience

Food safety professionals, consumers, public health and other state agency representatives,commodity groups, agricultural producers (crop and livestock), food chain supply industry representatives, retail food stores, restaurants, farmers markets.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	29	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs in food safety.

Year	Actual
2012	0

Output #2

Output Measure

- Number of producers that are trained on food safety issues.

Year	Actual
2012	0

Output #3

Output Measure

- Number of producers trained on federal and state legislation regarding food safety.

Year	Actual
2012	0

Output #4

Output Measure

- Number of front-line food handler staff trained on how to that reduce cross contamination.

Year	Actual
2012	0

Output #5

Output Measure

- Number of front-line food handler staff trained in proper cooking and storing temperatures.

Year	Actual
2012	0

Output #6

Output Measure

- Number of youth trained on hand washing practices.

Year	Actual
2012	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E. coli, Salmonella, Listeria, Campylobacter, etc.
2	Number of research programs to improve the microbial safety and quality of food.
3	Number of research programs to develop packaging systems that enhance food safety, quality and shelf life.
4	Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.
5	Number of programs to improve harvest, post-harvest and processing technologies related to food safety and product quality.
6	Number of research programs to examine the function and effect of dietary nutrients on immune response and other metabolic functions.
7	Number of producers that become more knowledgeable about food safety issues by participating in GAP audits and other food safety programs.
8	Number of producers that gain knowledge about federal and state legislation regarding food safety.
9	Number of front-line food handler staff and fellow workers that improve in cross contamination.
10	Number of youth that improve on hand washing practices.

Outcome #1

1. Outcome Measures

Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E. coli, Salmonella, Listeria, Campylobacter, etc.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #2

1. Outcome Measures

Number of research programs to improve the microbial safety and quality of food.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #3

1. Outcome Measures

Number of research programs to develop packaging systems that enhance food safety, quality and shelf life.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual

2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #4

1. Outcome Measures

Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done

{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #5

1. Outcome Measures

Number of programs to improve harvest, post-harvest and processing technologies related to food safety and product quality.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #6

1. **Outcome Measures**

   Number of research programs to examine the function and effect of dietary nutrients on immune response and other metabolic functions.

2. **Associated Institution Types**

   - 1862 Extension
   - 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #7

1. **Outcome Measures**

   Number of producers that become more knowledgeable about food safety issues by participating in GAP audits and other food safety programs.

2. **Associated Institution Types**

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #8

1. Outcome Measures

Number of producers that gain knowledge about federal and state legislation regarding food safety.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #9

1. Outcome Measures

Number of front-line food handler staff and fellow workers that improve in cross contamination.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

Outcome #10

1. Outcome Measures

Number of youth that improve on hand washing practices.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Food and Non-Food Quality, Nutrition, Engineering and Processing

☑ 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
205	Plant Management Systems	10%		0%	
402	Engineering Systems and Equipment	0%		10%	
404	Instrumentation and Control Systems	0%		9%	
501	New and Improved Food Processing Technologies	0%		20%	
502	New and Improved Food Products	0%		15%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		14%	
504	Home and Commercial Food Service	10%		0%	
511	New and Improved Non-Food Products and Processes	70%		14%	
512	Quality Maintenance in Storing and Marketing Non-Food Products	0%		6%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		12%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	3.1	0.0	6.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
145178	0	634339	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
145178	0	579189	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2578940	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research to: Connect Michigan industries with the research, education and entrepreneurial activity needed in the basic sciences, engineering and plant science and agriculture to provide the state with a foundation for vigorous development of a new biiobased economic sector; identify and isolate beneficial plant compounds that can be used to make new functional foods; develoop the processes and technologies to manufacture functional foods; pursue new artisan distilling process technology for raw material pretreatment, fermentation, distillation and aging; develop innovative processing that adds value to fresh or processed meat products; identify breeding and genetic improvements related to food quality, nutrition and processing; develop packaging systems to enhance food quality and shelf life; develop new biosensors and DNAchips that can rapidly and accurately detect a braod spectrum of harmful organisms in food and water, such as E. coli, Salmonella, Listeria, Campylobacter and Girardia; and train Native American adults on energy crops and renwable resources.

