2011 Michigan State University Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 06/21/2012

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 practical experience to generate economic prosperity, 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 AgBioResearch continues to be one of the most successful entities of its kind.

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

The successes and accomplishments of AgBioResearch and MSU Extension 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 the federal government invests in MSU AgBioResearch and MSU Extension leverages about **$13** in external contracts, grants and revenues that serve the state's residents. Every federal dollar is leveraged by **$3.90** of state appropriations. Michigan investments in AgBioResearch and MSU Extension leverage an additional **$105.7 million** in external contracts, grants and other revenues that serve Michigan residents.
- **Community Benefits:** Federal investment extends the reach of MSU AgBioResearch and MSU Extension programs that generate as much as **$388 million** in benefits to Michigan and the nation. For every federal dollar invested, MSU AgBioResearch and MSU Extension generate as much as $25.40 of benefits to the state and nation.
- **Benefit/Cost Ratio**: When state funds and community benefits are combined, the estimated benefits to Michigan residents and the nation exceed the initial federal investment 40:1.

It is important to note that this report reflects only a portion of AgBioResearch and MSU Extension and not the whole breadth of research and educational initiatives. AgBioResearch's total budget for FY 2011 was **$110.38 million**, with this report representing **$6.44 million** in federal Hatch dollars and equivalent match.

MSU AgBioResearch 2011 Quick Facts:

124 Hatch-funded researchers representing 65 FTEs
258 active projects
40 patent applications submitted
18 patents awarded
277 peer-reviewed publications

Key research accomplishments for FY 2011 include:

Weighing in on colon cancer risk -- Some 100,000 people in the United States are diagnosed with colon cancer each year and nearly half of them will die from the disease. AgBioResearch scientists were among the first to demonstrate that high levels of leptin, a key hormone in fat tissue, can promote tumor growth and progression. Research showed that leptin induces precancerous colon cells to produce more of a growth factor that can increase blood supply to cancer cells. Before the MSU finding, obesity had been identified as a significant risk factor in diabetes and heart disease, but its role in cancer was much less defined. The findings were widely publicized.

Charting a path to good food -- Nearly six out of 10 Michigan residents live in a place that has inadequate access to the food necessary for a healthy daily diet. Proposed solutions to this disparity, and others like it, are outlined in a first-of-its-kind document called the Good Food Charter. The charter identified six goals to be achieved by 2020 and describes 25 ways to reach these goals, including details on how to improve school meals and access to healthy foods in underserved areas.

Improving the safety and nutritional value of food -- Today, the Michigan food processing industry generates nearly $25 billion in overall economic activity and employs some 134,000 workers at nearly 1,600 licensed food processors. AgBioResearch scientists have been guiding the industry with leading edge research ranging from securing food safety to adding nutritional value. AgBioResearch scientist Kirk Dolan and members of his lab recently constructed an instrument to measure the thermal properties of food heated at elevated temperatures. Partnering with researchers from other areas of expertise, he and his lab have also helped analyze the impact that heating has on destroying E. coli K-12 in meat and determined methods to extend the shelf life of cherry juice concentrate, a high-value processed product.

Attacking allergic airway disease in its infancy -- Asthma rates in the United States have more than doubled in the past 30 years. The highest prevalence of chronic respiratory disease -- nearly 1 in 10 sufferers -- is recorded in children ages 0-17. In novel research, AgBioResearch scientist James Wagner discovered that a lesser known form of vitamin E called gamma-tocopheral has the potential to alleviate airway disease. In the rodent model, he found that this form of vitamin E can protect from and reverse allergic inflammatory processes of the lung by inhibiting the enzyme COX2.

Getting to the root of soil-borne diseases -- About 90 percent of the 2,000 major diseases of the principle crops in the United States are caused by soil-borne plant pathogens. They result in losses to farmers estimated at $4 billion a year. AgBioResearch scientist Jay Hao has successfully characterized the soil that is suppressive to potato common scab and established a program for fundamental soil-borne disease study. His research also has resulted in the discovery of a group of biological agents for disease control of potato, including Bacillus amyloliquefaciens.

Growing profits with berry varieties -- Michigan leads the nation in growing blueberries, producing 109 million pounds in 2010. To help keep this status, AgBioResearch scientist Jim Hancock has developed and released two late-season varieties and one midseason variety with a long storage life. In addition, the Michigan-developed varieties Aurora, Draper and Liberty -- released in 2005 -- have become the most widely planted blueberry varieties in the world.

"Going green" with more urban trees -- AgBioResearch scientist David MacFarlane is conducting groundbreaking research on urban treed spaces. Research over the past year in a 13-county area in southeastern Michigan showed that the quality of wood in urban trees was better than expected and that annual tree removals in the 13-county area could yield lumber equivalent to 5,500 homes per year, or an energy equivalent of 97 megawatts per year -- enough to run the MSU power plant for a year.

Creating a viable market for ecosystem services -- Research conducted on ecosystem services and the willingness of producers to adopt them as part of their management practices, and consumer

willingness to pay a premium for the required changes helped researchers develop supply curves, which show how much land Michigan farmers would be willing to put into these practices for various levels of payment. In addition, results revealed that residents would be willing to pay for reduced numbers of eutrophic lakes and reductions in greenhouse gas emissions, supporting potentially 20-50 percent of Michigan corn-soybean land going into low-input practices.

Using plant-based ecosystems to protect water resources and human health -- In addition to being viewed as a source of food or medicinal ingredients, plants are also a crucial component of natural treatment systems that can be used to protect both the environment and human health. For example, research conducted by AgBioResearch scientist Dawn Reinhold has shown that plants can reduce leaching of antimicrobials to water resources. Further, the outcomes indicated that the phytoaccumulation of antimicrobials in pumpkin and zucchini reduce concentrations of antimicrobials in agricultural fields, and that the consumption of these crops from fields where biosolids were applied present minimal risk to human health.

Focusing on the calf is the No. 1 way to manage Johne's disease -- Johne's disease is a highly contagious, untreatable, fatal gastrointestinal disease that affects about 8 percent of the beef herds and 68 percent of the dairy herds in the United States. A decade-long project to identify which management practices are the most effective at controlling the spread of the disease has resulted in the publication of a 28-page report that provides critical information to beef and dairy producers on how to effectively manage the disease and reduce its impact on farms. Research from this work will have a far-reaching effect on future profitability and sustainability of the industry.

Halting an infectious disease -- Dengue fever is among the most important reemerging infectious diseases, with an estimated 50 million to 100 million cases around the globe annually that lead to more than 20,000 deaths. It is caused by a virus transmitted by mosquitoes, and there is no vaccine or treatment. AgBioResearch scientist Zhiyong Xi has found that a bacterium can stop dengue viruses from replicating in mosquitoes and could have ramifications with other mosquito-borne diseases. The findings from this research will aid in the development of improved genetic methods to block the transmission of mosquito-borne infectious diseases, including not only dengue fever but also malaria and West Nile virus.

MSU Extension 2011 Quick Facts:

- **127,746 Adults trained through workshops and trainings from four Institutes**

Institute for Agriculture and Agribusiness

Business Management
4,989
Animal and Plant Production
37,059
Bioproducts and Bioenergy
401
Environmental Quality
5,322
Total for Agriculture and Agribusiness
47,771

Institute for Children and Youth*

Academic Success
4,233
Capacity Building
3,770
Career Education/Work Force Preparation
543
Leadership & Civic Engagement
452
Total for Children and Youth
8,998

*8,998 adults from 17,903 adult volunteers in 2011 were trained on special topics

Institute for Greening Michigan

Sustaining Community Prosperity
3,314
Natural Resources Stewardship
18,114
Government and Public Policy
3,824
Community Food Systems
3,729
Total for Greening Michigan
28,981

Institute for Health and Nutrition

HN-1: Disease Prevention and Management
806
HN-2: Food Safety
2,228
HN-3. Nutrition and Physical Activity
37,286
HN-4: Social and Emotional Health
1,676
Total for Health and Nutrition
41,996

- **185,259 Children and Youth (ages 5 - 19 years) involved in 4-H and Extension**

Science, Engineering, and Technology

Consumer and Family Science
6,362

Biological Sciences
9,681
Technology and Engineering
5,105
Physical Sciences
1,056
Environmental Education / Earth Sciences
51,537
Ag in the Classroom
11,096
Animals
60,533
Plant Science
21,123
Total Science, Engineering, & Technology
166,493

Citizenship

Civic Engagement
4,715
Community / Volunteer Service
13,002
Leadership and Personal Development
61,276
Communications and Expressive Arts
47,224
Total Citizenship
126,217

Healthy Lifestyles

Foods and Nutrition
44,418
Health
8,637
Personal Safety
2,142
Total Healthy Lifestyles
55,197

- **7,091 children between 0 - 5**

Total Actual Amount of professional FTEs/SYs for this State

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	153.0	0.0	90.0	0.0
Actual	188.0	0.0	65.0	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, AgBioResearch priorities and MSU Extension educational goals must remain fluid and flexible.

Research goals are continually evaluated for revelance 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 intiatives. Through strategic planning with 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 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 AgBioResearch and MSU Extension directors, who not only evaluate them, but use them in their regional and statewide presentations to describe future plans.

Jointly, AgBioResearch and MSU Extension address issues of oncern in local communities with research and teaching by using a nextwork of citizen advisory groups at the local and state levels. 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 14 outlying AgBioResearch Centers and on-campus facilities. The MSU Extension and 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. 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

Further, numerous individual meetings were held with staff, stakeholder advisory groups and the 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 and state legislators.

Following the establishment of the four intstitutes, 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 are being used to guide logic models for specific priorities in each institute and a statewide plan of work.

On the research side of the aisle, as of Jan. 1, 2011, the Michigan Agricultural Experiment Station became MSU AgBioResearch. The new name was selected following a yearlong process that included a self-assessment of the organization's strengths, weakenesses and opportunities moving forward, as well as numerous discussions (phone and face-to-face) with both internal and

external stakeholders about their perceptions of us and what we could do to better convey the value of our mission and to serve them. Final approval of the name change was given following several presentations to, and discussions with, AgBioResearch affiliated colleges, the Provost's office and MSU President Simon. Stakeholders at all levels were incentivized by the fact that they rely on the research we do to address real-world challenges by providing practical solutions that generate economic prosperity, sustain natural resources and enhance the quality of life for Michigan residents.

Finally, this past summer, MSU AgBioResearch and MSU Extension began 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 will be 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 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 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 recently completed, the previous Strengthening Michigan's Economy comprehensive survey before it, and other ongoing efforts offer multiple ways for people in various roles and locations to help identify the issues and opportunities for AgBioResearch priorities and MSU Extension edicational programming in the years ahead.

Community-based discussions in all Michigan counties, involving local advisory committees, the MSU Extension 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 focus groups, with representatives from Michigan colleges and units, are held as needed to glean faculty 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 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 AgBioResearch and MSU Extension. Stakeholders help decide the future direction for AgBioResearch through programs such as Project GREEEN, the Animal Agriculture Initiative and commodity advisory teams. There are extensive conversation and visits that also take place throughout the year with local, state and federal local officials, commodity group and industry representatives from the agricultural, natural resources and renewable energy industries.

For the AgBioResearch rebranding, the process included a SWOT analysis, peer conversations with faculty and extensive discussions (phone and face-to-face) with both internal and

external stakeholders. 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.

For MSU Extension, town hall meetings, individual meetings, feedback via email, blogs and surveys -- including the most recent online survey -- Advance Michigan -- 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 year 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 will be executed in FY 2012 in 82 counties.

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. Food safety will also be an issue that will receive increased attention and funding resources.

MSU Extension utlized the stakeholder input in forming the four institutes and the 21 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 in the past year:

- Genetic research needs to be a critical area of focus.
- Food safety and security and water 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 AgBioResearch will be even more critical in the future for MSU, Michigan, the nation and the world.

Things MSU Extension learned from its stakeholders in the past year:

Based on input from the restructuring process and other stakeholder input, MSU 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, 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.
- **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
8803220	0	6441895	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8326180	0	5317084	0
Actual Matching	8326180	0	6444274	0
Actual All Other	0	0	45653893	0
Total Actual Expended	16652360	0	57415251	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	3739725	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

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

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components	0%		2%	
703	Nutrition Education and Behavior	10%		3%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	0%		5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		5%	
721	Insects and Other Pests Affecting Humans	0%		1%	
723	Hazards to Human Health and Safety	5%		10%	
724	Healthy Lifestyle	20%		25%	
802	Human Development and Family Well-Being	20%		14%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%		10%	
805	Community Institutions, Health, and Social Services	5%		15%	
806	Youth Development	40%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	63.0	0.0	12.5	0.0
Actual Paid Professional	50.7	0.0	10.5	0.0
Actual Volunteer	88.0	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**
2246724	0	850733	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2246724	0	1031084	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	7304623	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Research activities to: determine the impact of school tobacco policy on preventing and reducing Michigan youth smoking; determine the relationships between obesity and family/meals/lifestyle factors, family lifestyle factors/education and food choices and general health, and environmental influences and obesity/general health/physical activity;better understand Lyme disease ecology in terms of spread, distribution and disease risk; analyze the relationships among social support, public policy and family characteristics and how they affect the function and well-being of rural low-income families; increase understanding and develop more effective environmental management systems; better understand public benefits for policy development in recreation and tourism resource management; and develop better models for the human health and human services sectors. better understand Lyme disease ecology in terms of spread, distribution and disease risk; analyze the relationships among social support, public policy and family characteristics and how they affect the function and well-being of rural low-income families; increase understanding and develop more effective environmental management systems; better understand public benefits for policy development in recreation and tourism resource management; and develop better models for the human health and human services sectors. Increase understanding about how environmental pollutants, especially ozone and endocrine disruptors affect human health; Increase understanding about how environmental pollutants, especially ozone and endocrine disruptors affect human healthng about how environmental pollutants, especially ozone and endocrine disruptors affect human health; ; ;;;better under fffff betrt better

• better understand Lyme disease ecology in terms of spread, distribution and disease risk; analyze the relationships among social support, public policy and family characteristics and how they affect the function and well-being of rural low-income families; increase understanding and develop more effective environmental management systems; better understand public benefits for policy development in recreation and tourism resource management; and 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; and 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, natural resource managers, environmental stewardship/protection organizations, agrifood commodity groups and agricultural industry representatives are audiences for research program outcomes. 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 used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8498	33992	14646	29292

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

Patent Applications Submitted

Year: 2011

Actual: 1

Patents listed
MICL02214 - Molecular mechanism of cytoplasmic incompatibility in microbial ecology of the rumen and gastrointestinal tract of U.S. feed animals - 61/452,840;3/15/11. In addition, 4 patents were issued during this timeframe for MICL01680 -- Value-added products for improving human, animal and plant health: 243513;10/21/10, 246324;2/24/11, 241475; 7/7/10 and 7,772,195; 8/10/10.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	4	42	46

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
2011	41

Output #2

Output Measure

- Number of adult participants trained in healthy lifestyles.

Year	Actual
2011	3728

Output #3

Output Measure

- Number of youth participants trained in healthy lifestyles.

Year	Actual
2011	4418

Output #4

Output Measure

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

Year	Actual

2011	2420

Output #5

Output Measure

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

Year	Actual
2011	1591

Output #6

Output Measure

- Number of adult participants trained in youth development.

Year	Actual
2011	2011

Output #7

Output Measure

- Number of youth participants trained in youth development.

Year	Actual
2011	8637

Output #8

Output Measure

- Number of adult participants trained in family resource management.

Year	Actual
2011	339

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 obesity and family meals/lifestyle factors/education,food choices and general health, and environmental influences/obesity/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 analyze the relationships among social support, public policy and family characteristics and/or 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 obesity and family meals/lifestyle factors/education,food choices and general health, and environmental influences/obesity/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
2011	10

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 physically active; discover health beneficial constituents in fruits,vegetables and generally regarded as safe (GRAS) plants; determine which foods protect against disease; determine the impact of phytonutrients on the absorption, metabolism and elimination of essential nutrients; and provide resources, education and technical assistance to low-income households to increase food security and consumption of vegetables.

Results
Research to determine the neuroprotective effect of anthocyanins (compounds found in plants that have powerful antioxidant properties) showed that when this compound -- isolated and purified from tart cherries -- was given orally to mice against middle cerebral artery occlusion and its potential mechanisms of neuroprotection, infarction volume (tissue death caused by lack of oxygen due to obstruction of tissue's blood supply) was significantly reduced by 25-27 percent in pre- and post-treated mice compared to control mice.

In research related to the health benefits associated with eating dry beans, it was demonstrated that bean-containing diets inhibit development of colon cancer by modulating cellular kinetics and reducing inflammation in colon epithelium.

In research to validate methods to predict food allergenicity, researchers have developed a novel infrared transdermal scanning thermometry as a useful, non-invasive method to quantify oral reactions to hazelnut food proteins in mice.

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
2011	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 hebicides 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: identify the role of inflammation in the development and/or progression of diabetic retinopathy; study chronic respiratory diseases caused by air pollutants to better understand how nasal tissues and cells may respond to inhaled toxicants; assess the toxicity of endocrine

disruptors mixtures; explore the mechanistic linkages between molecular phenotype and toxicity outcomes; and close the gap that exists regarding the specific components of air pollution that influence pulmonary neoplasia.

Results
New guidelines have been developed on how diabetic retinopathy research needs to be furthered and how new treatment developments can be brought to the community and health professionals.

Research performed in 2011 has 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 analyze the relationships among social support, public policy and family characteristics and/or 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
2011	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Healthy, vital communities with active citzenry 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: better understand the factors leading to well-regulated stress responses in young children; develop healthcare packaging that is easier to access, particularly for aging consumers and people with disabilities; develop models and family-based interventions that advance the well-being of National Guard soldiers and families post-deployment to a combat zone; build models to preventive and early intervention for children living with a family member with a serious illness; examine the relationship between the number of foster home placements for a youth and the number of community connections as emancipated adults; and develop a curriculum model for ANR education that encourages Michigan's secondary schools to become more rigorous and relevant.

Results
Lyme disease is the No. 1 vector-borne disease in the northern hemisphere and is actively spreading to new areas. New research findings suggest that ecological factors important to Lyme disease can't be defined by findings from one geographical area, so quantification of the disease is taking place at multiple test sites in the eastern U.S. and the Southeast. Information from these sites is beginning to be used to develop new interventions to help reduce disease risk and manage its spread.

Seventy-five industry professionals from most of the major medical device companies attended a Healthcare Packaging Immersion Experience at the MSU Leaning and Assessment Center. It centered on operating room and emergency room simulations to provide near-real conditions of use and highlight the issues that healthcare providers can face as a result of packaging (e.g., medication error, failure to present aseptically,inspection of the sterile barrier system).

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, 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
2011	2982

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adults, youth and lactating mothers are learning to and improving their dietary quality and they are becoming aware of the need to increase their physical activity and some are implementing the information that they have learned. By adopting a healthier life style this program and it's delivery can help improve the health status of clientele in Berrien, Cass and St. Joseph counties.

Woman, Infants and Children (WIC) participants received nutrition education when picking up there Project FRESH coupons at the agency and at the farmers market site weekly during the growing season. Seniors participants received nutrition education at the farmers market before picking up their Market FRESH coupons. See files for results and impact. By educating participants in Project/Market Fresh, they became more aware of their need to incorporate more fruits and vegetables in their diets in order to improve their health status.

What has been done
Nutrition education in the curriculum ERIB 4 and Organwise guys were delivered in Berrien, Cass and St. Joseph counties.

WIC participants and Seniors received education on increasing their fruit and vegetable consumption, how to store and prepare various fruits and vegetables.

Results
Of the adult participants who have completed the program, over 94% have made some type of dietary improvement at the point of exiting the program. More that 33% have reported exercising for 4 or more days a week, for a period of 60 minutes, the USDA standard. While 57% report that they are moderately active.

The changes in the Behavior Checklist reflect changes anywhere from 12% to 60%, with the lowest in the area of food safety and the highest in the area of reading food labels.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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
2011	3976

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The top three causes of death as reported by Michigan Department of Community Health are heart disease, stroke and cancer. According to the Department of Community Health,'The risk of stroke can be greatly reduced by making healthy lifestyle choices.' An overwhelming amount of research shows a correlation between lifestyle choices and reduction
in heart disease and certain cancers as well. Obesity is also at epidemic levels in these counties as well as the rest of the state of Michigan. This condition can also be affected by making healthy lifestyle choices.

What has been done
4-H programs across the state educate youth on healthy lifestyle approaches. Training ranges from health and nutrition/physical exercise to social and emotional health.

Results
In one evaluation during 2011 of 337 youth, analysis assessing change found 35% of the youth had a positive change reading food labels for better choices, 34% tried more new healthy foods, 32% thought more about what they were eating in regards to it being healthy, 29% changed eating more fruits daily, 25% improved on washing their hands, and 25% were more physically active.

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
2011	1936

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Parents are typically not trained in child development and positive ways in interacting with their children to help healthy development physically, intellectually, socially and emotionally. Research has shown abuse and neglect is highly correlated with isolation, lack of support and lack of appropriate child development information.

What has been done
MSUE implemented a parenting program to bring developmental information and provide parent coaching at every home visit using the
Parents as Teachers Born to Learn curriculum. Parenting capacity was measured through the Parent Knowledge Survey. The home visit is the key feature of the Parents as Teachers Born to Learn model. During
the home visit the parent and parent educator build a relationship which is key to positive outcomes for children and families. Home visits start with rapport-building, a chance to catch up on what has happened since the last visit and to ?check-in? with the parent on any
unmet current needs. Home visits progress to discussion of child development and a chance for the parent to participate in a developmentally appropriate activity. Throughout the visit,
the parent and parent educator are observing the child and the parent educator is coaching the parent in how to become a more skilled observer of their child's developing needs.

Results
Evaluation results found, 80% of the parents indicated an improvement in parenting skills as a result of Parents as Teachers home visits. 87% of parents increased their knowledge of child development and parenting skills. curriculum. 78% of the parents reported improved parent-child interactions.

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
2011	1432

3c. Qualitative Outcome or Impact Statement

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 developed workshops to address 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 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. The Social-Emotional Work Team implemened three anti-bullying/violence prevention initiatives in 2011:
-Alternatives to Anger (geared toward adolescents and adults who care for them)
-Safe Dates
-Community-Based Nurturing Program (focused on reducing bullying/violence through safe,

healthy, and fair environments for adolescents)

Results
Evaluation results of 400 youth found: 52% improved on the extent to which they recognized and responded to their own needs; 53% changed on the extent to which they recognized and responded to the needs of others (children/other youth/elders/other adults); 47% improved on the kinds of responses they report using; 41% changed on the extent to which they model positive behaviors and relationships; and 55% improved on their ability to use various coping skills.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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
2011	1891

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Each year, Michigan 4-H Youth Development involves more than 18,000 adults in providing fun, hands-on learning opportunities to more than 186,000 Michigan young people. 4-H also provides 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.

Results
The evaluation conducted by the Capacity Building Work Team of the Children and Youth Institute found: 94% of the volunteers trained increased the quality of their programming using a variety of age appropriate delivery systems around experiential learning and positive youth development; 77% of the volunteers trained gained knowledge and skills regarding the instruction and delivery of 4-H Science Programs to youth; and 98% of the volunteers gained knowledge about how to integrate life skills in their programs working with children and youth.

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
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Each year, Michigan 4-H Youth Development involves more than 10,000 teen volunteers in providing fun, hands-on learning opportunities to more than 186,000 Michigan young people. 4-H also provides volunteer training opportunities to foster and support positive youth development. It is critical that all (teen and adult) volunteers have a strong knowledge base of youth development.

What has been done
Trainings have been conducted to further develop teen volunteers' knowledge of youth development as well as create safe environments for young people to learn, have fun and develop socially, and ensure that the teens we entrust to work with young people only have the best interests of youth at heart.

Results
Approximately 96% of the teen volunteers demonstrated competency in youth development and club management. Over 50% of the youth volunteers were involved in community service projects.

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
2011	9

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: evaluate the anticipated socioeconomic benefits and costs associated with appropriate land use alternatives, including their anticipated environmental impacts; better understand public benefits for policy development in recreation and tourism resource management; explore information technology in planning vacations, nonmotorized transportation and consideration of wildlife risks by homeowners; answer questions posed to researchers by industry and government agencies; and better understand community capacity in the

management and decision making around natural resources, especially water and sanitation.

Results
Research on the neglected tropical disease, African trypanosomiasis, or sleeping sickness -- a disease carried by tsetse flies, has resulted in a major breakthrough in its mangement and control. The development of an ecological distribution model, married with a dynamic simulation model and climate projections will enable scientists to more accurately predict where the tsetse flies will be before they get there, allowing traps to be put in place before the pest arrives and stopping an epidemic before it happens.

Researchers have identified a bacterium that can stop dengue fever viruses from replicating in mosquitoes and potentially other mosquitoe-borne diseases. The finding will aid in the development of improved genetic methods to block the transmission of mosquito-borne infectious diseases, including dengue fever, malaria and West Nile virus.

The first Michigan Culinary Tourism Conference was held at the Kellogg Center on the MSU campus in Jan. 2011. More than 250 educators, farmers, restaurant owners and tourism industry members attended.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	305

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
The Work Team Finance, Housing and Energy from the Greening Institute evaluated their efforts and found 92% improved their financial planning, 80% improved their tracking of their credit and interest rates, and 32% improved their credit score.

4. Associated Knowledge Areas

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

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
2011	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As we head into the second decade of the new millenium, paradigms of an unfolding nutrition transition in many countries; an 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 healthand 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: determine the effects of selected nutrients and food components on the development of allergic airway diseases; help guide public health recommendations for dietary intakes of specific micronutrients and bioactive food components in order to prevent the development of allergic disorders, especially in the context of airway disease; and identify more effective, efficient and greener plant-based processes to produce pharmaceuticals.

Results
Research exploring a possible connection between a form of vitamin E - gamma-tocopheral - and asthma severity showed that pregnant mice with deficient vitamin E had more pups with asthma, suggesting that a recommended daily amount of gamma-tocopheral would be beneficial.

In influenza research, previous studies showed that calorie-restricted mice succumbed early in the course of influenza infection. Building on this finding, researchers have developed mthodologies to examine how natural NK cells mature and whether or not they are able to kill virus-infected cells during influenza infection. Protocols were also established for refeeding previously calorie-restricted mice to restore their immune response during influenza infection.

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77.1 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports

moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism thorough 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 intiatives; 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 to determine the neuroprotective effect of anthocyanins showed that when this compound was given orally to mice, infarction volume was significantly reduced by 25-27 percent in pre- and post-treated mice compared to control mice.
- Research has established that HIF1- and HIF2-mediated signaling affects asthma pathology and represents new asthma susceptibility factors that could lead to an effacacious means to prevent asthma in premature infants.
- Research on African trypanosomiasis, or sleeping sickness, has resulted in a major breakthrough in its management and control. The development of an ecological distribution model, married with a dynamic simulation model and climate projections will enable scientists to more accurately preduct where the insect vectors will be before they get there, allowing traps to be placed prior to their arrival and stopping an epidemic before it happens.
- Researchers have identified a bacterium that can stop dengue fever viruses from replicating in mosquitoes and potentially other mosquio-borne diseases. The finding will aid in the development of improved genetic methods to block the transmission of mosquito-borne infectious diseases.

Extension evaluative results -- Evaluations of Extension activities are done regularly using a variety of approaches that are based on the Insitute Work Team logic models and evaluation plans.

The following are some examples of the evaluation results of the Institute for Greening Work Team:

- 1024 youth engaged in gardening.
- 604 participants gained knowledge regarding linkages within food system.
- 419 gained knowledge regarding food systems issues and opportunities.
- 310 entrepreneurs increased their understanding and application of the skills, resources and processes that will lead to a successful business start-up or new venture
- 197 participants increased consumption of garden-grown produce.
- 131 gained knowledge regarding opportunities, barriers, and needed changes for farm to institution.
- 112 increased their knowledge of the fundamentals in public policy, governance, and land use procedure and process
- 107 participants improved their financial management.
- 66 participants increased their knowledge regarding Open Meetings Act, leadership

principles and roles, and other.

- 47 youth that aspired and developed new skills regarding entrepreneurship.

The following are some examples of the evaluation results of the Institute for Children and Youth Work Team:

- 3740 youth demonstrated use of life skills
- 2540 volunteers increased the quality of their programming using a variety of age appropriate delivery systems around experiential learning and positive youth development.
- 2074 youth expressed a positive attitude towards learning experiences
- 1507 youth developed a positive attitude towards science learning experiences
- 1462 youth built strong relationships with adults and peers.
- 1437 youth gained science skills (scientific methods), knowledge (content areas) and abilities
- 1243 volunteers increased their knowledge about programming that uses a variety of age appropriate delivery systems around experiential learning and positive youth development.
- 1220 children and youth made healthier life choices.
- 966 youth engaged in experiential learning around one or more concepts and skills for leadership
- 735 youth gained knowledge about careers they may be interested in
- 707 youth that are engaged and ready to learn across all developmental stages
- 525 adults involved in the life of children 0-5 gained basic knowledge and skills related to the development of assets in the children they care for.
- 506 youth took science courses.

The following are some examples of the evaluation results of the Institute for Health and Nutrition Work Team:

- 2211 participants increased their hand washing practices.
- 1151 participants gained knowledge of personal hygiene.
- 1093 participants gained knowledge of cooking and storing temps.
- 986 participants use proper processing techniques for low and high acid foods.
- 936 participants learned about the proper process for hand washing.
- 932 participants gained knowledge of temperatures.
- 738 participants gained knowledge of cross contamination.
- 711 participants use correct processing times.
- 677 participants use tested recipes for preserving foods.
- 647 participants gained knowledge in the use of proper processing techniques for low and high acid foods.
- 624 participants gained knowledge about selecting high quality foods for preservation.
- 553 participants demonstrated increased knowledge to the extent which they could identify healthy food choices.

Key Items of Evaluation

Key items from evaluations:

- Research to determine the neuroprotective effect of anthocyanins showed that when

this compound was given orally to mice, infarction volume was significantly reduced by 25-27 percent in pre- and post-treated mice compared to control mice.

• Research has established that HIF1 and HIF2-mediated signaling affects asthma pathology and represents new asthma susceptibility factors that could lead to an effacacious means to prevent asthma in premature infants.

• Research on African trypanosomiasis, or sleeping sickness, has resulted in a major breakthrough in its management and control. The development of an ecological distribution model, married with a dynamic simulation model and climate projections will enable scientists to more accurately predict where the insect vectors will be before they get there, allowing traps to be placed prior to their arrival and stopping an epidemic before it happens.

• Researchers have identified a bacterium that can stop dengue fever viruses from replicating in mosquitoes and potentially other mosquio-borne diseases. The finding will aid in the development of improved genetic methods to block the transmission of mosquito-borne infectious diseases.

• Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Soil, Water and Natural Resources

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%		11%	
111	Conservation and Efficient Use of Water	11%		12%	
112	Watershed Protection and Management	15%		12%	
123	Management and Sustainability of Forest Resources	8%		5%	
131	Alternative Uses of Land	17%		15%	
132	Weather and Climate	2%		0%	
133	Pollution Prevention and Mitigation	12%		15%	
134	Outdoor Recreation	1%		5%	
135	Aquatic and Terrestrial Wildlife	1%		10%	
806	Youth Development	12%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	10.8	0.0	15.0	0.0
Actual Paid Professional	27.1	0.0	8.0	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**
1203052	0	638050	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1203052	0	773313	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5478467	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research 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; 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 greenhouse gas mitigation strategies; 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; quantify the benefits and costs of a sample green roof system installed on campus; develop fish population/community computer models for species important to Michigan; 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; and identify, prevent and control exotic invasive pests and diseases of forests.

Extension activities include: 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; and 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 used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from

Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	7739	23217	11770	23540

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

Patent Applications Submitted

Year: 2011

Actual: 2

Patents listed

MICL01574 - Movement and degradation of organic contaminants and pesticides in soils and sediments: 12/915,428; 10/29/2010; and MICL02128 - Occurence, transport and fate of organic contaminants and pharmaceuticals: 12/915,428; 10/29/2010.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	10	35	45

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2011	30

Output #2

Output Measure

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

Year	Actual
2011	5859

Output #3

Output Measure

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

Year	Actual
2011	5797

Output #4

Output Measure

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

Year	Actual
2011	586

Output #5

Output Measure

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

Year	Actual
2011	4509

Output #6

Output Measure

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

Year	Actual
2011	1263

Output #7

Output Measure

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

Year	Actual
2011	712

Output #8

Output Measure

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

Year	Actual
2011	1131

Output #9

Output Measure

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

Year	Actual
2011	752

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 youth participants with increased knowledge in management and sustainability of forest resources.
7	Number of adult participants with increased knowledge of alternative uses of land.
8	Number of adult participants with increased knowledge of soil, plant, water and nutrient relationships.
9	Number of youth participants with increased knowledge of alternative uses of land.
10	Number of youth participants with increased knowledge of soil, plant, water and nutrient relationships.
11	Number of research programs that deal with fish population dynamics and the management of Great Lakes fisheries.
12	Number of research programs that deal with the security, stewardship and management of Michigan's water resources.
13	Number of research programs that analyze key soil characteristics to better assess their agricultural and environmental contribution, including crop yield.
14	Number of research programs that explore the occurrence, transport and fate/effect of organic contaminants, chemicals, pesticides, pharmaceuticals and particulates in soils.
15	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
2011	5

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 cnadidate 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 has successfully characterized the soil that is suppressive to potato common scab and established a program for fundamental soil-borne disease study.

Research in this area has also has resulted in the discovery of a group of innovative biological agents for disease control. One of the bacterial strains, Bacillus amyloliquefaciens (BAC03), shows strong antimicrobial activity against several important soil-borne pathogens.

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
2011	498

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michigan has a tremendous need to protect the precious natural resource of water. One need has been to educate farmers how to schedule water use in order to optimize the growing season while minimizing the waste of water and protecting watersheds.

What has been done
MSUE developed workshops to help farmers protect watersheds while preserving precious resources through an irrigation scheduling program. One training that was evaluated had 12 separate commodity areas represented in the program that included fruits, vegetables and row crops.

Results
Evaluations of 12 farm operations participating in the pay for service irrigation scheduling program found approximately 900 acres of production was impacted. Growers estimated they were are able to save 25 to 50% on their irrigation needs by following the scheduling recommendations. This accounts for an economic savings of an estimated 5.2 to 10.4 million gallons of water savings in one season for these farm operations. This change in these farms will have continued impact into the future.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

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
2011	4148

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
MSUE conducted the 4-H Great Lakes and Natural Resources Camp to help youth improve their knowledge and attitudes toward nature and encourage them to be involved in educating others about nature and issues in protecting it.

Results
An evaluation of 68 youth who attended the camp found changes in: Spending time in nature is important to me.
Learning about nature is important to me.
I like learning about nature.
I like learning things outside of school
Nature makes me happy.
I like nature.
I like to be outside.

More importantly, the youth also changed in:

To what extent do you believe that you can influence the solution of an environmental issue by acting with others?
To what extent do you feel knowledgeable about how to give a lesson or a presentation about nature, the environment, or Great Lakes Camp to others?
To what extent do you feel confident that you are able to give a lesson or a presentation about nature, the environment, or Great Lakes Camp to others?

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	498

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example, In Michigan, there are approximately 19.5 million acres of forestland. The majority of this acreage (56%) is owned by private woodland owners and represents about 10.98 million acres of forestland. Over the last several decades, this privately owned acreage has become more parcelized and fragmented as a result of development pressures, increasing property taxes and other economic and regulatory policies that make it difficult to maintain larger forest parcels intact. To illustrate this point, the 1980 forest survey of Michigan reported that there were over 180,000 private forest landowners in Michigan. Recent estimates (2010) now estimate that there are over 498,000 private forest landowners in Michigan and climbing. In addition, a significant percentage of these private landowners are becoming older and as they age more of this forested property is beginning to transfer over to their heirs. If not properly planned in advance, this transfer of property to the next generation often results in more parcelization as heirs are forced to sell portions of the property to pay the estate and income taxes.

What has been done
MSU Extension, in association with the Michigan Department of Natural Resources, Michigan Forest Association and other organizatinos, adapted and presented the Oregon State University Ties to the Land Curriculum. The program has been conducted at 5 locations in the state.

Results

Follow-up survey results indicated that landowners had greater confidence and ability to pass their land on to their heirs and believed that the program made it more likely that their property will remain intact, in the family and in woodland.

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
2011	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
MSU and DNR researchers developed an elk survey methodology and model to estimate the elk poulation size in Michigan. This technique allows researchers to estimate the population size with a 95% confidence interval.

DNR-APHIS research to understand the influences and methods to control and manage bovine tuberculosis in free-ranging white-tailed deer found that the efficiency and effectiveness of a

trap/test/cull management effort could be improved by vaccinating test-negative animals.

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

Not Reporting on this Outcome Measure

Outcome #7

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
2011	961

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The growing complexity of local development decisions, coupled with risk management concerns and recent court decisions has fueled an interest in land use training. A Michigan State University survey of Michigan planning officials revealed that nearly 80 percent of respondents believe continuing education should be a requirement for anyone who wants to remain a planning official. That belief appears to be widely held, if a Michigan Map showing the locations of Michigan Citizen Planner programs and the number of participants is any indication

What has been done

MSUE has implemented over 3,500 training sessions/modules involving 21,000 participants since 2002, including both traditional classroom and new online training available since 2007.

Results
The Michigan Citizen Planner is changing how decisions are made. The program?s participant survey results show that Citizen Planner graduates are improving their knowledge, enabling communities to follow established development plans. Volunteer land use decision makers are resolving situations with more confidence and less controversy, and members are serving longer terms on boards and commissions. Michigan Citizen Planner is also helping local officials forge relationships with their peers in other communities, building a foundation for increased coordination in future land use decisions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

Outcome #8

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
2011	5011

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Natural Resource Literacy is currently an urgent focus of statewide initiatives as evidenced by the new Great Lakes Literacy framework and by work led by MDNR to prepare a statewide Environmental Literacy Plan.

What has been done
Many MSUE programs focus on natural resource literacy and stewardship participation. Connecting and integrating these programs, with a strong focus on increasing engagement and leadership in natural resource stewardship is an important need for MSUE and for natural

resource managers across the state. The signature outcome of this effort is sustainably managed land- and water-based natural resources in Michigan.

Results
77,503 lbs. of pesticides were reduced via MSU programming and resources as reported by attendees at four locations of NW IPM Tree Fruit Updates with unique, nonrecurring attendees sharing practices adopted over recent history. Reduction of pesticides is based on insect and disease model forecasting that assists growers in management decision making as well as the adoption of mating disruption for the control of insect pests. Furthermore, participants reported utilizing 39,626 lbs. less of the traditional broad spectrum pesticides in favor of new, narrow-spectrum chemistries that limit the impact on non-target organisms.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Number of youth 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
2011	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
131	Alternative Uses of Land
806	Youth Development

Outcome #10

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #11

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
2011	5

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
MSU researchers are the first to identify a stress hormone in the sea lamprey, using the 500-million-year-old species as a model to understand the evolution of the endocrine system. This new discovery will bolster understanding on how this extremely destructive pest has successfully adapted since the Paleozoic Era.

Researchers completed model development for a decision analysis of Lake Michigan salmonine stocking, updated and refined a decision analysis model that federal biologists use to explore options for sea lamprey control on the St. Mary's River, and developed an adaptive management strategy for double-crested cormorant management in Michigan.