2. Brief description of the target audience

Agriculture and natural resources industry representatives, crop and animal producers, biotechnology company representatives, state agency representatives, private citizens, small and medium-sized entrepreneurs and Native American growers.

3. How was eXtension used?

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

Ask an Expert statistics were analyzed for our program areas and found for Food and Non-Food Quality, Nurtition, Engineering and Processing there were 5 staff paid by formula funds (1 fte). An examples is:

Question: what baseline tests do oil/gas well drilling companys have to test for in the groundwater before and after drilling.

Answer: The baseline water quality would be from the nearest water well. If there is not a nearby water well and a water well is required for fracking water, a water well is drilled on site. This is what

occurred when Encana drilled the Pioneer well in Missaukee County. The water well is drilled before the oil and gas well, so a test of the water prior to any drilling of the oil and gas well can document baseline water quality. I have seen oil and gas companies agree to the water testing in the lease. If it is not in the lease then you will need to discuss your concerns with them about monitoring water quality. They should not object to this. Tell them you want the water tested before, during and after drilling and fracking. It is recommended that a qualified, independent company conduct the water test so there is no question later about what materials and methods were used to collect the water sample.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1191	3200	0	0

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

Patent Applications Submitted

Year: 2012

Actual: 14

Patents listed

MICL02007 - Development of Nanostructured Biosensors for Rapid Detection of Disease-Causing Agents in Food and Water - 61/646,426, 5/14/2012; 61/528,892, 8/30/2011; 61,557,644, 11/9/2011; 13/477,199, 5/22/2012; 13/184,998, 7/18/2011; 13/477,205, 5/22/2012. MICL0211 -Characterizing Packaging Systems through Assessment of Mass Transfer and Degradability of Biopolymers - 61/509,034, 7/18/2011. MICL02185 - Nanostructured Interfaces for Biocalaysis - 61/558,091, 11/10/2011; 61/530,708, 9/2/2011; 61/531,304, 9/6/2011. MICL02189 - Bioderived Fuels and Chemicals - 61/568,726, 12/9/2011; 13/183,114, 7/14/2011; 13/145,731, 7/21/2011. MICL02217 - Evaluation, Development and Implementation of Sustainable Packaging Systems - 61/509,034, 7/18/2011.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	25	25

V(F). State Defined Outputs

Output Target

<u>Output #1</u>

Output Measure

- Number of research projects focusing on food quality, nutrition, engineering and processing.

Year	Actual
2012	22

Output #2

Output Measure

- Number of participants trained in bioenergy and bioproducts.

Year	Actual
2012	591

Output #3

Output Measure

- Number of participants trained on food safety within the community food systems.

Year	Actual
2012	600

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to connect Michigan industries with research, education and entrepreneurial activity needed in the basic sciences, engineering, plant science and agriculture to provide the state with a foundation for vigorous development of a strong biobased economic sector.
2	Number of research projects to develop the processes and technologies to manufacture functional foods.
3	Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water.
4	Number of research programs to identify breeding and genetic improvement related to food quality, nutrition and processing.
5	Number of research programs to develop packaging systems to enhance food quality and shelf life.

Outcome #1

1. Outcome Measures

Number of research programs to connect Michigan industries with research, education and entrepreneurial activity needed in the basic sciences, engineering, plant science and agriculture to provide the state with a foundation for vigorous development of a strong biobased economic sector.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michigan, along with many other states, continues to work on revitalizing its economy. A critical component of the state's and the nation's revitalization effort is to decrease dependence on foreign oil, while creating jobs and encouraging further alternative energy investments. These efforts will have a significant impact on agriculture and manufacturing throughout the Great Lakes region and beyond, as sustainable alternatives to petroleum-based products are developed to strengthen the state's economy.

What has been done
Research to: develop innovative bioelectrocatalytic converters that achieve mediated electron transfer to dehydrogenases and optimize the reactor's performance for coupled bioconversions having commercialization potential; and to facilitate the development of bio-derived fuels and chemicals through property characterization.