4. Associated Knowledge Areas

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

Outcome #12

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
2011	7

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: 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 showed that plants can significantly reduce leaching of antimicrobials to water resources. Further, the outcomes indicated that the phytoaccumulation of antimicrobials in pumpkin and zucchini reduce concentrations of antimicrobials in agricultural fields, and that the consumption of these crops from fields where biosolids were applied present minimal risk to human health.

Researchers worked with the Michigan Department of Environmental Quality to develop a landscape-based model to set standards for nutrient levels in the state's lakes and streams. Lake nutrients are used to judge whether a state is meeting Clean Water Act standards.

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
133	Pollution Prevention and Mitigation

Outcome #13

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
2011	2

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 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
Researchers demonstrated that crop diversification with shrubby legumes mixed with soybean and peanuts could be the key to sustaining the green revolution in Africa. Field studies showed that this diversified rotation provides multiple benefits compared to simply planting a continuous corn crop, including allowing twice as much sunlight capture and nitrogen fixation, which supplements fertilizer and improves the efficiency of any fertilizer that is applied. This translates to more stable grain production and enhanced nutritional grain.

Research showed that sand topdressing and crumb rubber can be used to improve native soil athletic field playability.

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 #14

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
2011	5

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: evaluate the occurance 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 occurance of antibiotics in animal farms and their mobility; and to control and convert rural waste to resources.

Results
Anerobic digestion research demonstrated that a substantial increase in biogas resulted by mixing manure with 20% by weight of food service waste. In a separate project, dewatered food processing waste was successfully reconstituted in manure, resulting in a substantial increase in biogas production. Biogas production from biomass is considered CO2 neutral and therefore does not emit additional Greenhouse Gases into the atmosphere. Additionally, biogas production from anaerobic digestion presents the additional advantage of treating organic waste and reducing the environmental impact of these wastes.

Research investigating the environmental fate and transport of lincomycin (an antibiotic frequently detected in wastewater treatment plant effluents and runoff from agricultural production systems) demonstrated that lincomycin sorption increase as soil solution pH increased from 5.8. to 7.8, then decreased significantly at pH 8.9. The maximum sorption occurred between 7.3 and 7.8, near the protein kinase A level or lincomycin (7.6). These findings demonstrate that inorganic cations commonly present in surface and ground waters could effectively compete with trace levels of ionic pharmaceuticals for sorption in sites in soil, hence altering their transport and transformation processes in the environment.

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

Outcome #15

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
2011	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 identify ways reduce the need to apply commerical nitrogen by strategically applying manure and planting an oil-seed radish cover crops to maximize nitrogen uptake by plants resulted in a savings of between $25 (manure only) and $60 (manure and cover crop) per acre when growing corn. If a similar practice of using livestock manure applications and cover crops

were to be followed on just 10% of the Michigan corn crop, researchers predict it would result in an annual economic benefit to Michigan corn growers of between $1.25 million and $3 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
132	Weather and Climate

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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 has successfully characterized the soil that is suppressive to potato common scab and established a program for fundamental soil-borne disease study.
• Researchers developed an elk survey methodology and model to estimate the elk poulation size in Michigan. This technique allows researchers to estimate the population size with a 95% confidence interval.
• Research showed that plants can significantly reduce leaching of antimicrobials to water resources. Further, the outcomes indicated that the phytoaccumulation of antimicrobials in pumpkin and zucchini reduce concentrations of antimicrobials in agricultural fields, and that the consumption of these crops from fields where biosolids were applied present minimal risk to human health.
• Anerobic digestion research demonstrated that a substantial increase in biogas resulted by mixing manure with 20% by weight of food service waste. Biogas production from biomass is considered CO2 neutral and therefore does not emit additional greenhouse gases into the atmosphere. Additionally, biogas production from anaerobic digestion treats organic waste in a way that reduc its environmental impact.
• Research to identify ways to reduce the need to apply commerical nitrogen by strategically applying manure and planting an oil-seed radish cover crops to maximize nitrogen uptake by plants resulted in a savings of between $25 (manure only) and $60 (manure and cover crop) per acre when growing corn. If a similar practice of using livestock manure applications and cover crops were to be followed on just 10% of the Michigan corn crop, researchers predict it would result in an annual economic benefit to Michigan corn growers of between $1.25 million and $3 million.

Extension evaluative results -- Evaluations of Extension activities are done regularly using a variety of approaches that are based on the Insitute Work Team logic models and evaluation plans.

The following are some examples of the evaluation results of the Institute for Greening Work Team:

• 315 natural resource-based industries increased competitiveness
• 2076 volunteers gained skills and knowledge in how to serve effectively as volunteers in natural resource programs
• 66 landowners and loggers increased their knowledge in natural resource stewardship programs

The following are some examples of the evaluation results of the Institute for Agriculture and Agribusiness Work Team:

• 153 participants increased enviornmental stewardship practices
• 137 farms improved irrigation methods and practices
• 52 business increased use of IPM consultants in developing and implementing environmental plans

Key Items of Evaluation

Key items from evaluations:

• Research has successfully characterized the soil that is suppressive to potato common scab and established a program for fundamental soil-borne disease study.
• Researchers developed an elk survey methodology and model to estimate the elk

poulation size in Michigan. This technique allows researchers to estimate the population size with a 95% confidence interval.

- Research showed that plants can significantly reduce leaching of antimicrobials to water resources. Further, the outcomes indicated that the phytoaccumulation of antimicrobials in pumpkin and zucchini reduce concentrations of antimicrobials in agricultural fields, and that the consumption of these crops from fields where biosolids were applied present minimal risk to human health.
- Anerobic digestion research demonstrated that a substantial increase in biogas resulted by mixing manure with 20% by weight of food service waste. Biogas production from biomass is considered CO2 neutral and therefore does not emit additional greenhouse gases into the atmosphere. Additionally, biogas production from anaerobic digestion treats organic waste in a way that reduc its environmental impact.
- Research to identify ways reduce the need to apply commerical nitrogen by strategically applying manure and planting an oil-seed radish cover crops to maximize nitrogen uptake by plants resulted in a savings of between $25 (manure only) and $60 (manure and cover crop) per acre when growing corn. If a similar practice of using livestock manure applications and cover crops were to be followed on just 10% of the Michigan corn crop, researchers predict it would result in an annual economic benefit to Michigan corn growers of between $1.25 million and $3 million.
- Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Plant Sciences

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%		15%	
202	Plant Genetic Resources	6%		8%	
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%		18%	
206	Basic Plant Biology	3%		11%	
211	Insects, Mites, and Other Arthropods Affecting Plants	3%		9%	
212	Pathogens and Nematodes Affecting Plants	15%		10%	
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: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	32.4	0.0	29.0	0.0
Actual Paid Professional	20.5	0.0	14.0	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**
907156	0	1169759	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
907156	0	1417741	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	10043856	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research 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; 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; and continue variety trials for crops important to Michigan, including wheat, corn, soybeans and forages.

Extension activities 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; and train native american adults in sustainable agriculture.

2. Brief description of the target audience

Michigan growers, private citizens, agriculture and natural resources industry representatives, biotechnology company representatives, and state agencies, and Native American growers.

3. How was eXtension used?

eXtension was used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5419	16257	5281	10562

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

Patent Applications Submitted

Year: 2011

Actual: 4

Patents listed

MICL01814 - Applied behavioral ecology of insects: 61/362,061; 07/07/2010; MICL01779 - The physiology and biochemistry of herbicide action, selectivity and degradation: 13/046,424; 03/11/2011; MICL01733 - Baculovirus biotechnology: 12/937,767; 12/27/2010; and MICL02179 - A proteomics study of self-incompatibility in sweet cherry: 61/366,977; 07/23/2010. In addition, 5 patents were awarded during this reporting period: MICL01779 - the physiology and biochemistry of herbicide action, selectivity and degradation: 7,902,118; 03/08/2011; and 7,906,709; 03/15/2011. MICL02098 - Influence of cultural and chemical factors on weed management: 7,902,118; 03/08/2011. MICL01997 - Galectins and Pre-mRNA splicing: 3,931,614; 03/14/2011; and 7,781,648; 08/24/2010.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	13	58	71

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research projects on plant sciences.

Year	Actual
2011	57

Output #2

Output Measure

- Number of adult participants trained in plant management systems.

Year	Actual
2011	3290

Output #3

Output Measure

- Number of youth participants trained in plant management systems.

Year	Actual
2011	5281

Output #4

Output Measure

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

Year	Actual
2011	812

Output #5

Output Measure

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

Year	Actual
2011	1254

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.

Not Reporting on this Outcome Measure

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
2011	947

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 1996 the industry was in peril. Yields hit an all-time low due to pest, disease and production issues that greatly reduced crop health. Farmers were looking to get out of sugar beet farming and switch to more profitable crops. Industry representatives reached out to MSU to help solve the problem.

What has been done
Working with the Michigan Sugar Company, MSU spearheaded the creation of the Michigan Sugar Beet Advancement program, an interdisciplinary team of scientists, Extension educators, industry representatives and farmers. The team tackled over 30 critical issues, such as poor emergence of plants, diseases and nematodes (parasitic worms that attack roots). In 2011, over 1,500 farmers were trained on strategies to advance sugar beet growing that included promoting the adoption of new tillage practices, using primed (pre-germinated) seed, planting earlier, evaluating new varieties through field trials on farmers? lands as well as improving the beets? sugar quality.

Results
Through research and education, farmers were able to improve sugar content from 16 percent to

18 percent, which increased farmers? profits without them having to farm any additional acreage. The majority of the sugar beet producers are now utilizing Quadris Fungicide on beet to control Rhizoctonia Root rot. A one ton increase in yield is equivalent to $ 10 million dollars in increased revenue. These advancements have allowed Michigan growers to produce 4 million tons of sugar beets, which translate to 1 billion pounds of white sugar. In terms of jobs, there are now 1,100 farm families raising sugar beets, and 2,300 full- and part-time people working at Michigan Sugar Company. This work has been disseminated through the North Central Region, the web, and The American Society of Sugarbeet Technologist.

4. Associated Knowledge Areas

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

Outcome #3

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
2011	1317

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agriculture is critical to Michigan?s economy and an increasingly important segment of the state?s budget. Michigan agriculture and supporting industries provide employment for a large segment of the state?s population Continued expansion of food production relies on social acceptability and economic viability of agricultural production, processing, delivery and marketing from locally to internationally. Critical to this process is the adoption of appropriate and optimal pest managment practices accross all comodities that take an eco-systems approach to safeguard farm and environmental health while being compatible with end-user profitability, human safety and community expectations.

What has been done
MSUE developed IPM workshops that addressed the need of various commodities across the spectrum of food production.

Results

Results of Evaluation at Tree Fruit IPM Updates

Forty-three participants out of 111 attendees completed surveys. All participants self-identified as growers except for one manager and one consultant. Respondents to the survey represented 15,055 acres of fruit production in Michigan, including tart cherry (10,232 acres), sweet cherry (2,609 acres), apple (2,011 acres), plum (10 acres), peach (37 acres), and winegrape (19 acres). Ninety-five percent of respondents reported scouting for insects and diseases to determine the need for a pesticide application. Seventy-two percent reported scouting for beneficial insects such as lacewings and predatory mites. Ninety-one percent use weather and biology based recommendation from MSU to determine the need for pesticide management. Based on MSU programming or content respondents reported that 51% utilize a safe mix/load pad to prevent soil and water contamination, 36% have closed a well on their property to prevent groundwater contamination, 45% have built new (or improved existing) pesticide storage facilities, 82% use air gaps to prevent groundwater contamination, and 74% use tree row volume to minimize the quantity of pesticides applied.

Apple Summary

Seventy-eight percent utilize the codling moth degree day model output, leading to an average reduction of 1.8 insecticide applications in 91% of respondents. Forty-two percent of respondents reported using codling moth mating disruption, reducing insecticide inputs by an average of 2.08 applications with most reporting a reduction in organophosphate application specifically. One hundred percent reported using the apple scab disease model with 50% reducing the duration of primary scab management based on the model output, resulting in a small reduction in fungicide use for 5 respondents. One hundred percent of respondents reported utilizing the Maryblyt fire blight model resulting in 62% of respondents decreasing antibiotic applications. Lastly, apple growers reported utilizing an average of 3.8 applications of the new, narrow spectrum insecticides in lieu of broad-spectrum materials.

Cherry Summary

Seventy-eight percent reported using mating disruption to control peachtree borer and 43% for lesser peachtree borer, saving an average of one organophosphate application annually. Eighty-one percent use the cherry leaf spot model, with 43% reporting an average 2.5 less fungicide applications. Lastly, cherry growers reported utilizing an average of 2.2 applications of the new, narrow spectrum insecticides in lieu of broad-spectrum materials.

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
2011	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 quanitfying multi-trophic crop/pest beneficial interactions.

Results
Research on the production and use of thermophilic compost and vermicompost as important tools for organic and sustainable production of vegetable transplants and high tunnels for year round vegetable production had a successful year in 2011. Vermicomposting of campus preconsumer produce residue and coffee grounds provided an average of 600 pounds per week from January through April; vermicomposting bed surface area increased from 60 square feet in early 2011 to 240 square feet in November; and an estimated 6,000 pounds per week of pulped pre- and post-consumner food waste were processed with thermophilic composting from August through October. The results confirm the efficacy of this practice for organic crop production for small farms.

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
2011	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 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

Results from research tests on emerald ash borer (EAB) conducted over the past eight years at six different test sites in Michigan indicate that several insecticide products provide ash trees with a high level of protection against EAB. Imidacloprid applied as a soil drench in May of each year consistently gave > 90% control of EAB on trees with a dbh of 8" or less; trunk injection of emamectin benzoate at 0.1 mg ai per inch dbh gave a very high level of protection for one or two years after a single treatment, while trunk injection at the rate of 0.4 mg ai per inch dbh protected the same moderate-sized test trees for two or three years.

Varroa mite is a devastating pest that threatens the honey bee industry worldwide. Recently, this mite has developed insecticide resistance in many countries. Researchers studying how the verroa mite develops resistance to a class of pesticides called pyrethroids tested five pyrethroids to see how toxic they were to this pest. At least one of the pyrethroids was extremely toxic. If a new pesticide can be registered, it will benefit beekeepers and growers in Michigan and around the world.

A comprehensive IPM plan for controlling fruitworms in Michigan blueberries has been developed. The plan was introduced to more than 300 Michigan growers and consultants and will be implemented on about half of the blueberry acreage across Michigan in 2012, resulting in a nearly 10,000-pound reduction in the insecticides applied to that acreage.

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
2011	3

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: 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
Tart cherry harvesting equipment commonly used in Michigan requires low-density orchards (120-240/trees/acre).Some European orchards are being planted at 1,150 trees per acre. MSU researchers have found one current over-the-row harvester that removes fruit efficiently and without damaging trees or fruit, but Michigan trees would need to be smaller and more compact. The long-term impact of this project could be increased cropping and yields and allow for up to 622 trees per acre with a yield of more than 36,000 pounds of fruit (triple the current production).

Researchers developed a disease management scheme for the major potato storage diseases by testing the use of fungicides or biofundgicides during the growing season and in storage. A list of recommendations was developed that will help Michigan growers ensure that potatoes will both enter and leave storage in excellent condition.

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
2011	9

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 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 two oat variety trials held at MSU, the higest yielding entries were MN 09255 (112 bu/acre with a test weight of 35.4 lbs./bu) and Ida (105 bu/acre and 30 lbs./bu test weight). In the barley trial, Bowers was the highest yielding cultivar (63 bu/acre and 39.3 test weight). In the canola trial, the highest yielding cultivars were Dynasti (48 bu/acre) and Amanda (45 bu/acre).

Research detecting and assessing potential causes of internal chestnut deterioration determined that computed tomography (CT) scanning allowed for successful sorting of defective from quality chestnuts. CT scanning identified healthy tissue 100% of the time and only misclassified the type of defective tissue 20% of the time.

MSU scientists have developed and released two late-season blueberry varieties and one midseason variety with a long storage life. In addition, the Michigan-developed varieties Aurora, Draper and Liberty -- released in 2005 -- have become the most widely planted blueberry varieties in the world.

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
2011	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 foiliage 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 examining the use of discarded fruit trees as a source of heat and electricity has determined that using removed fruit trees as a source of biomass energy in a combined heat and power system shows great promise in offsetting some or all of the energy costs associated to the processing side of fruit production and in lessening industry dependence on the large quantities of

fossil fuels used in fruit processing.

Researchers screening for Phytopthora resistance in vegetable crops discovered an age-related resistance in cucumber -- the young fruit are very susceptible, but as the fruit develops, it becomes resistant to Phytopthora. As a result of this finding, growers are better informed about when they need to use sprays to protect the fruit.

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
216	Integrated Pest Management Systems

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
2011	12

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 inplant 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

Researchers have discovered a new gene that will help envision more-efficient molecular factories of the future. Clumped Chloroplasts (a new class of proteins) play a key role in helping chloroplasts, separate when the chloroplasts divide. The newly identified proteins are also critical in the perpetuation of chloroplasts during cell division. This discovery could lead to improvements in crops through breeding and/or genetic manipulation for improved chloroplast distribution.

In research to achieve optimal fruit maturity and quality in Michigan's climate, it was demonstrated that Concord berries accumulate 50% of their final weight at harvest by 1200 GDD at base 50F, just six weeks after bloom. This provides a critical tool for anticipating final crop to reduce crop accordingly and reach the fruit quality target.

Research to determine the biochemical mechanisms that cause self-incompatibility has resulted in the development of a two-day protocol optimized for pollen tube staining of fixed cherry styles. This protocol is easy and effective because it provides a greater resolution and optical clarity and will provide valuable information on the physiology of the cherry style and germinating pollen.

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
2011	2797

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agricultural producers are more likely to implement new practices and apply new products if the products have been successfully utilized or implemented by other producers.

What has been done
MSUE produced workshops for producers and agribusiness agronomists

Results
An evaluation found:
68% plan to use the new information to make crop or pest management decisions in 2011
44% expect the new information they learned and plan to implement to save or earn them additional money

The average amount of expected savings or earnings was $15.98 per acre.

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
2011	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
Research testing new herbicides and identifying better application strategies for herbicides already on the market for weed control in blueberries have helped growers incorporate new herbicides into their management plans and to more effectively use older ones. With good weed control, growers can realize a 10-20% increase in marketable yield, representing a $10 million to $20 million per year boost to the state's economy.

Research on raspberry herbicides showed that Diuron at 3 lbs./acre and Terbacil at 2 lbs./acre were safe on raspberry and controlled most annual weeds. Both herbicides suppressed quackgrass until mid-July. Terbacil controlled white campion and Diuron provided partial control of white campion. Halosulfron at 0.047 or 0.094 lbs./acre pre emergence or directed postemergence was safe on raspberries and controlled rough fleabane and Canada thistle. Clopyrid at 0.25 lbs./acre broadcast controlled rough fleabane and Canada thistle. Use of effective and crop-safe herbicides resulted in greater marketable yields of raspberries.

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
2011	6

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
Preliminary analysis from research seeking to better understand host-nematode-soil-nutrient interactions indicates that there is an unbalanced distribution of the virus-vectoring dagger nematode in relation to other nematodes within the perennial rhizosphere, and that nematode communities appear to be different in the same soils at different temperatures. These findings are an important contibution toward the goal of managing all nematodes as part of a soil ecosystem.

Trials conducted in soils with varying amounts of sand and clay content to compare the performance of nematodes and fungus in different soil types (with and without micro-jet sprinkler irrigation) demonstrated that micro-sprinkler systems improve the efficacy of biopesticides and biological control agents targeting plum cuculio (PC) larvae in soil. Further, work using

entomopathic nematodes delivered in compost designed to extend the lifespan of nematodes in the soil (which would increase greater PC control). Results showed an 80% PC kill rate for up to 13 days in the soil, convincingly demonstrating improved efficacy of nematodes when delivered in compost.