Results
Research to explore the development of the next generation of alternative fuels has resulted in the creation of a reactor system design, called Bioreactor for Incompatible Gases, which received a provisional patent from MSU Technologies. The novel reactor uses a fermentation process driven by microbes - whose food is hydrogen gas, oxygen gas and carbon dioxide gas - to create isobutanol. Isobutanol has a high energy content ? about 85 percent that of gasoline. One of the big advantages of isobutanol is that it is a direct substitute for gasoline. Ethanol, another alternative fuel, can only be added to gasoline in low concentrations. That?s one of the reasons for the emerging interest in isobutanol as an alternative fuel. The reactor system is being scaled up and tested by Michigan Biotechnology Institute.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
511	New and Improved Non-Food Products and Processes
512	Quality Maintenance in Storing and Marketing Non-Food Products

Outcome #2

1. Outcome Measures

Number of research projects to develop the processes and technologies to manufacture functional foods.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dwindling farm acreage, more expensive production and processing costs, and increased consumer expectations have prompted research into creating new - and enhancing existing - processes and technologies that manufacture healthy, functional foods. More significant, perhaps, is the potential of functional foods to mitigate disease, promote health and reduce health care costs.

What has been done
Research to: identify, develop and/or apply technology to ensure that the Michigan fruit, vegetable, chestnut and canola oil industries remain economically and environmentally sustainable; develop and process dairy foods that are consistent with the benefits of ingesting probiotics; develop improved methods for the design and operation of thermal processing systems for protein foods; develop technologies to support management systems for quality grains and oil seeds; evaluate the efficacy of processes and ingredients that impact known safety hazards in muscle foods; and to pursue new process technology for raw material pretreatment, fermentation, distillation and aging related to artisan distilling.

Results
Research focused on improving the safety of commercially produced food products has found that x-ray technology is effective in killing bacterial pathogens, such as E. coli and Salmonella, on baby spinach and lettuces without causing undesirable changes in product quality. Rayfresh Foods, Inc., in Ann Arbor, Mich., used MSU?s findings to build the first commercial-sized x-ray machine for food irradiation.

Research to investigate E. coli contamination on commercial-sized food processing lines has resulted in improved conveyer belt materials and designs for optimal cleaning and sanitizing.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The rapid detection of harmful organisms and disease-causing agents in food and water, and the ability to track and trace sources is critical to human health. In the food safety arena, it is estimated that 48 million food-borne illnesses occur each year in the U.S., accounting for 128,000 hospitalizations and more than 3,000 deaths. Biosensors can play a key role in food safety by quickly identifying contaminants in water supplies, food processing and assembly lines, raw food materials and food products before they cause problems further up the food chain.

What has been done
Research to: Synthesize, characterize and evaluate nanostructured interfaces that enable molecular level investigations of systems of medical, scientific and technological interests; investigate using radio frequency identification (RFID) in tracking, traciig and security issues related to the movement of goods through the supply chain; and to combine the novelty of nanoscale transducing material and biosensing techniques to address the detection and diagnostic challenges in food and water safety.

Results
Research on the development of biosensors to detect target pathogens for public protection has resulted in the recent development of nanoparticle-based biosensors for the detection of pathogens such as E.coli and Salmonella enteritidis. Scientist Vangie Alocilja and her team have developed and applied for patents on more than 20 biosensors, including mechanisms to detect E. coli, Salmonella, Mycobacterium tuberculosis and Bacillus anthracis - the bacterium that causes anthrax - as well as sensors that can detect various viruses, including the influenza virus.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #4

1. Outcome Measures

Number of research programs to identify breeding and genetic improvement related to food quality, nutrition and processing.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Genetic diversity is required to meet certain production needs in plant and animal agriculture to allow for sustained genetic improvement and to facilitate rapid adaptation to changing breeding

objectives. Recent efforts in gene discovery and functional genomics are providing the necessary understanding to develop and evaluate different approaches to manipulate phytochemical composition.