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
2011	7

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 examine eight types of ornamental shrubs and four types of conifers to evaluate the effectiveness of three irrigation levels based on estimated daily water use (DWU) showed that scheduling irrigation based on DWU could reduce water use without negatively affecting plant growth or the environment. Using DWU also allows growers to more easily group plants by water needs, which results in more efficient irrigation. This lowers costs associated with pumping water, system wear and construction of increased-capacity runoff containment structures.

Researchers found that using legume groundcovers, such as alfalfa and white clover, in Christmas tree fields can add a significant amount of nitrogen to the soil and control weeds early in the growing season. By using legume groundcovers, growers can potentially reduce their fertilizer use by up to 50%, saving Michigan's Christmas tree industry up to $450,000 per year.

Researchers evaluating the water and fertilizer requirements of Fraser fir developed recommendations for more sustainable and efficient irrigation schedules. These recommendations could bring Michigan Christmas tree growers a savings of up to $60 per irrigated acre.

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.

Not Reporting on this Outcome Measure

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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:

• A comprehensive IPM plan for controlling fruitworms in Michigan blueberries has been developed. The plan was introduced to more than 300 Michigan growers and consultants and will be implemented on about half of the blueberry acreage across Michigan in 2012, resulting in a nearly 10,000-pound reduction in the insecticides applied to that acreage.

• Research detecting and assessing potential causes of internal chestnut deterioration determined that computed tomography (CT) scanning allowed for successful sorting of defective from quality chestnuts. CT scanning identified healthy tissue 100% of the time and only misclassified the type of defective tissue 20% of the time.

• Researchers have discovered a new gene that will help envision more-efficient molecular factories of the future. Clumped Chloroplasts (a new class of proteins) play a key

role in helping chloroplasts, separate when the chloroplasts divide. The newly identified proteins are also critical in the perpetuation of chloroplasts during cell division. This discovery could lead to improvements in crops through breeding and/or genetic manipulation for improved chloroplast distribution.

• Research testing new herbicides and identifying better application strategies for herbicides already on the market for weed control in blueberries have helped growers incorporate new herbicides into their management plans and to more effectively use older ones. With good weed control, growers can realize a 10-20% increase in marketable yield, representing a $10 million to $20 million per year boost to the state's economy.

• Trials conducted in soils with varying amounts of sand and clay content to compare the performance of nematodes and fungus in different soil types (with and without micro-jet sprinkler irrigation) demonstrated that micro-sprinkler systems improve the efficacy of biopesticides and biological control agents targeting plum cuculio (PC) larvae in soil. Further, work using entomopathic nematodes delivered in compost designed to extend the lifespan of nematodes in the soil (which would increase greater PC control). Results showed an 80% PC kill rate for up to 13 days in the soil, convincingly demonstrating improved efficacy of nematodes when delivered in compost.

• Researchers found that using legume groundcovers, such as alfalfa and white clover, in Christmas tree fields can add a significant amount of nitrogen to the soil and control weeds early in the growing season. By using legume groundcovers, growers can potentially reduce their fertilizer use by up to 50%, saving Michigan's Christmas tree industry up to $450,000 per year.

Extension accomplishments:

One example:

1) Tree Fruit Consultants' Breakfast Meetings and Grower Integrated Pest Management (IPM) Updates are held 20 to 25 times annually from April through August each season. Audience consists of chemical company representatives, sales personnel, and scouts (40%) and growers (60%). Current information provided includes current pest development, weather data, crop stage, horticultural development and management information to approximately 100 participants (growers and pesticide company reps) each week.

We surveyed participants in 2011 and here are the numbers:

• 92% of participants indicated that these meetings save them money in their farming business. The average estimated savings was $6837.50 per farm. Using the average number of 60 growers who attend each week, this per year savings amounts to $410,250.00 due to proper timing of spray applications covered in the IPM meetings.

• 95% of those who attend feel their yield and quality is better having attended.

• When asked if the information presented by MSU Extension at these meetings is unique and available nowhere else, 85% responded yes, 11% said no and 4% said sometimes.

• Growers indicated (95%) that the monitoring of apple scab spore development by MSU Extension is very important to their pest management decision making.

2) Information delivery is quick and timely via Code-A-Phone system and E-mail list service (over 130 individuals on e-mail list). Updates are created nearly daily from May until mid June and then done twice per week through August and once per week through November 1.

• When surveyed, growers (n=35) estimated cost savings to their business for the Code-A-Phone Service per year to be $1800 or in total $63,000 per year savings for those surveyed.

- 97% of users indicated the information is timely and 100% indicated it was useful.
- 100% of respondents indicated that the Code-A-Phone information is vital to their fruit business.
- Estimated value to all fruit growers in Grand Rapids Tree Fruit area (n=240 farms) = $432,000.

Another Example:

The 2011 Michigan Garden Plant Tour was hosted by six young plant growing operations plus Michigan State University during the first two weeks in August.

A total of 1,627 individual's visits were made to the seven host sites. Significant impact that was collected from 102 responses to a 400 sample Survey Monkey evaluation sent via email was gathered. Attendees were asked the amount of increased business income they have generated from attending previous Michigan Garden Plant Tours in their operation. Sixty-one percent reported anywhere between a $500 to over $20,000 increase in business income as a result of attending the tour in past years. By projecting the results from the survey to the entire number of participants, we estimate an overall increase in floriculture crop sales of $3.8 million dollars was derived from this effort. Since this audience is from across the United States, these impacts are significant.

Another impact we measured is the number of new plant varieties that attendees will offer their customers in 2012 as a result of attending the 2011 Tour. Approximately 92% of attendees that responded to the survey indicated they would be adding new plants next year. If we apply the values obtained from the survey to all Tour participants this year, they will be offering their customers a total of approximately 13,500 new plant varieties in 2012.

Results from evaluation from the Institute of Agriculture and Agribusiness Work Teams found:

- 2518 participants with improved knowledge in new production and management technologies
- 4077 participants that use sound horticulture production practices that improve production, reduce inputs, and increase production efficiency
- 1,994 producers increased their confidence needed for immediate adoption of recommendations that lead to significant changes in their opertional practices,
- 680 producers better positioned to respond to food production issues resulting in less production and marketing losses
- 563 increased compliance with federal and state legislations, MIOSHA, FQPA, FDA-Food Safety, etc.

Key Items of Evaluation

Key items from evaluations:

- A comprehensive IPM plan for controlling fruitworms in Michigan blueberries has been developed. The plan was introduced to more than 300 Michigan growers and consultants and will be implemented on about half of the blueberry acreage across Michigan in 2012, resulting in a nearly 10,000-pound reduction in the insecticides applied to that acreage.
- Research detecting and assessing potential causes of internal chestnut deterioration determined that computed tomography (CT) scanning allowed for successful sorting of defective from quality chestnuts. CT scanning identified healthy tissue 100% of the time and only misclassified the type of defective tissue 20% of the time.
- Researchers have discovered a new gene that will help envision more-efficient molecular factories of the future. Clumped Chloroplasts (a new class of proteins) play a key role in helping chloroplasts, separate when the chloroplasts divide. The newly identified proteins are also critical in the perpetuation of chloroplasts during cell division. This discovery could lead to improvements in crops through breeding and/or genetic manipulation for improved chloroplast distribution.
- Research testing new herbicides and identifying better application strategies for herbicides already on the market for weed control in blueberries have helped growers incorporate new herbicides into their management plans and to more effectively use older ones. With good weed control, growers can realize a 10-20% increase in marketable yield, representing a $10 million to $20 million per year boost to the state's economy.
- Trials conducted in soils with varying amounts of sand and clay content to compare the performance of nematodes and fungus in different soil types (with and without micro-jet sprinkler irrigation) demonstrated that micro-sprinkler systems improve the efficacy of biopesticides and biological control agents targeting plum cuculio (PC) larvae in soil. Further, work using entomopathic nematodes delivered in compost designed to extend the lifespan of nematodes in the soil (which would increase greater PC control). Results showed an 80% PC kill rate for up to 13 days in the soil, convincingly demonstrating improved efficacy of nematodes when delivered in compost.
- Researchers found that using legume groundcovers, such as alfalfa and white clover, in Christmas tree fields can add a significant amount of nitrogen to the soil and control weeds early in the growing season. By using legume groundcovers, growers can potentially reduce their fertilizer use by up to 50%, saving Michigan's Christmas tree industry up to $450,000 per year.
- Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Food and Non-Food Quality, Nutrition, Engineering and Processing -- discontinued

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: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	8.5	0.0
Actual Paid Professional	0.0	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{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

2. Brief description of the target audience

3. How was eXtension used?

x

V(E). Planned Program (Outputs)

1. Standard output measures

2011	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: 2011
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research projects focusing on food quality, nutrition, engineering and processing.
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of adults trained on new and improved non-food and bioeconomy related products and processes.
  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 identify and isolate plant compounds and/or develop the processes and technologies to manufacture functional foods.
2	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, Cryptosporidium and
3	Number of adults with new and improved knowledge on non-food and bioeconomy related products and processes.
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.
6	Number of research programs to connect Michigan industries with 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 biobased economic sector.

Outcome #1

1. **Outcome Measures**

Number of research programs to identify and isolate plant compounds and/or develop the processes and technologies to manufacture functional foods.

Not Reporting on this Outcome Measure

Outcome #2

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, Cryptosporidium and

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of adults with new and improved knowledge on non-food and bioeconomy related products and processes.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of research programs to identify breeding and genetic improvement related to food quality, nutrition and processing.

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Number of research programs to develop packaging systems to enhance food quality and shelf life.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of research programs to connect Michigan industries with 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 biobased economic sector.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges

Brief Explanation

This planned program area was discontinued in last years report, as the projects were migrated into new federal priorities required in the plan of work.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Economics, Marketing and Policy

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	30%		18%	
602	Business Management, Finance, and Taxation	22%		12%	
603	Market Economics	20%		7%	
604	Marketing and Distribution Practices	5%		5%	
605	Natural Resource and Environmental Economics	5%		16%	
606	International Trade and Development	0%		11%	
608	Community Resource Planning and Development	15%		10%	
609	Economic Theory and Methods	0%		10%	
610	Domestic Policy Analysis	3%		6%	
611	Foreign Policy and Programs	0%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	32.4	0.0	10.0	0.0
Actual Paid Professional	27.1	0.0	4.0	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**
1201062	0	319025	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1201062	0	386656	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2739234	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research 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; identify and evaluate human resources management practices in Michigan agricultural and green industries; 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; and identify and evaluate the policy, technology and marketing issues faced by Michigan organic growers and develop responses.

Extension 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; and 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 used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4380	13141	47	0

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

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

no patents to report for this period.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	1	19	20

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2011	15

Output #2

Output Measure

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

Year	Actual
2011	558

Output #3

Output Measure

- Number of adult participants trained in business management, finance and taxation.

Year	Actual
2011	941

Output #4

Output Measure

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

Year	Actual
2011	1134

Output #5

Output Measure

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

Year	Actual
2011	1747

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.

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
2011	473

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One of the top priorities of the Five-year Issues Identification process was helping farmers become more profitable.

What has been done
One example, MSU Extension developed workshops that addressed best business practices forsoy bean producers. Over 255 producers were trained.

Results
?35% of the participants returned their evaluations
?All of the participants reported that they learned new information
?97% utilized or implemented the information or practices they learned for the program to manage or produce their 2011 soybean crop
?96% indicated that the information was beneficial to their businesses in 2011
?96% participants said that the management information gathered from the participants of the Michigan Soybean Yield contest has been beneficial to their farms
?23 farms earned or saved additional money by utilizing the information they learned from the program
?The actual amount of additional money they reported earning or saving was $20.74 per acre
?Since the new information was implemented on 9,191 acres in 2011, the actual financial impact of this program was $190,636 in 2011 alone.

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
2011	753

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Cash flow and income tax management is a primary need of agricultural producers as they are on the cash accounting system versus on the accrual, so they have much ability to manage their income taxes from year to year. Families and lenders need a good tax management and cash flow in order to allow the business to survive and prosper.

What has been done
MSUE provides traing that assist individuals and firms to take control of input and output recordkeeping systems along with the supporting financial data to improve profitability.

Results
Evaluation of the Telfarm tax management training found producers saved on an average over $10,000 per farm. Producers learned the necessary management skills and strategies that can help them achieve their tax management goals. Many tax changes in the depreciation system allow for fast depreciation, enabling a significant reduction in the taxable income. In one evaluation of 40 farms found the program impacted tax savings of $3.7 Million with total annual expenses for the 40 farms being over $56.3 Million with $6.9 Million going to labor and cash recipts of almost $65.8 Million.

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
2011	964

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In Michigan, there are approximately 19.5 million acres of forestland. The majority of this acreage (56%) is owned by private woodland owners and represents about 10.98 million acres of forestland. Over the last several decades, this privately owned acreage has become more parcelized and fragmented as a result of development pressures, increasing property taxes and other economic and regulatory policies that make it difficult to maintain larger forest parcels intact. To illustrate this point, the 1980 forest survey of Michigan reported that there were over 180,000 private forest landowners in Michigan. Recent estimates (2010) now estimate that there are over 498,000 private forest landowners in Michigan and climbing. In addition, a significant percentage of these private landowners are becoming older and as they age more of this forested property is beginning to transfer over to their heirs. If not properly planned in advance, this transfer of property to the next generation often results in more parcelization as heirs are forced to sell portions of the property to pay the estate and income taxes.

What has been done
MSU Extension, in association with the Michigan Department of Natural Resources, Michigan Forest Association and other organizatinos, adapted and presented the Oregon State University Ties to the Land Curriculum. The program has been conducted at 5 locations in the state reaching over 100 landowners.

Results
Follow-up survey results indicated that landowners had greater confidence and ability to pass their land on to their heirs and believed that the program made it more likely that their property will remain intact, in the family and in woodland.

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
2011	1398

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Citizens and community decision makers need information and skills in facilitation to address planning needs and multiple perspectives in the community.

What has been done
New approaches to delivering the Citizen Planner Program to respond to changing needs of the community ? The NE Citizen planner pilot project was launched in October 2011, with three communities ? Cheboygan County, Alpena and Presque Isle Counties participating. The standard session-session Citizen Planner Program was delivered to these three sites via Adobe Connect. The pilot program was offered at a substantial discount, since this was an experimental approach. Additional evaluation strategies wereused to learn about the effectiveness of this delivery method. The program concluded in mid-November 2011.

Results
Evaluation outcomes to date included:

Participant knowledge gain ? Participants receive an 8-question survey with each Planners Moments Unit, assessing knowledge of concepts presented during the video. Test scores were high, with most participants scoring 80 percent or better on the assessments. Respondents generally rated the presentations ?informative,? with per-unit averages ranging from 3.37 to 4.03 (1=not at all informative, 5=very informative).

Cost recovery ? An existing letter of understanding between MSUE and NWMCOG reserves 10 percent of Planners Moments program income for administrative costs, with that amount split

evenly between MSUE and NWMCOG. This year $180 was returned to MSUE and deposited with the Greening Michigan Institute.

Sustainability ? Subscription fees ?in the bank? will fully fund the program for 2012, and both MSUE and NWMCOG are committed to continuing the effort. For the 2012 series, the PRAC Education Committee would like to emphasize case examples from northwest Michigan communities, highlighting planning and placemaking best/innovative practices, with more from community members, less expert commentary.

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
2011	4

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: 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 tradeoffs associated with ecological problems; and to better understand what forces spark Michigan food system conflict

and how these conflicts can be tranformed into opportunities for citizenship.

Results
Research examining the implications of sustainability principles for U.S. agriculture showed that reorientation of the publically funded agricultural science portfolio would accelerate movement toward agricultural sustainability. The work was multidisciplinary and was reported in a National Academy of Science book entitled, Toward Sustainable Agricultural Systems in the 21st century. Special emphasis was placed on how to conduct engaged transdisciplinary scholarship woard agricultural sustainability, including U.S. water policy.

A biomass framing workshop attended by 32 people representing various sectors of the woody biomass supply chain resulted in the development of an issue guide that presents various opportunities and challenges facing the emerging woody biomass sector in Michigan. A video, "Michigan Talks Biomass" was also produced and posted on the Food Democracy Prohject website.

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
2011	5

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: further the understanding of coupled human and natural systems and sustainability; more broadly develop conceptual and analytical 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 entrepreneuship and the Michigan agrifood sector.

Results
Research to identify high priority areas for research related to Michigan public finance has resulted in the publishing of two papers - Property Taxation, Education Finance Reform and Tax Base Growth (Regional Science and Urban Economics), which highlights the importance of jurisdictional competition in determining the pattern of development in southeast Michigan; and a paper on The Causes and Consequences of Fiscal Stress in Michigan Cities (Regional Science and Urban Economics).

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

2011 1

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: profile and characterize consumers and markets for eco-friendly products.

Results
A month-long pilot study was done in May 2011 with 120 volunteers at six Michigan garden centers using eye-tracking glasses to determine consumer preferences. An additional study was done in November and December using 265 volunteer participants at a Detroit garden center using two poinsetia and one Christmas tree display. Participants were asked to view displays with and without price and information signs. Data is currently under analysis and will be used to quantify and characterize the drivers of customer preferences in ornamental markets using structural equation modeling.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
603	Market Economics
604	Marketing and Distribution Practices
608	Community Resource Planning and Development
609	Economic Theory and Methods

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
2011	2

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
Research on creating a viable market and enacting the appropriate supporting policies for ecosystem services resulted in the development of supply curves can be used to determine how much land Michigan farmers would be willing to put into ecosystem service practices for various levels of payment. On the consumer side, researchers surveyed Michigan residents on their willingness to pay for the ecosystem services that these changed farm practices would require. Results revealed that Michigan residents 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 land 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
2011	3

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
Research on recreational fishing in Michigan has shown that fishing license sales have declined markedly over the past 15 years; Michigan license sales have declined by 33% (compared to an 11% decline nationally). The largest declines are for 24 to 44-year olds. Further, respondent characteristics related to fishing have been identified: the average recreactional angler began fishing at 8 years old, has fished for 33 years and 60% have fished with family or friends, with 5% competing in fishing events. Most (77%) fished in inland lakes, followed by rivers (44%) and Great Lakes connecting waterways (42%). This information is now being used by the Michigan Department of Natural Resources to direct their recreational fisheries management decisions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics

605 Natural Resource and Environmental Economics

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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 on recreational fishing in Michigan has shown that fishing licence sales have declined markedly over the past 15 years; Michigan license sales have declined by 33% (compared to an 11% decline nationally). The largest declines are for 24 to 44-year olds. Further, respondent characteristics related to fishing have been identified: the average recreactional angler began fishing at 8 years old, has fished for 33 years and 60% have fished with family or friends, with 5% competing in fishing events. Most (77%) fished in inland lakes, followed by rivers (44%) and Great Lakes connecting waterways (42%). This

information is now being used by the Michigan Department of Natural Resources to direct their recreational fisheries management decisions.

• Research on creating a viable market and enacting the appropriate supporting policies for ecosystem services resulted in the development of supply curves that can be used to determine how much land Michigan farmers would be willing to put into ecosystem service practices for various levels of payment. On the consumer side, researchers surveyed Michigan residents on their willingness to pay for the ecosystem services that these changed farm practices would require. Results revealed that Michigan residents would be willing to pay for reduced numbers of eutrophic lakes and reductions in greenhouse gase emissions. That payment could support potentially 20 to 50 percent of Michigan corn-soybean land going into lowe input practices.

E**xtension notable accomplishments:**

One example:

Issue (who cares and why)? The economy of the State of Michigan is becoming less dependent on manufacturing. The agri-business system is emerging as a dynamic and growing sector of the economy. This has led to an increase in the number of individuals interested in developing their own businesses with many related to food. Many existing businesses also seek opportunities to expand. These new and expanding ventures need good business planning skills to evaluate their concept to determine if investment is warranted.

What has been done? Innovation Counselors have been trained by the Product Center to work with new entrepreneurs and existing business owners in the agriculture, food, and bioeconomy sectors assist in the business planning process.

Results/Impact? Through mid-year, the Innovation Counselors conducted 2,197 counseling sessions with new entrepreneurs or existing businesses. They coached 246 clients through concept development, assisted 110 with basic business planning, and assisted 114 with advanced services such as feasibility studies, product testing and market analysis. Ten new ventures were launched. The Product Center has assisted 174 business launches resulting in 750 new jobs, 364 retained jobs, $228.9 million in capital investment, and $309.7 million in increased annual sales (cumulative first year sales only). See attached Product Center summary sheet for more information.

Institute of Agriculture and Agribusiness Work Team's evaluation found in this area:

914 producers and processors with improved understanding of national and international policy issues and decisions

872 entrepeneurs use business planning skills to make informed decisions regarding business opportunities

374 young people better equipped to manage farm business

175 farmers with increase understanding of alternative opportunities in the food, agriculture industries

101 producers use a business plan for their farm business and new ventures.

Institute of Greening Work Team's evaluation found in this area:

146 new business start-ups and ventures

310 entrepreneurs that increased their understanding and able to apply skills, resources, processes that will lead to a successful business start-up and venture

47 youth who aspired and developed entrepeneurial skills

Key Items of Evaluation

Key items from evaluations :

- Research on recreational fishing in Michigan has shown that fishing license sales have declined markedly over the past 15 years; Michigan license sales have declined by 33% (compared to an 11% decline nationally). The largest declines are for 24 to 44-year olds. Further, respondent characteristics related to fishing have been identified: the average recreactional angler began fishing at 8 years old, has fished for 33 years and 60% have fished with family or friends, with 5% competing in fishing events. Most (77%) fished in inland lakes, followed by rivers (44%) and Great Lakes connecting waterways (42%). This information is now being used by the Michigan Department of Natural Resources to direct their recreational fisheries management decisions.
- Research on creating a viable market and enacting the appropriate supporting policies for ecosystem services resulted in the development of supply curves that can be used to determine how much land Michigan farmers would be willing to put into ecosystem service practices for various levels of payment. On the consumer side, researchers surveyed Michigan residents on their willingness to pay for the ecosystem services that these changed farm practices would require. Results revealed that Michigan residents would be willing to pay for reduced numbers of eutrophic lakes and reductions in greenhouse gase emissions. That payment could support potentially 20 to 50 percent of Michigan corn-soybean land going into low input practices. .
- Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Animal Production and Protection

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%		15%	
303	Genetic Improvement of Animals	4%		10%	
304	Animal Genome	3%		11%	
305	Animal Physiological Processes	0%		9%	
307	Animal Management Systems	45%		13%	
308	Improved Animal Products (Before Harvest)	0%		1%	
311	Animal Diseases	25%		16%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	1%		0%	
315	Animal Welfare/Well-Being and Protection	1%		10%	
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: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	13.5	0.0	15.0	0.0
Actual Paid Professional	21.5	0.0	6.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
952136	0	531708	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
952136	0	644427	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4565389	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research to: better understand the processes that control/influence reproduction at the molecular and genetic level; develop and test new cropping, grazing and feeding strategies for cattle, sheep and other ruminants for maximum profitability and animal health and minimal environmental impact; develop and evaluate new nutritional management strategies for non-ruminant animals for maximum animal health and minimal environmental impact; develop and evaluate management tools and strategies for animal manure management that is cost-effective, easy to implement and exceeds stringent environmental standards set by the state; develop and evaluate management/training strategies for race horses to reduce injuries; develop an understanding of the molecular processes that influence growth and meat quality in food animals; add to the understanding of various food animal genomes by improving and integrating genetic maps; better understand 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, including bovine viral diarrhea virus, leptospirosis, bovine tuberculosis, *Campylocacter jejuni*, West Nile virus, and bovine spongiform encephalitis; and investigate 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; and 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, biotechnology company representatives, and state agency representatives and state and local elected officials.

3. How was eXtension used?

eXtension was used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2531	7593	15138	0

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

Patent Applications Submitted

Year: 2011

Actual: 1

Patents listed

MICL02127 - Increasing the efficiency of somatic cell nuclear transfer cloning in bovine: 12/974,781; 12/21/2010; and PCT/US2010/056252; 11/10/2010. In addition, one patent was awarded for the same project: 7,858,308; 12/28/2010.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	6	29	35

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on animal production and protection.

Year	Actual
2011	26

Output #2

Output Measure

- Number of adult participants trained in animal management systems.

Year	Actual
2011	2531

Output #3

Output Measure

- Number of youth participants trained in animal management systems.

Year	Actual
2011	15138

Output #4

Output Measure

- Number of adult participants trained in animal diseases.

Year	Actual
2011	876

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 develop and test new cropping, grazing and feeding strategies for cattle, sheep and other ruminants.
6	Number of research programs to develop and evaluate new nutritional management strategies for non-ruminant animals.
7	Number of research programs to understand the molecular processes that influence growth and meat quality in food animals.
8	Number of research programs to add to the understanding of various food animal genomes by improving and integrating genetic maps.
9	Number of research programs to develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.
10	Number of research programs to understand the environmental fate and biological effects of vaccines, steroids and other substances fed to animals.
11	Number of research programs to develop and evaluate management/training strategies for horses to reduce injuries.
12	Number of research programs to add to the understanding of animal behavior and welfare.
13	Number of research programs to test new cropping, grazing and feeding strategies for food animals.
14	Number of research programs to understand the genetic and molecular processes that contro/influence the immune system in 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
2011	2537

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agriculture is critical to Michigan?s economy and an increasingly important segment of the state?s budget. Michigan agriculture and supporting industries provide employment for a large segment of the state?s population Continued expansion of food production relies on social acceptability and economic viability of agricultural production, processing, delivery and marketing from locally to internationally. Producers need critical information in a timely manner.

What has been done
MSUE conducted a series of webinars consisting of four parts and twelve segments called Consideration for Marketing Beef Locally to educate producers and improve their skills to market beef locally.

Results
An evaluation found:

Seventy seven percent of participants reported they plan to use information presented in each of the twelve segments presented in four webinars. Producers also reported plans to make changes in their operations over the next nine months. These included:
?7% who were not currently raising beef planned to begin raising beef
?48% planned to expand existing beef herd
?17% planned to begin direct marketing of beef
?55% planned to expand direct marketing of beef
?17% planned to begin marketing a differentiated beef product
?34% planned to expand marketing a differentiated beef product
?14% planned to develop a processed meat product
?14% planned to develop a branded meat product
Data reported on size and type of information showed both large and small scale producers

involved in the series. Total number of head reported for the various production types included:
?Cow/calf 1656 head
?Backgrounder 630 head
?Feedlot 3220 head

Survey results of a six month follow-up to assess behavior changes found the results mirrored the planned changes reported in the initial evaluation quite closely showing some significant changes in the operations of the participants as reported:
?12% who were not raising beef before started raising beef
?25% expanded their beef herd
?12% began direct marketing of beef
?50% expanded direct marketing of beef
?25% began marketing a differentiated beef product

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.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of adult participants with increased knowledge of animal diseases.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Calf care is an important aspect of dairy herd management. The highest rate of illness and mortality occurs during the first two months of the life of a replacement heifer. Proper care at birth through weaning of the calf can minimize the incidence of illness and the death loss.

What has been done
Calf care schools were held in Cadillac (January) and Zeeland (March). Presentations covered the care of the calf from birth through weaning (e.g. colostrum feeding and management, nutrition, housing, health, recordkeeping). Speakers included MSU Extension dairy educators and local veterinarians.

Results
Evaluation results found participants responding to the following statements (on a scale of 1=low and 5=high).

Rate your level of knowledge 3.49 before; 4.41 after
Rate your understanding of your job 3.92 before; 4.59 after
Rate your enthusiasm for your job 4.24 before; 4.61 after

The level of knowledge increased the most for the following topics:
Maternity pen management 3.42 before; 4.32 after
Care at calving 3.24 before; 4.31 after
Colostrum management 3.05 before; 4.37 after
Diarrhea in newborn calves 3.21 before; 4.38 after
Other health concerns 3.26 before; 4.22 after

79% of the participants planned to make changes based on this program. The most frequent changes planned were: colostrum management, maternity pen management, keeping better records

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases

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
2011	4

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: 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
Reproductive efficiency research for beef and dairy operations has identified a novel oocyte (follistatin) and cumulus cell correlates (cathsepins B,S,Z) of bovine oocyte competence and demonstrated therapeutic effects of follistatin and cathepsin inhibitor treatments in vitro on bovine embryonic development. Such information may ultimately help form a platform for development of new technologies to enhance fertility of beef and dairy cattle.

In research to determine why fertility in lactating dairy cows is compromised from the time they are heifers, the development of fertility programs to enhance progesterone levels naturally versus synthetically has resulted in an average 50% increase in fertility and close to a 60% conception rate.

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

Outcome #5

1. Outcome Measures

Number of research programs to develop and test new cropping, grazing and feeding strategies for cattle, sheep and other ruminants.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of research programs to develop and evaluate new nutritional management strategies for non-ruminant animals.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Number of research programs to understand the molecular processes that influence growth and meat quality in food animals.

Not Reporting on this Outcome Measure

Outcome #8

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
2011	4

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
Research to develop a baseline database of biosecurity practices employed by beef and dairy managers has combined on-farm and online databases to summarize frequencies for management practices used by Michigan beef and dairy farms. Results are being used to compare each farm to the larger group and give each farm an assessment. Summary data will be used to promote biosecurity efforts to the broader population of beef and dairy producers to enhance their decision making.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
305	Animal Physiological Processes

Outcome #9

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
2011	3

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-1980s 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: better understand parasitic and mutualistic interactions in a bacteria-nematode insect association; collect and screen for bacterial strains with antagonistic properties for foodborne 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 decade-long project to identify which management practices are the most effective at controlling the spread of Johne's disease has resulted in the publication of a 28-page report that provides critical information to beef and dairy producers on how to effectively manage the disease and reduce its impact on farms. Research from this work will have a far-reaching effect on future profitability and sustainability of the industry.

Research investigating the function and evolution of opportunistic pathogenicity has discovered that the symbionts Photorhabdus symbionts (a bacteria) and Hterorhabditis nematodes are acquired as a persistent biofilm and maternally transmitted to offspring that develop inside the maternal body, resulting in matricide. This discovery provides a novel insight into some forms of dormancy relevant to chronic infections and disease recurrence.

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 #10

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
2011	3

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
In determining the immunology of core-antigen bacterins toward the protection against coliform mastitis, trials demonstrated that a series of multiple immunizations with J5 E. coli bacterin is more effective in stimulating antibody response when injection sites are sequentially rotated about the body, as opposed to injection in the same location. This finding will help determine if cows in advanced stages of this disease have an impaired ability to produce antibody responses and/or lymphocytes cytokine responses following immunization.

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 #11

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
2011	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
Research investigating the biology of equine herpesvirus-5 associated lung fibrosis, established that equine herpesvirus-5 (EHV-5) is the cause of equine multinodular pulmonary fibrosis (EMPF). This data is the first to definitively link EHV-5 to disease in horses, and the first to associate a viral infection within the lungs with the development of lung fibrosis in an outbred population of animals.

4. Associated Knowledge Areas

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

Outcome #12

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
2011	3

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
Research testing the ability of glucosamine and chondroitin sulfate (GLN/CS) to mitigate inflammatory and mechanical stress in vitro has demonstrated that GLN/CS treatments can partially mitigate the catabolic response to inflammatory stress and mechanical trauma in equine cartilage explants. These results provide additional support for the continued study on the benefit of GLN/CS for horses with cartilage degeneration.

4. Associated Knowledge Areas

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

Outcome #13

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
2011	4

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 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 examining the forage production and utlization, milk production and performance of robotic milking in pasture-based dairy system in southwestern Michigan showed that milk yield, voluntary milkings and body weight were higher during total mixed ration (TMR) feeding, intermediate for partial total mixed ration feeding (pTMR) and lower for pasture with supplementation of concentrate (PC). Conversely, activity of cows during PC feeding increased by 43% and 68% compared to pTMR and TMR, respectively. Further, supplement intake increased as days in milk (DIM) increased, whereas voluntary visits to robotic milkers decreased with DIM in the three feeding systems tested. This information is being used to inform dairy grazing innovations for the Upper Midwest.

4. Associated Knowledge Areas

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

Outcome #14

1. Outcome Measures

Number of research programs to understand the genetic and molecular processes that contro/influence the immune system in food animals.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The release of immune-activating and modulating factors has broad implications for improving the immune response of food animals. For dairy cows in particular, a better understanding of the neutrophil system is critical to the sustainability of dairy operations and cow health. Research to improve immmune recognition for all food animals is necessary to protect agains or eliminate viruses, cancer, etc.

What has been done
Research to: better understand the regulation of gene expression during early embryogenesis; and to gain a clear understanding of the molecular and cellular mechanisms that mediate changes in neutrophil function in peri parturient dairy cows.

Results
Research findings showed that in a certain cell type in a mouse embryo, a regulatory protein know as Brahma Related Gene 1 fails to turn off a gene critical to early embryo vitality. This work has important implcations for humans and cattle because the states being looked at in mouse development where the higest number of pregnancies are lost -- those occurring between days 0.05 and 6.5 -- correspond to the early stages of development for humans and cattle.

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
311	Animal Diseases

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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:

- Reproductive efficiency research for beef and dairy operations has identified a novel

oocyte (follistatin) and cumulus cell correlates (cathsepins B,S,Z) of bovine oocyte competence and demonstrated therapeutic effects of follistatin and cathepsin inhibitor treatments in vitro on bovine embryonic development. Such information will ultimately help form a platform for development of new technologies to enhance fertility of beef and dairy cattle.

- In research to determine why fertility in lactating dairy cows is compromised from the time they are heifers, the development of fertility programs to enhance progesterone levels naturally versus synthetically has resulted in an average 50% increase in fertility and close to a 60% conception rate.
- A decade-long project to identify which management practices are the most effective at controlling the spread of Johne's disease has resulted in the publication of a 28-page report that provides critical information to beef and dairy producers on how to effectively manage the disease and reduce its impact on farms. Research from this work will have a far-reaching effect on future profitability and sustainability of the industry.
- Research investigating the biology of equine herpesvirus-5 associated lung fibrosis, established that equine herpesvirus-5 (EHV-5) is the cause of equine multinodular pulmonary fibrosis (EMPF). This data is the first to definitively link EHV-5 to disease in horses, and the first to associate a viral infection within the lungs with the development of lung fibrosis in an outbred population of animals.

Extension Institute Agriculture and Agribusiness Work Team evaluation found:

- 2518 participants improved their knowledge of new production and management technologies
- 1994 producers increased their confidence needed for immediate adoption of recommendations that lead to significant changes
- 680 producers better positioned themselves to respond to food production issues
- 550 producers better prepared to address food safety issues by participating in GAP audits and other food safety programs

Key Items of Evaluation

Key items from evaluations:

- Reproductive efficiency research for beef and dairy operations has identified a novel oocyte (follistatin) and cumulus cell correlates (cathsepins B,S,Z) of bovine oocyte competence and demonstrated therapeutic effects of follistatin and cathepsin inhibitor treatments in vitro on bovine embryonic development. Such information will ultimately help form a platform for development of new technologies to enhance fertility of beef and dairy cattle.
- In research to determine why fertility in lactating dairy cows is compromised from the time they are heifers, the development of fertility programs to enhance progesterone levels naturally versus synthetically has resulted in an average 50% increase in fertility and close to a 60% conception rate.
- A decade-long project to identify which management practices are the most effective at controlling the spread of Johne's disease has resulted in the publication of a 28-page report that provides critical information to beef and dairy producers on how to effectively manage the disease and reduce its impact on farms. Research from this work will have a far-reaching effect on future profitability and sustainability of the industry.

- Research investigating the biology of equine herpesvirus-5 associated lung fibrosis, established that equine herpesvirus-5 (EHV-5) is the cause of equine multinodular pulmonary fibrosis (EMPF). This data is the first to definitively link EHV-5 to disease in horses, and the first to associate a viral infection within the lungs with the development of lung fibrosis in an outbred population of animals.
- Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Global Food Security and Hunger

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	0%		4%	
102	Soil, Plant, Water, Nutrient Relationships	15%		16%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		23%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		5%	
205	Plant Management Systems	35%		12%	
307	Animal Management Systems	15%		6%	
308	Improved Animal Products (Before Harvest)	0%		11%	
603	Market Economics	35%		3%	
604	Marketing and Distribution Practices	0%		5%	
606	International Trade and Development	0%		12%	
610	Domestic Policy Analysis	0%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	10.8	0.0	8.0	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**
479962	0	638050	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
479962	0	773313	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5478467	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

To meet the challenges faced in this program, activities included research to: genetically improve dry beans, rice, soybean, wheat, vegetable crops (e.g., tomatoes, potatoes) 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; ensure food access and security to all; develop strategies and approaches that enhance the sustainability of vegetable production systems; and identify beneficial plant-microbe interactions and soil properties and their influence on crop yield.

Extension activities included: assisting producers and processors in national and international policy issues the impact industry competitiveness.

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 selected officials and policymakers, national and international policy statndard boards and councils, other researchers and academics, and the interested public.

3. How was eXtension used?

eXtension was used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger

- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	914	2742	1024	0

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

Patent Applications Submitted

Year: 2011

Actual: 2

Patents listed

MICL01806 - Breeding genetics for the improvement of potato for yield, quality and pest resistance; 85/275,387; 03/24/2011, and and MICL01654 - Genetic improvement of bean for yield, pest resistance and food value; 61/401,335; 08/11/2010. In addition, one patent was received: MICL01810 - Genetic improvement of strawberries and blueberries; PP21,777; 03/15/2011.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	3	34	37

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2011	32

Output #2

Output Measure

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

Year	Actual
2011	914

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 efficiences in food animals.
3	Number of research programs to identify current and emerging key public policy issues on trade, environmental and agricultural 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 trained in national and international policy issues that impact 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
2011	14

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 sources of the genes that can be used for variety improvement. Further, current transformation techniques are not applicable to all plant species.

What has been done
Research to: improve plant architecture, disease, stress resistance and quality traits for dry beans; develop and utilize new technologies, genes and germplasm for vegetable crop improvement and safe deployment of genetically engineered crops; breed new high quality blueberry and strawberry cultivars that are resistant to the common array of biotic and abiotic stresses; develop a model system for the genetic studies of important domestication traits in cereal; develop food-grade specialty soybean varieties; characterize and identify genes responsible for conferring mutant phenotypes during fruit development and ripening of tomato; development and release of improved soft red and soft white winter wheat varieties and germplasm; and develop and refine a novel transformation system suitable for large-seeded legumes.

Results
MSU potato research is making great strides leading to more scab resistant lines advancing through its breeding program. Twenty four of 80 breeding lines were at least moderately resistant to Colorado potato beetle in detached leaf bioassays. Researchers also examined some wild species accessions and identified individual lines with resistance from S. chaoense, S. berthaultii and S. pinnatisectum.

Research identified the gene controlling the transition from the black-colored hull of the ancestral wild rice, Oryza rufipogon, to the straw-white hull of cultivated rice. Characterization of the genetic basis of these types of changes will clarify the mechanisms of crop domestication and facilitate crop improvement and new domestications.

Two lines of pest-resistant soybean developed by an MSU scientist promise healthier harvests for growers. Sparta,the Soybean Aphid Shield is the new trade name for genetics developed. With one exception, all the major U.S. soybean genetics companies have licensed this germplasm because the level of resistance to soybean aphids is very high.

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 resistant selections do not yellow and also do not fall off.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The molecular basis underpinning beef and pork quality is highly complex, and continued advances in understanding the biological processes that contribute to the delivery of consistent

quality meat is critical to the sustainability and security of the industry. Knowledge gained from research efforts in this area can be beneficial in defining and optimizing management systems for quality, providing assurance of meat quality and in tailoring quality to suit market needs.