What has been done
Research to: determine the impact of heat stress on meat quality; help address the detection and diagnostic challenges in global health, biodefense and food/water safety; assess the risk of humans to mycotoxins via food-borne and air-borne exposure and develop appropriate mitigation strategies; understand the process of E. coli chromosomal DNA replication and its regulation at the biochemical level; identify protein markers that are indicators for soft wheat processing quality; limit human exposure to aflatoxin in food to help prevent liver cancer; characterize the role of hypoxia in metal-induced toxicity; and to develop innovative processing that adds value to fresh or processed meat products.

Results
Preliminary research conducted on the application of deoxynivalenol (DON) and its effects on serotonin levels showed that obese mice fed low levels of DON lose weight and body fat. Initially, the mice refuse all food, but their bodies adapt and they eat about 10 percent less than they had been and maintain that lower intake level and weight loss. As Americans continue to struggle with obesity, the market for safe, effective weight loss products continues to balloon with waistlines.

Research to improve poultry carcass chilling and enhance muscle protein functionality showed that the crust-freezing method (rapidly freezing the outer layer of a product to seal in moisture) improved air-chilling efficacy and meat tenderness when breast muscle was simultaneously stretched during chilling. In related research, hot-boned turkey breasts after crust-freezing were minced at sub-zero temperature for an extended time. The combination of crust freezing and cold-mincing technique significantly improved protein-gelation and meat turnover time.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

Outcome #5

1. Outcome Measures

Number of research programs to develop packaging systems to enhance food quality and shelf life.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In packaging systems, chlorine dioxide gas is used for vapor-phase decontamination in treating produce before packaging and sanitizing products inside their packages. Yet very little is known about its effects on packaging material properties and performances. In terms of the containers themselves, use of a reusable, plastic-based packaging system would greatly reduce the costs associated with packaging and address environmental issues.

What has been done
Research to: Promote functional and sustainable packaging systems that optimize the utilization of raw materials; and to develop and use new types of packaging systems for fruits and vegetables.

Results
Research exploring new approaches for decontaminating fresh and fresh-cut produce using chlorine dioxide found that the greatest effect on the reduction of Salmonella populations on tomatoes was found when tomatoes were chlorinate washed, followed by chlorine dioxide gas and refrigeration.

Research exploring new approaches for decontaminating fresh and fresh-cut produce using chlorine dioxide found that the greatest effect on the reduction of Salmonella populations on tomatoes was found when tomatoes were chlorinate washed, followed by chlorine dioxide gas and refrigeration.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
503	Quality Maintenance in Storing and Marketing Food Products

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The ongoing economic challenges being faced by Michigan -- including the recent federal funding sequestration process -- continue to affect this planned program area. Consequences have included fewer new hires, delaying the award of new financial obligations, reducing levels of continued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants.Although overall research FTEs only decreased by one -- from 65 FTEs to 64 FTEs this past year, we are down from 77.1 FTEs just two years ago. Attrition and faculty departures also continue to have an impact on program outcomes.

The extreme weather conditions during last year's growing season also delayed or greatly diminished some of the research projects being conducted at our various research centers both on- and off-campus, particularly related to plant research around food and biofuel crops.

We also opted in this year's annual reporting to revert back to our original 6 planned program areas for ease of reporting and better integration of research and Extension efforts. This has, once again, resulted in some instances in skewed results for some planned programs and outcome measures.This should be rectified after this year's reporting cycle.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and whether continuation funding and/or new dollars are appropriate and necessary as funds are available.

That said, the most notable qualitative impacts realized in this program were:

- X-ray technology has been found to be effective in killing bacterial pathogens, such as E. coli and Salmonella, on baby spinach and lettuces without causing undesirable changes in product quality. Rayfresh Foods, Inc., in Ann Arbor, Mich., used MSU's findings to build the first commercial-sized x-ray machine for food irradiation.
- A decade of research and evaluation on the development of biosensors to detect target pathogens for public protection has resulted in the recent development of nanoparticle-based biosensors for the detection of pathogens such as E.coli and Salmonella enteritidis. To date, MSU AgBioResearch scientist Vangie Alocilja and her team have developed and applied for patents on more than 20 biosensors, including mechanisms to detect E. coli, Salmonella, Mycobacterium tuberculosis and Bacillus anthracis - the

bacterium that causes anthrax - as well as sensors that can detect various viruses, including the influenza virus.

- An evaluation of the potential benefits of deoxynivalenol (DON) used as a potential weight loss product showed that obese mice fed low levels of DON lose weight and body fat. Initially, the mice refuse all food, but their bodies adapt and they eat about 10 percent less than they had been and maintain that lower intake level and weight loss.
- Advances made in evaluating sustainable packaging options have resulted in a new biobased blend of packaging made of thermoplastic cassava starch (TPCS) and polylactic acid (PLA) that solves many of the limitations of PLA or TPCS alone, such as fragility and hydrophilicity. The production of TPCS/PLA blends enables the use of cassava starch and creates a new platform for the production of functional membranes and establishes a unique market for farmers around the world while creating a new biobased blend with enhanced mechanical and barrier properties for short-term packaging applications.

Examples Of MSUE Evaluation Results Not Previously Reported For This Area:

Cottage Food Safety

Issue (who cares and why)

The Michigan Cottage Food Law enabling the product of certain foods in a home kitchen for direct sales is still new. Members of the MSU Extension and Product Center Counselors collaborated with an MSUE educator to provide food safety, cottage food, and business development content in a single session that could be easily presented around the state.

What has been done

Educators revised materials developed in 2011 designed to be presented in three seperate sesions into a single of the Food Safety Team to conduct four Cottage Food: How to Start a Successful Business sessions Michigan. Additional educators utilized the curriculum and pilot on-line registration system all over Michigan. During February and March, four programs were given in Berrien, Branch, Hillsdale, and Lenawee Counties involving 88 participants.

Results/Impact

Based on 74 evaluations surveys returned, 15 new cottage food businesses were established. On average, 93% of the participants reported understanding what is necessary to run a successful food business, and 78% felt that the sessions met or more than met their needs in starting a cottage food business.

Key Items of Evaluation

Key research results are:

- X-ray technology has been found to be effective in killing bacterial pathogens, such as E. coli and Salmonella, on baby spinach and lettuces without causing undesirable changes in product quality. Rayfresh Foods, Inc., in Ann Arbor, Mich., used MSU's findings to build the first commercial-sized x-ray machine for food irradiation.
- The recent development of nanoparticle-based biosensors for the detection of pathogens such as E.coli and Salmonella enteritidis to help protect public health. MSU

AgBioResearch scientists Vangie Alocilja and her team have developed and applied for patents on more than 20 biosensors, including mechanisms to detect E. coli, Salmonella, Mycobacterium tuberculosis and Bacillus anthracis - the bacterium that causes anthrax - as well as sensors that can detect various viruses, including the influenza virus.

• Advances in sustainable packaging have resulted in a new biobased blend of packaging made of thermoplastic cassava starch (TPCS) and polylactic acid (PLA) that solves many of the limitations of PLA or TPCS alone, such as fragility and hydrophilicity. The production of TPCS/PLA blends enables the use of cassava starch and creates a new platform for the production of functional membranes and establishes a unique market for farmers around the world while creating a new biobased blend with enhanced mechanical and barrier properties for short-term packaging applications.

• The application of deoxynivalenol (DON) and its effects on serotonin levels showed (in preliminary results) that obese mice fed low levels of DON lose weight and body fat. Initially, the mice refuse all food, but their bodies adapt and they eat about 10 percent less than they had been and maintain that lower intake level and weight loss. As Americans continue to struggle with obesity, the market for safe, effective weight loss continues to balloon with waistlines.

Results from MSUE Institute Workteams relevant to this area:

Agriculture and Agribusiness Institute-Bioenergy

- 192 tons of carbon sequestered by bioenergy crops
- 205 new acres of no-till or perennial crop production
- 40% - Amount of fossil energy displaced by bioenergy, % of fossil energy

Health and Nutrition Institute-Food Safety

• 671 producers become more knowledgeable about food safety issues by participating in GAP audits and other food safety programs

Greening Michigan Institute-Food Safety

- 119 participants increased understanding of food insecurity issues
- 162 food council members gained knowledge needed to effectively serve.
- 130 decision makers gained knowledge of the roles food councils can play in their community