What has been done
Research to: discover and evaluate genetic factors that influence growth, carcass merit and meat quality of swine and cattle; increase the efficiency of protein production and the quality of meat and milk in ruminants primarily through nutritional methods; and develop forage systems that will increase milk yield, decrease feed costs and decrease the feed resources used to meet nutritional requirements, minimizing excretion of nutrients as waste products.

Results
Evaluation of temperament phenotypes in the MSU Angus x Limosin beef resource population found that calf exit velocity from the working chute was significantly negatively correlated with the average daily gain and beef color, indicating that calves with flighty dispositions grow more slowly and have poorer quality carcasses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Public policy has taken on considerable improtance 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 is now 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: investigate the causes and effects of price, yield and revenue risk in agriculture and the food system; evaluate the economics of alternative strategies for managing these risks; develop and test a theoretical model of behavioral relationships between retail buyers and suppliers to understand the distribution systems related to the entry of U.S. agribusiness products into Chinese and Indian consumer retail markets; better understand the implications of global food supply chain structure and performance; and to better understand how science and technology are used in the creation, maintenance and modification of agricultural grades and standards.

Results
A study addressing the growing connection between energy markets and food and feed crop markets in the U.S. found that as ethanol production expands, the connections and spillovers between crude oil and corn prices increase dramatically, leading to important implications for risk management strategies in the commodity sector.

A study on spatial maize price transmission across market channels in Southern Africa found that spatial price transmission was weak during periods in which governments were heavily involved in cross-border maize trade, but strong when the government was absent from the market. The results have important implications for the impacts of maize marketing policies in Southern Africa.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics
604	Marketing and Distribution Practices
606	International Trade and Development
610	Domestic Policy Analysis

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
2011	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Globally, agriculture has performed remarkably well over the past 50 years by keeping pace with rapid population growth and delivering food at progressively lower prices. But this success has been at the expense of the natural resource base, through overuse of natural resources as inputs or through their use as a sink for pollution. To ensure sustainability of, and reduced risk to, the agriculture industry, research that helps develop strategies and methods related to mixed farming, mixed cropping, crop rotation, crop selection and varietal improvement is critical if agriculture is to meet future global demands without adversely affecting the resource base.

What has been done

Research to: increase our knowledge of beneficial plant-microbe interactions of agricultural importance to develop sustainable ecosystems; develop optimal sampling schemes for accurate mapping of various soil and plant characteristics; improve the sustainability of intensive vegetable production systems through the use of cover crops, soil amendments, and alternative production strategies; optimize reduced tillage production systems and evaluate their impact on pest and nutrient management, as well as yield and quality of vegetable crops; better understand micronutrients in plants; and determine the impact of alternative cropping systems and environmental conditions on weed population dynamics and weed management.

Results

Field studies conducted to test and demonstrate the impact of alternative cultural practices on asparagus performance in a replant situation showed that appropriate soil amendment, use of brassica cover crops and cultivar selection are all critical components of asparagus cropping systems and have high potentials to enhance yield.

Studies evaluating the impact of low tunnels on cucumber and tomato production showed significant improvements in frost protection and earliness. The use of low tunnels allowed harvesting cucumbers two to three weeks earlier than the rest of the industry.

4. Associated Knowledge Areas

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

Outcome #5

1. **Outcome Measures**

Number of producers and processors trained in national and international policy issues that impact industry competitiveness.

Not Reporting on this Outcome Measure

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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:

• Two lines of pest-resistant soybean developed by an MSU scientist promise healthier harvests for growers. Sparta,the Soybean Aphid Shield is the new trade name for genetics

developed. Some 2,000 strains of soybeans were tested against aphids to isolate four with different resistant genes. From those, germplasm was developed to breed into varieties suited to Michigan's shorter growing season. With one exception, all the major U.S. soybean genetics companies have licensed this germplasm because the level of resistance to soybean aphids is very high.

- 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 resistant selections do not yellow and also do not fall off.
- Field studies conducted to test and demonstrate the impact of alternative cultural practices on asparagus performance in a replant situation showed that appropriate soil amendment, use of brassica cover crops and cultivar selection are all critical components of asparagus cropping systems and have high potentials to enhance yield.
- Studies evaluating the impact of low tunnels on cucumber and tomato production showed significant improvements in frost protection and earliness. The use of low tunnels allowed harvesting cucumbers two to three weeks earlier than the rest of the industry.

Extension evaluative results -- Evaluations of Extension activities are done regularly using a variety of approaches that are based on the Insitute Work Team logic models and evaluation plans.

The following are some examples of the evaluation results of the Institute for Agriculture and Agribusiness Work Team for this area:

- 914 producers and processors with improved knowledge of national and international policy issues and decisions and the impact on thir own firm and industry competiveness
- 175 participants increased their knowledge of alternative opportunities in the food and agriculture industries
- 563 farms and producers increased compliance with federal and state legislations
- 57 new entrepeneurs and investors that increased capital investment in food and agriculture.
- 69 new opportunities in food production for Michigan
- 1978 Michigan Citizens became more accepting that locally grown food is safe and nutritious,

The following are some examples of the evaluation results of the Institute for Greening Work Team:

- 1024 youth engaged in gardenting
- 9 new regional coalitions implemented
- 197 participants increased consumption of garden-grown produce.
- 12 new schools that increase use of garden-based education.
- 131 participants gained knowledge regarding opportunities, barriers, and needed changes for farm to institution
- 419 participants gained knowledge regarding food systems issues and opportunities
- 604 participants gained knowledge regarding linkages within food systems.
- 112 participants increased their knowledge in the fundamentals in public policy,

governance, and land use procedure and process

Key Items of Evaluation

Key items from evaluations:

- Two lines of pest-resistant soybean developed by an MSU scientist promise healthier harvests for growers. Sparta,the Soybean Aphid Shield is the new trade name for genetics developed. Some 2,000 strains of soybeans were tested against aphids to isolate four with different resistant genes. From those, germplasm was developed to breed into varieties suited to Michigan's shorter growing season. With one exception, all the major U.S. soybean genetics companies have licensed this germplasm because the level of resistance to soybean aphids is very high.
- 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 resistant selections do not yellow and also do not fall off.
- Field studies conducted to test and demonstrate the impact of alternative cultural practices on asparagus performance in a replant situation showed that appropriate soil amendment, use of brassica cover crops and cultivar selection are all critical components of asparagus cropping systems and have high potentials to enhance yield.
- Studies evaluating the impact of low tunnels on cucumber and tomato production showed significant improvements in frost protection and earliness. The use of low tunnels allowed harvesting cucumbers two to three weeks earlier than the rest of the industry.\
- Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

..

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Climate Change

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	10%		15%	
131	Alternative Uses of Land	10%		12%	
132	Weather and Climate	50%		27%	
133	Pollution Prevention and Mitigation	20%		33%	
135	Aquatic and Terrestrial Wildlife	5%		7%	
136	Conservation of Biological Diversity	5%		6%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	7.4	0.0	4.0	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
327540	0	319025	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
327540	0	386656	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2739234	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

As the red rises in thermometers worldwide, MSU is positioning itself to play a leadership role in addressing emerging climate changes issues and opportunities. Research was undertaken to: ensure sustainable crop and livestock productivity in the face of addressing emerging climate change; determine the impact of global warming on the Great Lakes water budget and fisheries; develop effective tools and agricultural management practices for air emission mitigation related to greenhouse gas reduction on agricultural lands and operations; and to take advantage of emerging economic opportunities offered by climate change mitigation technologies. Extension activities included: assisting farmers in projecting crops using up-to-date information from local weather stations and research data, train farmers how to reduce pollution that impacts climate and help coastal communities adapt as water levels change due to climate shifts.

2. Brief description of the target audience

Agricultural producers, natural resource/ecosystems managers, environmental organizations, commodity groups and industry representatives, elected officials and policy makers at all levels, other researchers and academics, and the interested public.

3. How was eXtension used?

eXtension was used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	732	2196	1211	0

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

Patent Applications Submitted

Year: 2011

Actual: 2

Patents listed

MICL01884 - Identification of strategic microsites for promoting soil carbon sequestration; PCT/US2010/046532; 8/24/2010 and 61/392,785; 10/13/2010.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	1	16	17

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on climate change.

Year	Actual
2011	15

Output #2

Output Measure

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

Year	Actual
2011	854

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to help ensure and agriculture system (and its 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 trained in responding to food production issues resulting in less production and marketing losses.

Outcome #1

1. Outcome Measures

Number of research programs to help ensure and agriculture system (and its 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
2011	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agriculture is easily affected by dramatic changes in climate and weather. Temperature increases can cause stress in livestock and trigger faster crop growth, often meaning less time for plants to mature. Warmer climates also increase the number of weeds, insect pests and crop diseases and could cause them to spread beyond their normal range. These changes could pose a great threat to the nation's farmers if they don't have the research-based knowledge, tools and resources they need to help them adapt.

What has been done
Research to: provide economic intelligence to facilitate adjustments in agricultural systems related to the challenges and opportunities provided by climate change; estimate the impacts of weather and climate on representative crop production systems in Michigan and the Great Lakes region during past and projected future time frames; better understant the dynamics of agricultural land changes under both socioeconomic and climatic drivers; investigate the full range of ways that populations may respond to anthropogenic environmental change, from ecological responses to evolutionary responses; establish measuring and monitoring protocols and models for verification of emissions reductions on farming operations so that dairy/livestock farmers have opportunities to participate in climate exchange markets and sell offset credits as an additional revenue source; and use growth chambers to study climate change to determine both current and predicted future environmental conditions.

Results
Saturated fatty acids(FA) reduce enteric methane emissions of diary cows, but sometimes also reduce dry matter intake and milk yield. A study comparing effects and exploring possible mechanisms associated with feeding saturated FA on lactational performance of early lactation Holstein cows showed that cows on a diet with no added fat had the greatest DMI. Dietary fat

source with greater chain length (Energy Booster 100) increased DMI linearly for multiparous cows, but in a quadratic fashion for primiparous cows. In a related study, coconut oil, although resulting in significant reductions in enteric methane emissions of lactating dairy cows does not appear to be a likely candidate for dietary use because of quite marked reductions in feed intake, milk yield and milk fat concentration.

Research to better understand the invasion process of garlic mustard has shown that the success of its invasion depends upon the match between the genotype that happens to make it to the area and the other organisms present. This finding may help prevent future adverse invasions and aid in ensuring the success of intentional introductions for production agriculture or biological control.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
132	Weather and Climate
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity

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
2011	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nearly one-tenth of all human-induced greenhouse gas emissions in the United States are caused by agriculture, according to the U.S. Global Change Research Program. Meanwhile, the world population has more than doubled in the past 50 years and is still increasing by 75 million people per year, according to the U.N. Food and Agriculture Organization. Thus, reducing

agriculture's carbon footprint will be essential as the system adapts to meet the needs of growing numbers of people.

What has been done
Research to: identify strategic microsites for promoting soil carbon sequestration; evaluate field level fluxes of nitrous oxide in row-crop systems; establish effective green roof systems; optimize protein and amino acid utilization of non-ruminant species as it relates to growth, performance and lactation; and evaluate dietary and post-excretion strategies as tools for air emission mitigation from livestock facilities.

Results
Research to identify strategically located micro-niches, which aid in the sequestering of carbon and strenghten soil aggregates showed that Flavobacterium spp. are likely responsible for the accelerated erosion of native soil aggregates and contribute to the loss of organic carbon from soils.

In green roof research over the past 5 years, 20 green roof test plots on the MSU Plant and Soil Sciences Building have been analyzed to determine how much carbon the roof system's plants and soil are storing. Results show that, if all the commercial and industrial roofs in metropolitan Detroit had green roofs similar to these plots, they could sequester approximately 55,252 metric tons of carbon. That's similar to removing more than 10,000 midsized SUVs or trucks off the road for a year.

Research to assess the overall impact of farming activities on atmosphere chemistry shows that NO2 production continues to be the largest single source related to global warming potential in all annual crop ecosystems. The NO2 fluxes across 9 different fertilization levels showed a non-linear response of NO2 flux to fertilizer inputs regardless of crop (corn vs. wheat). CH4 oxidation is affected by fertilization but not by tillage in non-cropped sites. In cropped sites, CH4 oxidation is already low and not further affected by tillage or N fertilizer. These and other results offer significant promise for reducing the GWP of agricultural systems.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
133	Pollution Prevention and Mitigation

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
2011	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Higher water temperatures and changes in the timing, intensity and duration of precipitation can affect water quality. Higher temperatures reduce dissolved oxygen levels, which can have an effect on aquatic life. Higher temperatures could also increase the risk of drought. Flood magnitudes and frequencies will very likely increase in most regions which can affect water quality, as large volumes of water can transport contaminants into water bodies and also overload storm and wastewater systems. Further, changes in water quality could have implications for all types of uses, including the recreational use of lakes and rivers and the productivity of freshwater fisheries. Research addressing these issues is critical to sustaining our water resources and aquatic life.

What has been done
Research to: determine the impact of global warming on the water budget of the Great Lakes region; investigate the consequences of globalization on fisheries and aquatic resources and its influence on current and future approaches of fisheries governance systems, as well as the global impacts on fisheries and aquatic resources associated with climate change; and to quantify the effects of land use/cover and climate changes on lake hydrology, chemistry and biology - the most important spatial scale for detecting effects -- and examine the complex interactions between the two stressors.

Results
A suite of regional climate models (RCMs) have been developed for the Great Lakes region. Various studies have assessed RCM performances for different regions of the world, but none have focused on the Great Lakes region. Results from these RCM simulations will be used to understand the impact of global changes on the Great Lakes water budget. Knowing what to expect in precipitation and other variables will allow for the development of adaptive strategies to help growers maximize crop productivity in a changing climate, while natural resource managers can use the information in their daily decision making.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #4

1. Outcome Measures

Number of producers trained in responding to 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
2011	680

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Managing Risk associated with climate variability & change is critical in both sustaining agriculture in Michigan.

What has been done
MSUE has implemented workshops and webinars to educate farmers and producers about using weather modeling in making better decisions.

Results
An evaluation found that 78% of respondents (representing 56,316 acres) will reference weather modeling to make management decisions in the future.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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:

- In green roof research over the past 5 years, 20 green roof test plots on the MSU Plant and Soil Sciences Building have been analyzed to determine how much carbon the roof system's plants and soil are storing. Results show that, if all the commercial and industrial roofs in metropolitan Detroit had green roofs similar to those at MSU, they could sequester approximately 55,252 metric tons of carbon. That's similar to removing more than 10,000 midsized SUVs or trucks off the road for a year.
- A suite of regional climate models (RCMs) have been developed for the Great Lakes region. Various studies have assessed RCM performances for different regions of the world, but none have focused on the Great Lakes region. Results from these RCM simulations will

be used to understand the impact of global changes on the Great Lakes water budget. Knowing what to expect in precipitation and other variables will allow for the development of adaptive strategies to help growers maximize crop productivity in a changiong climate, while natural resource managers can use the information in their daily decision making.

• Research to identify strategically located micro-niches, which aid in the sequestering of carbon and strenghten soil aggregates found that Flavobacterium spp. are likely responsible for the accelerated erosion of native soil aggregates and contribute to the loss of organic carbon from soils.

MSUE's Agriculture Work Team's evaluation found:

• 71 new risk management strategies were adopted to insure economic viability and growth of their businesses.

• 45 participants gained knowledge about the role of crop insurance as a tool to recover from weather risks

• 563 farms increased their compliance to federal and state legislation

• 4077 participants gained sound horticulture production practices for efficiency and reduction of input of chemicals into the environment

• 66 landowners and loggers that gained knowledge of natural resource stewardship

Key Items of Evaluation

Key items from evaluations:

• In green roof research over the past 5 years, 20 green roof test plots on the MSU Plant and Soil Sciences Building have been analyzed to determine how much carbon the roof system's plants and soil are storing. Results show that, if all the commercial and industrial roofs in metropolitan Detroit had green roofs similar to those at MSU, they could sequester approximately 55,252 metric tons of carbon. That's similar to removing more than 10,000 midsized SUVs or trucks off the road for a year.

• A suite of regional climate models (RCMs) have been developed for the Great Lakes region. Various studies have assessed RCM performances for different regions of the world, but none have focused on the Great Lakes region. Results from these RCM simulations will be used to understand the impact of global changes on the Great Lakes water budget. Knowing what to expect in precipitation and other variables will allow for the development of adaptive strategies to help growers maximize crop productivity in a changiong climate, while natural resource managers can use the information in their daily decision making.

• Research to identify strategically located micro-niches, which aid in the sequestering of carbon and strenghten soil aggregates found that Flavobacterium spp. are likely responsible for the accelerated erosion of native soil aggregates and contribute to the loss of organic carbon from soils.

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Sustainable Energy

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		20%	
202	Plant Genetic Resources	0%		27%	
205	Plant Management Systems	12%		13%	
402	Engineering Systems and Equipment	0%		15%	
511	New and Improved Non-Food Products and Processes	75%		13%	
605	Natural Resource and Environmental Economics	13%		12%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	3.4	0.0	3.0	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**
151994	0	265854	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
151994	0	322214	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2282695	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The fundamental transformation of the nation's current extractive fossil fuel energy economy to a sustainable energy economy is a critical challenge facing the United States today. In Michigan, renewable energy can help provide the state with the economic base it needs to revitalize itself and to compete in today's global economic climate, while -- at the same time -- create a cleaner environment and reduce dependence on expensive imported fossil fuels.

Activities in this planned program include research 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; to develop biomass for use in biofuel production; to develop improved and novel biofuel crops and compounds; to design optimum forests and crops for bioenergy production; to develop management practices for bioenergy feedstock production systems; produce value-added biobased industrial and chemical products; and develop processes and technologies for biofuel, biomaterial and biomanufacturing production systems.

Extension priorities in this area are: training to help farmers learn about bioenergy crops as well as issues, barriers and opportunities in this area.

2. Brief description of the target audience

Agriculture and natural resource industry representatives, commodity groups, natural resource managers -- especially forest-related, biofuel/bioenergy producers, biotechnology company representatives, bioenergy entrepreneurs, state agencies -- including transportation, elected state and federal officials and other policy makers -- other researchers and academics, and the interested public.

3. How was eXtension used?

eXtension was used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	401	1600	0	0

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

Patent Applications Submitted

Year: 2011

Actual: 23

Patents listed

MICL01940 - Regulation of lipid metabolism in plants and algae; 61/389,883; 10/05/2010. MICL02184 - Regional biomass processing centers for sustainable biofuels and animal feeds; 110/DELNP/2012; 08/24/2010; 10814256.3; 08/24/2010; TEC2009-0052-01CA; 08/24/2010; TEC2009-0052-01BR; 08/24/2010; PCT/US2010/046525; 08/24/2010; 201110097994.X; 04/19/2011; 1148/DEL/2011; 04/19/2011; 2011201768; 04/19/2011; PI1101598-5; 04/19/2011; 11162906.9; 04/19/2011; MX/a/2011/004206; 04/19/2011; 2,737,704; 04/19/2011; 12/976,344; 12/22/2010; and PCT/US2011/033079; 04/19/2011. MICL02189/2166 - Bio-derived fuels and chemicals: facilitating development through property characterization; PCT/US2010/058787; 12/02/2010; 61/364,069. MICL01533 - Genetic engineering of oilseed crops; 13/039,018; 03/02/2011; PCT/US2010/062407; 12/29/2010. MICL02141 - Molecular insights into geobacter films; PCT/US2011/028807; 03/17/2011; 61/378,188; 08/30/2010; and 61/378.240; 8/30/2010. In addition, there were 7 patents awarded: MICL01940 - Regulation of lipid metabolism in plants and algae; 7,868,156; 01/11/2011. MICL02184 - Regional biomass processing centers for sustainable biofuels and animal feeds; PI9910017-7; 05/31/2011; 2007248736; 08/05/2010; and 7,915,017; 03/29/2011. MICL01533 - Genetic engineering of oilseed crops; 7,868,156; 01/11/2011; 7,932,433; 04/26/2011; and 7,915,480; 03/29/2011.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	14	14

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on sustainable energy.

Year	Actual
2011	14

Output #2

Output Measure

- Number of adults trained in sustainable energy.

Year	Actual
2011	401

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 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 efficiences 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 adults trained in sustainable bioenergy crop production.

Outcome #1

1. Outcome Measures

Number of research programs to identify and isolate novel genes, markers, mechanisms and 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
2011	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As sustainable energy becomes increasingly important to our future viability, it is critical to develop the necessary range of knowledge and technologies to use plants to produce chemical feedstocks and fuels with more renewable and more environmentally acceptable methods than current sources such as petrochemicals. To ensure success in this arena, an integrated plant molecular/genomics/bioinformatics/plant transformation approach needs to be developed for the production of biofuels and other biobased materials and products from crops.

What has been done
Research to: develop improved oilseed crops through the genetic engineering of metabolism; develop novel biofuel crops and algal strains suitable for the production of biofuel feedstocks; develop biochemical pathway mappings to create a pathway/genome database for each species; explore the thermochemical conversion of woody biomass to fuels and chemicals; develop innovative bioelectrocatalytic reactors that achieve mediated electron transfer to dehydrogenases; investigate how to manipulate target genes to control biofilm properties such as biomass and electricity potential; and produce a combination of chemical and biological transformation of levulinic acid to produce derivatives that will have important uses in the materials, pharmaceutical and general chemistry industry.

Results
Researchers discovered a gene that is responsible for the production of compounds known as acetyl glycerrides (acTAGs), which drive the production of a novel, high-quality oil in the seeds of burning bush. Since burning bush isn't a suitable oil crop, scientists isolated a gene responsible for acTAG production and inserted it into Arabidopsis to verify that it could be used in other plants. It succeeded. The lower viscosity of acTags show promise as a direct-use biofuel for some diesel engines and are also expected to perform better at lower temperatures than regular

vegetable oils, possibly making them suitable for conversion into diesel fuel.

Researchers have unraveled the mystery of how the bacterium, Geobacter sulferreducens, generates electricity while cleaning up nuclear waste and other toxic metals. They have identified the Geobacters' nanowires as being the primary catalyst for uranium reduction, and were then able to genetically engineer a Geobacter strain with enhanced nanowire production. The modified version improved the efficiency of the bacteria's ability to immobilize uranium and improved its viability as a catalytic cell. Patents have been filed, which could lead to the development of microbial fuel cells capable of generating electricity while cleaning up after environmental disasters.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Number of research programs to examine and improve efficiences 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
2011	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Use of crops for biofuels has developed rapidly in the United States since the U.S. Congress passed federal energy bills emphasizing biomass in 2005 and 2007. As petroleum reaches its practical limits, the importance of biomass as a transportation fuel feedstock will increase. For this reason, research focused on improving agricultural biomass production, biomass conversion in biorefineries, and biomass use is critical to laying the foundation for this emerging industry.

What has been done

Research to: develop practices for bioenergy feedstock production systems and marginal lands; develop new biofuel compounds; increase energy efficiency and promote alternative energy use in production agriculture; analyze the technical potential of biomass to provide biofuels in the United States without indirect land use change; model landscape design to provide both economic and environmental benefits; and develop effective strategies for grassland restoration in working landscapes.

Results

Research to examine the ecology of virus interactions with biofuel grasses found that, as grasses are selected for digestibility and growth rates, their susceptibility to viruses and attraction to sucking insects, such as aphids, increased. This finding points to the need for more systematic testing when selecting for traits for biofuels and a better understanding of what to watch for in vector or virus susceptibility.

Research to increase energy efficiency on animal and crop production farms, greenhouses and rural businesses in Michigan resulted in the training and certification of 19 auditors, with an empahasis on dairy farm energy management. Energy audits for 34 farms, six greenhouses and eight rural businesses were completed for a total projected energy savings of 65,000 MMBtu and a dollar savings of more than $2 million. In addition, 12 renewable energy assessments were conducted, resulting in a projected energy production of 1000 MMBtu at a projected revenue of $261,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes

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
2011	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The biobased economy will grow rapidly during the 21st century. For this reason, analysis efforts are needed to outline how this new industry can achieve both environmental and economic sustainability. For perhaps the first time, humanity can design and develop a new industry, the biorefining industry, to achieve both economic and environmental goals.

What has been done
Research to: conduct an economic and environmental evaluation of biofuels.

Results
Regional competitiveness of miscanthus and switchgrass under various scenarios of crude oil prices and farmer risk preferences was assessed using simulation techniques and the subsides required to enable biomass producers to break even on their costs. The results suggest that perennial energy crops yielding at least 10 tons per acre annually will be competitive with a traditional corn-soybean rotation if crude oil prices are high ($88-178 per barrel). If crude oil prices are low, energy crops will not be competitive with existing crops and additional subsidy support would be required.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Number of adults trained in sustainable bioenergy crop production.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	385

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Volatility in energy markets, a myriad of alternatives and environmental, economic and social impacts of renewable energy are not well understood by the public. Opportunities exist in agriculture to develop new products and new markets for crops and residues.

What has been done
The Work Team Bioproducts and Bioenergy from the Institute of Agriculture and Agribusiness developed programs that disseminated information on production and processing of renewable energy opportunities from agricultural sources.

Results
Of the 401 participants trained in this area, 385 (96%) gained knowledge in production and processing of renewable energy. The Work Team is continuously developing the programming for this area as well as the evaluation that accompanies it.

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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:

- Researchers have unraveled the mystery of how the bacterium, Geobacter sulferreducens, generates electricity while cleaning up nuclear waste and other toxic metals. They have identified the Geobacters' nanowires as being the primary catalyst for uranium reduction, and were then able to genetically engineer a Geobacter strain with enhanced nanowire production. The modified version improved the efficiency of the bacteria's ability to immobilize uranium and improved its viability as a catalytic cell. Patents have been filed, which could lead to the development of microbial fuel cells capable of generating electricity while cleaning up after environmental disasters.
- Research to increase energy efficiency on animal and crop production farms, greenhouses and rural businesses in Michigan resulted in the training and certification of 19 auditors, with an empahasis on dairy farm energy management. Energy audits for 34 farms, six greenhouses and eight rural businesses were completed for a total projected energy savings of 65,000 MMBtu and a dollar savings of more than $2 million. In addition, 12 renewable energy assessments were conducted, resulting in a projected energy production of 1000 MMBtu at a projected revenue of $261,000.
- Regional competitiveness of miscanthus and switchgrass under various scenarios of crude oil prices and farmer risk preferences was assessed using simulation techniques and the subsides required to enable biomass producers to break even on their costs. The results suggest that perennial energy crops yielding at least 10 tons per acre annually will be competitive with a traditional corn-soybean rotation if crude oil prices are high ($88-178 per barrel). If crude oil prices are low, energy crops will not be competitive with existing crops and additional subsidy support would be required.

Due to this is a new initiative, Extension evaluation is limited in this are with the few findings reported above under outcome.

Key Items of Evaluation

Key items from evaluations:

- Researchers have unraveled the mystery of how the bacterium, Geobacter sulferreducens, generates electricity while cleaning up nuclear waste and other toxic metals. They have identified the Geobacters' nanowires as being the primary catalyst for uranium reduction, and were then able to genetically engineer a Geobacter strain with enhanced nanowire production. The modified version improved the efficiency of the bacteria's ability to immobilize uranium and improved its viability as a catalytic cell. Patents have been filed, which could lead to the development of microbial fuel cells capable of generating electricity while cleaning up after environmental disasters.
- Research to increase energy efficiency on animal and crop production farms, greenhouses and rural businesses in Michigan resulted in the training and certification of 19 auditors, with an empahasis on dairy farm energy management. Energy audits for 34 farms, six greenhouses and eight rural businesses were completed for a total projected energy savings of 65,000 MMBtu and a dollar savings of more than $2 million. In addition, 12 renewable energy assessments were conducted, resulting in a projected energy production of 1000 MMBtu at a projected revenue of $261,000.

- Regional competitiveness of miscanthus and switchgrass under various scenarios of crude oil prices and farmer risk preferences was assessed using simulation techniques and the subsides required to enable biomass producers to break even on their costs. The results suggest that perennial energy crops yielding at least 10 tons per acre annually will be competitive with a traditional corn-soybean rotation if crude oil prices are high ($88-178 per barrel). If crude oil prices are low, energy crops will not be competitive with existing crops and additional subsidy support would be required.
- **The following are some examples of the evaluation results of the Institute for Greening Work Team:** Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

Research to increase energy efficiency on animal and crop production farms, greenhouses and rural businesses in Michigan resulted in the training and certification of 19 auditors, with an empahasis on dairy farm energy management. Energy audits for 34 farms, six greenhouses and eight rural businesses were completed for a total projected energy savings of 65,000 MMBtu and a dollar savings of more than $2 million. In addition, 12 renewable energy assessments were conducted, resulting in a projected energy production of 1000 MMBtu at a projected revenue of $261,000. Research to increase energy efficiency on animal and crop production farms, greenhouses and rural businesses in Michigan resulted in the training and certification of 19 auditors, with an empahasis on dairy farm energy management. Energy audits for 34 farms, six greenhouses and eight rural businesses were completed for a total projected energy savings of 65,000 MMBtu and a dollar savings of more than $2 million. In addition, 12 renewable energy assessments were conducted, resulting in a projected energy production of 1000 MMBtu at a projected revenue of $261,000.

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Childhood Obesity

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
703	Nutrition Education and Behavior	40%		35%	
724	Healthy Lifestyle	45%		32%	
801	Individual and Family Resource Management	5%		16%	
802	Human Development and Family Well-Being	10%		17%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	12.0	0.0	1.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
533631	0	106342	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
533631	0	128885	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	913078	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The U.S. childhood obesity rate -- now 17 percent -- has more than tripled during the past 35 years. Overweight kids have a 70 to 80 percent chance of becoming overweight adults. In Michigan, almost two out of three Michigan residents are overweight or obese.

To address these challenges, research was undertaken to: disseminate 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; identify and document environmental and cultural influesnces on health behaviors contributing to overweight and obesity in children that can be shared with individuals, families and communities; and develop effective community-based environmental and policy supports for physical activity and healthy eating.

Extension activities include: training for both youth and adults regarding the recommendations from the food guide pyramid on protions and the variety of food that should be eaten, training for youth on physical exercise and coping strategies to improve social/emotional health.

2. Brief description of the target audience

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

3. How was eXtension used?

eXtension was used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger
- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4521	12563	13159	0

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

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	1	6	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on childhood obesity.

Year	Actual
2011	6

Output #2

Output Measure

- Number of youth trained in controlling food portions.

Year	Actual
2011	13157

Output #3

Output Measure

- Number of adults trained in controlling food portions.

Year	Actual

2011	4521

Output #4

Output Measure

- Number of youth trained in healthy physical activity.

Year	Actual
2011	2159

Output #5

Output Measure

- Number of youth trained in positive coping skills.

Year	Actual
2011	356

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 diet 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 youth trained in controlling food portions.
5	Number of adults trained in controlling food portions.
6	Number of youth trained in healthy physical activity.
7	Number of youth trained in positive coping skills.

Outcome #1

1. Outcome Measures

Number of research programs that address obesity and diet quality, and diet 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
2011	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overweight children 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. 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 eating behavior.

What has been done
Research to: develop and implement an intervention to improve nutrition screening/participatory guidance regarding age-appropriate food behaviors to optimize nutrition and reduce risk for childhood obesity; examine and identify the current nutrition assessment protocols and dietary guidance practiced by pediatric residents and other healthcare providers; and determine the effets of food marketing practices targeting children on dietary attitudes and behaviors.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

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
2011	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Americans are heavier than ever. According to the Centers for Disease Control and Prevention, obesity now affects about one-third of the U.S. population. Researchers cite diets of calorie-dense but nutrient deficient food, increasingly sedentary lifestyles and public planning strategies that favor motorists over walkers and cyclists as significant causes of what is being called an obesity epidemic. To help address this issue, researchers are teaming up with a variety of state and community partners to help make it easier for people to be physically active and eat healthier.

What has been done
Research to: investigate the associations between proximity of fast food restaurants and convenience stores, and school rates of overweight children; assist schools, state and community-based groups, agencies and organizations with policy and environmental changes and nutrition and physical education programs to make it easier for children and adults to eat healthier and be physically active; and evaluate interventions for schools that facilitate positive education, policy and environmental change for improved nutrition and physical activity among children.

Results
Nearly six out of 10 Michigan residents live in a place that has inadequate access to the food necessary for a healthy daily diet. Proposed solutions to this disparity, and others like it, are outlined in a first-of-its-kind document, the Good Food Charter. The charter identified six goals to be achieved by 2020 and describes 25 ways to reach these goals, including details on how to improve school meals and access to healthy foods in underserved areas.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

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
2011	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity is directly associated with an increased risk of cancer at several organ sites, including the colon. Some 149,000 Americans will be diagnosed with colon cancer and 50,000 will die from it this year, according to the AmMerican Cancer Society. More than 1 million people have been diagnosed with colon or rectal cancer in the United States, the National Cancer Institute reported, making the issue of obesity and cancer a priority for the health of the nation.

What has been done
Research to: identify approaches and interventions to reduce the systemic inflammation associated with obesity to help prevent obesity-related cancer.

Results
MSU scientists were among the first to demonstrate that high levels of leptin, a key hormone in fat tissue, can promote tumor growth and progression. Research showed that leptin induces precancerous colon cells to produce more of a growth factor that can increase blood supply to cancer cells. Before the MSU finding, obesity had been identified as a significant risk factor in diabetes and heart disease, but its role in cancer was much less defined. The findings were widely publicized.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

724 Healthy Lifestyle

Outcome #4

1. Outcome Measures

Number of youth trained in controlling food portions.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	6842

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.

What has been done
By having nutrition education staff throughout the State, Michigan State University Extension?s Health and Nutrition Institute is well positioned to address issues of obesity. The Nutrition and Physical Activity (NPA) workgroup is one of the four workgroups of the Health and Nutrition Institute (HNI) at the Michigan State University Extension (MSUE). The main goals of the NPA are (1) to improve dietary quality of children, youth, adults, and seniors; and (2) to increase physical activity of children, youth, adults, and seniors. Both goals, improving dietary quality and increasing physical activity, are mediums for obesity prevention and healthy weight maintenance.

Results
Results from evaluation surveys administered to children who participated in youth programming with curricula such as Healthy Classrooms- Healthy Schools, Show Me Nutrition, and JIFF found:
?27% of children from kindergarten to second grade reported an increase in the frequency in which they drink milk or eat cheese at least two times a day.
?24% of children from third to fifth grade reported an increase in the frequency in which they choose healthy snacks when they have the choice.
?24% of children from third to fifth grade reported an increase in the frequency in which they eat fruits or drink real fruit juice every day.
?32% of children from sixth to eighth grade reported an increase in the frequency in which they choose healthy snacks when they have the choice

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Number of adults trained in controlling food portions.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	3978

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As parents go, so do the children. Health and nutrition programs target whole families with healthy recipes, proper serving guidelines, access to fruits and vegetables, and physical exercise.

What has been done
MSUE implemented health and nutrition program statewide.

Results
For example, during the fiscal year 2010-2011, the programs at Saginaw and Genesee counties saw the following results:
?48% of adults completing the series demonstrate adoption of healthy eating practices by reporting an increase in fruits consumption during a typical day.
?50% of adults completing the series demonstrate adoption of healthy eating practices by reporting an increase in vegetable consumption during a typical day.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

724 Healthy Lifestyle

Outcome #6

1. Outcome Measures

Number of youth trained in healthy physical activity.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	2159

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Physical activity is critical to the health and well being of children and adults. More encouragement and opportunity to be physically active is needed for most people, especially people with a disposition to be overweight.

What has been done
MSUE has expanded many of its nutrition program (and other programs as well) to include more physical activities as well as education about the importance of both good eating habits and exercise.

Results
Evaluations of participating children and youth found that 42% changed their physical activity away from the program (i.e., at home, after school programs, etc.)

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

Outcome #7

1. Outcome Measures

Number of youth trained in positive coping skills.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

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.

Social-emotional health and well-being involves the social, mental, psychological and spiritual aspects of an individual?s life across the lifespan. This includes forming and maintaining satisfying and healthy relationships, taking another?s perspective, resolving interpersonal conflict, feeling capable and whole, expressing emotions, navigating stress, having supportive relationships, and having a positive sense of self ? including developing a healthy sense of identity around aspects related to race and ethnicity, gender, sexuality, spirituality and abilities/disabilities. As is true for all aspects of human development, social-emotional well-being must be addressed across multiple levels, including the personal, interpersonal, institutional and cultural levels.

MSU Extension has an important role to play in addressing issues of youth violence through community-based educational programs for adults who care for and work with youth. The overarching goal of these efforts 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.

What has been done
During 2011, six MSU Extension Educators in the Health and Nutrition Institute working under the Social Emotional Health and Well-Being Work Team, provided evidence- based educational series Community Based Nurturing Parenting (Stephen Bavolek). This 6-10 week group series focuses on guiding parents on the nurturing philosophy, positive ways to deal with stress and anger, infant/toddler development, brain development, communicating with respect, understanding feelings, building self worth and praising children, understanding family morals, values, rules, and alternatives to spanking.

Results
During 2011, we correlated two PFS constructs with outcomes and indicators in the HNI-SE work team logic model. The results showed that there was a 48.28% improvement in 42 out of 87 participants assessed in the Nurturing and Attachment construct. In addition, 40 out of 98 participants assessed showed a 40.82% improvement in the Family Functioning and Resiliency construct.

The evaluation method used for the Community Based Nurturing Parenting was The Protective Factors Survey, developed by theFRIENDSNationalResourceCenter. The reliability of each construct of the PFS has been estimated using an internal-consistency measure of reliability. Cronbach?s coefficient alpha. Constructs measured in the PFS include Family Functioning and Resiliency, Social Supports, Concrete Supports and Nurturing and Attachment.

The Nurturing and Attachment construct is defined as the emotional tie along with a pattern of positive interaction between parent and child that develops over time. This correlated to the HNI SE Action Outcome and Indicator as follows: HN4-AD1 (Action Outcome) Improve ability to respond to one?s own social-emotional needs and the social-emotional needs of others and HN4-AD1-I1 (Action Indicator) the extent to which they recognize and respond to their own needs.

The Family Functioning and Resiliency construct is defined as having adaptive skills and strategies to persevere in times of crisis and the family?s ability to openly share positive and negative experiences and mobilize to accept, solve and manage problems. This correlated with the HNI SE Learning Outcomes and Indicators as follows: HN4-LD1 (Learning Outcome) Improved knowledge about the qualities of healthy and unhealthy relationships and HN4-LD1-l2 (Learning Indicator) the extent to which they can identify negative/abusive relationship behaviors.

4. Associated Knowledge Areas

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

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

Brief Explanation

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - 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 intiatives; 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:

• Nearly six out of 10 Michigan residents live in a place that has inadequate access to the food necessary for a healthy daily diet. Proposed solutions to this disparity, and others like it, are outlined in a first-of-its-kind document, the Good Food Charter. The charter identified six goals to be achieved by 2020 and describes 25 ways to reach these goals, including details on how to improve school meals and access to healthy foods in underserved areas.

• MSU scientists were among the first to demonstrate that high levels of leptin, a key hormone in fat tissue, can promote tumor growth and progression. Research showed that leptin induces precancerous colon cells to produce more of a growth factor that can increase blood supply to cancer cells. Before the MSU finding, obesity had been identified as a significant risk factor in diabetes and heart disease, but its role in cancer was much

less defined. The findings were widely publicized.

• In a pilot test (n=42 parents)for a newly developed home feeding intervention for resource-limited parents of 3-5 year old children, interventions parents rated the program favorably, with a majority agreeing/strongly agreeing that the program was beneficial (94%), suggested good ways to handle problems (81%) and was effective in changing mealtimes (94%).

Extension evaluative results -- Evaluations of Extension activities are done regularly using a variety of approaches that are based on the Insitute Work Team logic models and evaluation plans.

The following are some examples of the evaluation results of the Institute for Children and Youth and Institute of Health and Nutrition Work Teams:

- 1220 children and youth made healthy life choices
- 103 children decreased risky behavior
- 3740 youth demonstrated use of life skills
- 44414 children and youth increased their knowledge about healthy eating
- 8637 children and youth increased their knowledge about physical health
- 198 youth learn to recognized and responded to their own needs
- 212 youth learn to recognized and responded to the needs of others

Key Items of Evaluation

Key items from evaluations:

• Nearly six out of 10 Michigan residents live in a place that has inadequate access to the food necessary for a healthy daily diet. Proposed solutions to this disparity, and others like it, are outlined in a first-of-its-kind document, the Good Food Charter. The charter identified six goals to be achieved by 2020 and describes 25 ways to reach these goals, including details on how to improve school meals and access to healthy foods in underserved areas.

• MSU scientists were among the first to demonstrate that high levels of leptin, a key hormone in fat tissue, can promote tumor growth and progression. Research showed that leptin induces precancerous colon cells to produce more of a growth factor that can increase blood supply to cancer cells. Before the MSU finding, obesity had been identified as a significant risk factor in diabetes and heart disease, but its role in cancer was much less defined. The findings were widely publicized.

• In a pilot test (n=42 parents)for a newly developed home feeding intervention for resource-limited parents of 3-5 year old children, interventions parents rated the program favorably, with a majority agreeing/strongly agreeing that the program was beneficial (94%), suggested good ways to handle problems (81%) and was effective in changing mealtimes (94%).

• Being the first year for the Institute Work Teams, evaluation results were used for program improvement, refinement of evaluation tools and changes to logic models and plans of work.

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Food Safety

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment	0%		15%	
404	Instrumentation and Control Systems	0%		6%	
501	New and Improved Food Processing Technologies	36%		20%	
502	New and Improved Food Products	2%		25%	
503	Quality Maintenance in Storing and Marketing Food Products	11%		10%	
701	Nutrient Composition of Food	0%		3%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	12%		8%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	39%		9%	
723	Hazards to Human Health and Safety	0%		4%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	7.3	0.0	5.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
322923	0	478538	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
322923	0	579985	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4108850	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Each year, about 76 million people in the United States get sick from contaminated food. According to the U.S. Food an Drug Administration's Bad Bug Book, more than 50 bacteria, viruses, parasites and toxins are considered food-borne pathogens.

In an effort to help improve food processing technologies and minimize the risk of food-borne illness, efforts in this area include research to: ensure microbial safety of foods; develop effective biosensors, RFID tags and other technologies for track, trace and security issues; develop sustainable packaging 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.

Extension activities include: assisting producers with improving the quality of their food and food safety issues as food is sent to markets and stores; training food handlers from restaurants and farmers' markets on food safety issues; and teaching children/youth about proper hand washing.

2. Brief description of the target audience

Food safety professionals, consumers, public health and other state agency representatives, risk assessors, commodity groups, agricultural producers (crop and livestock), food chain supply industry representatives, retail food stores, restaurants and farmers' market collaboratives and associations, and other researchers and academics.

3. How was eXtension used?

eXtension was used in all program areas in this report. Due to limitations of the data and reports at this time, only total site visits (53,175 visits, 132,406 total pageviews, 2.49 pageviews per visit, and 511 total cities) and total questions resolved (1,418) can be reported. Using membership lists from Communities of Practice (CoP) consisting of 153 members, estimates for each plan in this report have been created.

- 52 in 1. Human Health, Environment, Family, Youth, Society and Community
- 18 in 2. Soil, Water and Natural Resources
- 17 in 3. Plant Sciences
- 11 in 4. Economics, Marketing and Policy
- 30 in 5. Animal Production and Protection
- 2 in 6. Global Food Security and Hunger

- 3 in 7. Climate Change
- 10 in 8. Sustainable Energy
- 6 in 9. Childhood Obesity
- 4 in 10. Food Safety

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	624	1872	11253	0

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

Patent Applications Submitted

Year: 2011

Actual: 4

Patents listed

MICL02007 - Development of nano-structured biosensors for rapid detection of disease-causing agents in food and water: 61/519,442; 05/23/2011; 13/068,427; 05/11/2011; 61/365,551; 07/19/2010; and 61/519.468; 05/23/2011.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	24	24

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on food safety.

Year	Actual
2011	22

Output #2

Output Measure

- Number of producers trained on federal and state legislation regarding food safety.

Year	Actual
2011	563

Output #3

Output Measure

- Number of front-line food handler staff trained on how to reduce cross-contamination.

Year	Actual
2011	57

Output #4

Output Measure

- Number of front-line food handler staff trained in proper cooking temperatures and storing processes.

Year	Actual
2011	94

Output #5

Output Measure

- Number of youth trained on hand washing practices.

Year	Actual
2011	11253

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 research programs to develop more effective harvest and post-harvest protocols and practices to minimize loss and enhance 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 are trained on food safety issues.
8	Number of producers that are trained on federal and state legislation regarding food safety.
9	Number of front-line food handler staff trained on how to reduce cross-contamination.
10	Number of front-line food handler staff trainer in proper cooking temeratures and storing processes.
11	Number of youth trained 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
2011	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 76 million food-borne illnesses occur each year in the United States, accounting for 325,000 hospitalizations and 5,000 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: combine the novelty of nanoscale transducing material and biosensing techniques to address the detection and diagnostic challenges in food and water safety; investigate using radio frequency identification in tracking, tracing and security issues related to the movement of goods through the food supply chain; and to synthesize, characterize and evaluate nanostructured interfaces that enable molecular level investigations of systems of medical, scientific and technological interests.

Results
Research to improve the mass transfer of hydrogen to catalytic surfaces has resulted in enhancements in high yield and selectivity under much milder reaction conditions than typically reported with the combination of nanocatalysts with microfluidics. The turnover frequencies of reactions in the microfluidic reactor were hundreds of times higher than those measured in identical reactions in batch reactors. The combination of well-defined nanocatalysts and microfluidics provides an excellent platform for high throughput screening of catalysts, and for conducting mechanistic studies of reaction kinetics.

A new MSU company was formed to develop and commercialize an inexspensive test for

handheld biosensors to detect a broad range of threats, such as E. coli, Salmonella, anthrax and tuberculosis. A significant leap forward in detection and diagnostic technology, it utlizies novel nanoparticles with magnetic, polymeric and electrical properties developed by an MSU AgBioResearch scientist. The unique preparation, extraction and detection protocol enables the entire process to be conducted in the field without significant training.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

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
2011	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Each year, about 76 million people in the United States get sick from contaminated food. More than 50 bacteria, viruses, parasites and toxins are considered food-borne pathogens, including the "Big Three" of bacterial food contaminants: Listeria monocytogenes, Salmonella and E. coli O157:H7. Microbial testing aimed at ensuring the safety of food products is very important for producers and processors in order to avoid consumer health issues linked to the ingestion of food-borne pathogens.

What has been done
Research to: develop strategies to enhance the safety, quality and shelf-life of ready-to-eat foods, with a focus on the transfer of E.coli O157:H7 during commercial processing of leafy greens; assess the risk of humans to mycotoxins via food-borne and air-borne exposure and develop appropriate mitigation strategies to protect human and animal health; increase the understanding of the mechanisms and dynamics of antimicrobial resistance transmission between humans,

animals and the environment; identify the mechanisms by which probiotic bacteria exert their beneficial effects when ingested by host animals; understand the process of E. coli chromosomal DNA replication and its regulation at the biochemical level; and help prevent liver cancer by limiting human exposure to aflatoxin in food.

Results
Research to elucidate the mechanisms by which probiotic bacteria exert their benefical effects when ingested by host animals has resulted in significant progress related to the functional genomics of probiotic Lactobacilllus reuteri. Scientists have continued to optimize recombineering in L. reuteri and Lactoccus lactis and now have the ability to change individual base pairs in the genome without the need for antibiotic selection. In addition, studies showed that L. reuteri was capable of protecting mice from lethal challenge of E. coli O157:H7 and demonstrated that L. reuteri has potent anti-inflammatory activity that is modulated by the composition of the bacterial membrane. These advances have led to new areas of research in how L. reuteri affects health and disease.

Research to assess the risk of humans to mycotoxins via food-borne and air-borne exposure and develop appropriate mitigation strategies to protect human and animal health showed that the common foodborne pathogen trichothecene deoxynivalenol (DON) induced anorexia in a mouse model within 2 hours of expsoure via injection or orally. This model will prove useful in characterizing DON-induced anorexia and should be applicable to elucidating mechanisms underlying this adverse nutritional effect.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

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
2011	3

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 term of the containers themselves, use of a resuable 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 package systems that optimize the utilization of raw materials; develop and use new types of packaging systems for fruits and vegetables; and to identify new approaches for decontaminating and improving the quality of fresh and fresh-cut produce.

Results
Research to evaluate, develop and implement sustainable packaging systems resulted in the development of functional membranes to fight long-standing packaging challenges such as antimicrobial and/or antioxidant capabilities. Antimicrobial and antioxidant structures were designed to release compounds in contact with food when they are most needed in order to reduce spoilage and extend shelf life. These findings have already generated three filed patents.

Research to establish the degree of efficacy of ClO2 gas applications for fresh leafy greens and tomatoes has shown that increasing release spots per bag or maximizing gas releasing area improves inactivation efficacy of antimicrobial gas inside the package. The use of ClO2 gas in packaging systems with optimal design could be an effective component in a hurdle strategy to compliment the sanitation process that takes place in the production line.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

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
2011	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasing numbers of domestic livestock and more resource-intensive production methods are encouraging animal epidemics around the world --a problem that is particularly acute in developing countries, where livestock diseases present a growing threat to the food security of already vulnerable populations. Further, the economic impacts of zoonotic diseases are enormous. For example, the World Bank estimates that if avian influenza becomes transmissible from human to human, the potential cost of a resulting pandemic could be US$3 trillion. These issues require substantial research investment and thinking through the health effects of agricultural intensificiation to control epidemics that are decimating herds and endangering humans.

What has been done
Research to: better understand the microbial ecology of the rumen and gastrointestinal tract of livestock; detect emerging or re-emerging infectious diseases in livestock and poultry; develop sound and economical control and prevention strategies for bovine viral diarrhea virus; determine the efficacy of antibacterial drugs as a therapy for clinical mastitis; develop and enhance the efficacy and technology of Gram-negative bacterins; and to measure the rates of the natural transformation of antibiotic resistance and virulence genes in chickens.

Results
Research has shown that Borax works well in reducing hydrogen sulfide emissions in swine manure. In addition, boron is an essential micronutrient for plants that is often added to commercial fertilizers. The soils in Michigan are deficient in boron, so by adding boron though the manure, the nutritional value of the manure for crops is enhanced.

In research related to the immune response against Mycobacterium bovis, the causal agent of the re-emerging bovine tuberculosis, a disease predictor model was developed and used on blood samples obtained from 48 cattle of known infection status, 20 cattle infected with TB and 28 cattle not infected but showing false positive reactors on diagnostic tests for bovine TB. The sensitivty of the model was 93% for detection of infected cattle, and the specificity was 95% for correctly identifying non-infected cattle that had been classified as suspect reactors.

4. Associated Knowledge Areas

KA Code	Knowledge Area

502	New and Improved Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	6

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, contamination, spoilage, insects or rodents takes on a greater importance as world food demand grows. Cutting post-harvest losses could add a sizable quantity to the global food supply and reduce the need to intensify in the future. Estimates of total post-harvest food loss are controversial and range widely, generally from about 10 percent to as high as 40 percent.

What has been done
Research to: develop innovative processing that adds value to fresh or processed meats; develop harvest/post-harvest technology to help the fruit, vegetable and chestnut industries remain economically and environmentally sustainable; enhance the value of dairy and dairy-based products; identify protein markers that are indicators for soft wheat processing quality; develop improved methods for the design and operation of thermal processing systems for protein foods; and to help increase the economic value of foods through application of traditional and advanced technologies.

Results
Sage, alfalfa and sourwood honey were compared to sucrose, high fructose corn syrup and inulin as to their ability to support growth, activity and viability of traditional yogurt cultures and probiotic organisms. It was found that all of the sweeteners studied are suitable to produce yogurts with adequate numbers of viable organisms consistent with the recommended doses for ingesting probiotics to receive their health benefits.

Research to identify flour proteins for their potential relationships to cake-, cookie, and cracker-baking qualities found that a stronger protein flour was shown to be more desirable for crackers than for cakes and cookies.

Researchers have recently constructed an instrument to measure the thermal properties of food heated at elevated temperatures. Partnering with researchers from other areas of expertise, they have also helped analyze the impact that heating has on destroying E. coli K-12 in meat and determined methods to extend the shelf life of cherry juice concentrate, a high-value processed product.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
701	Nutrient Composition of Food

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
2011	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Researchers have, for many years, noted the nutrient deficiencies associated with cases of impaired immune response and a tendency to infectious disease. The problem of under-nutrition affecting immune system response is not limited to the malnutrition typically found in developing countries. The elderly, people with eating disorders, alcoholics, persons with certain diseases, and premature and small-for-gestational-age babies may have immune system problems related to nutrient status. The better we can understand the metabolism and function of nutrients and

their role in immune response, the more effective preventive and intervention strategies can be.

What has been done
Research to: determine the effects of dietary zinc on the immune response.

Results
Research on dietary zinc and its effect on the immune response continues to demonstrate a role for hormone and hormone-like molecules in forms of malnutrition such as zinc deficiency and protein calorie deficiency. Leptin, which controls feeding behavior, was found to be high in malnutrition being also essential for the development of lymphocytes, neutrophils and moncytes in the bone marrow. The latter is an important and novel new finding offering therapeutic possibilities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

Outcome #7

1. Outcome Measures

Number of producers that are trained on food safety issues.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Number of producers that are trained on federal and state legislation regarding food safety.

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Number of front-line food handler staff trained on how to reduce cross-contamination.

Not Reporting on this Outcome Measure

Outcome #10

1. **Outcome Measures**

Number of front-line food handler staff trainer in proper cooking temeratures and storing processes.

Not Reporting on this Outcome Measure

Outcome #11

1. **Outcome Measures**

Number of youth trained on hand washing practices.

Not Reporting on this Outcome Measure

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

Although hopefully through the worst, the economic challenges being faced by Michigan continue to affect these programs -- particularly related to staffing levels -- due to budget cuts, funding reallocations, appropriations changes and competing public priorities. For example, in the last reporting year, a 15 percent funding cut resulted in a decrease of Hatch-funded faculty from 77 FTEs to 65 FTEs. Attrition and faculty departures also continue to have an impact on outcomes. Further, because of the inclusion of the five new national priorities in last year's report, many of the projected numbers in our original planned programs were revised and, as a result, were skewed significantly in some cases. This should largely be rectified after this year's reporting cycle, as the reports moving forward will reflect accurate numbers for all planned programs reported on

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research - As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism thorough 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 intiatives; 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:

- A new MSU company was formed to develop and commercialize an inexpensive test for handheld biosensors to detect a broad range of threats, such as E. coli, Salmonella, anthrax and tuberculosis. A significant leap forward in detection and diagnostic technology, it utlizies novel nanoparticles with magnetic, polymeric and electrical properties developed by an MSU AgBioResearch scientist. The unique preparation, extraction and detection protocol enables the entire process to be conducted in the field without significant training.
- Research to elucidate the mechanisms by which probiotic bacteria exert their benefical effects when ingested by host animals has resulted in significant progress related to the functional genomics of the probiotic, Lactobacilllus reuteri. Scientists have continued to optimize recombineering in L. reuteri and Lactoccus lactis and now have the ability to change individual base pairs in the genome without the need for antibiotic selection. In addition, studies showed that L. reuteri was capable of protecting mice from a lethal challenge of E. coli O157:H7 and demonstrated that L. reuteri has potent anti-inflammatory activity that is modulated by the composition of the bacterial membrane. These advances have led to new areas of research in how L. reuteri affects health and disease.
- Research to evaluate, develop and implement sustainable packaging systems resulted in the development of functional membranes to fight long-standing packaging challenges such as antimicrobial and/or antioxidant capabilities. Antimicrobial and antioxidant structures were designed to release compounds in contact with food when they are most needed to reduce spoilage and extend shelf life. These findings have already generated three filed patents.
- In research related to the immune response against Mycobacterium bovis, the causal agent of the re-emerging bovine tuberculosis, a disease predictor model was developed and used on blood samples obtained from 48 cattle of known infection status, 20 cattle infected with TB and 28 cattle not infected but showing false positive reactors on diagnostic tests for bovine TB. The sensitivty of the model was 93% for detection of infected cattle, and the specificity was 95% for correctly identifying non-infected cattle that had been classified as suspect reactors.
- Sage, alfalfa and sourwood honey were compared to sucrose, high fructose corn syrup and inulin for their ability to support growth, activity and viability of traditional yogurt cultures and probiotic organisms. It was found that all the sweeteners studied are suitable to produce yogurts with adequate numbers of viable organisms consistent with the recommended doses for ingesting probiotics to receive their health benefits.
- Research on dietary zinc and its effect on the immune response continues to demonstrate a role for hormone and hormone-like molecules in forms of malnutrition such as zinc deficiency and protein calorie deficiency. Leptin, which controls feeding behavior, was found to be high in malnutrition, being also essential for the development of lymphocytes, neutrophils and moncytes in the bone marrow. The latter is an important and novel new finding offering therapeutic possibilities.

Extension evaluative results -- Evaluations of Extension activities are done regularly

using a variety of approaches that are based on the Insitute Work Team logic models and evaluation plans.

The following are some examples of the evaluation results of the Institute for Health and Nutrition Teams:

- 2211 participants increased in hand washing practices
- 95 front-line food handler staff improved in cooking and storing temperatures
- 57 front-line staff reduced the risk of cross contamination.
- 986 participants (general audience) used proper processing techniques for low and high acid foods.

The following are some examples of the evaluation results of the Institute for Agriculture and Agribusiness Work Teams:

- 269 pre-emptive actions taken to prevent reduction in product quality and safety
- 1978 Michigan Citizens increased their attitudes and trust in the safety of locally grown food
- 550 producers participated in audits from food safety programs to address food safety issues.

The following are some examples of the evaluation results of the Institute for Greening Work Teams:

- 419 producers gained knowledge regarding food systems issues and opportunities

Key Items of Evaluation

Key items from evaluations:

- A new MSU company was formed to develop and commercialize an inexpensive test for handheld biosensors to detect a broad range of threats, such as E. coli, Salmonella, anthrax and tuberculosis. A significant leap forward in detection and diagnostic technology, it utlizies novel nanoparticles with magnetic, polymeric and electrical properties developed by an MSU AgBioResearch scientist. The unique preparation, extraction and detection protocol enables the entire process to be conducted in the field without significant training.
- Research to elucidate the mechanisms by which probiotic bacteria exert their benefical effects when ingested by host animals has resulted in significant progress related to the functional genomics of the probiotic Lactobacilllus reuteri. Scientists have continued to optimize recombineering in L. reuteri and Lactoccus lactis and now have the ability to change individual base pairs in the genome without the need for antibiotic selection. In addition, studies showed that L. reuteri was capable of protecting mice from a lethal challenge of E. coli O157:H7 and demonstrated that L. reuteri has potent anti-inflammatory activity that is modulated by the composition of the bacterial membrane. These advances have led to new areas of research in how L. reuteri affects health and disease.
- Research to evaluate, develop and implement sustainable packaging systems resulted

in the development of functional membranes to fight long-standing packaging challenges such as antimicrobial and/or antioxidant capabilities. Antimicrobial and antioxidant structures were designed to release compounds in contact with food when they are most needed to reduce spoilage and extend shelf life. These findings have already generated three filed patents.

• In research related to the immune response against Mycobacterium bovis, the causal agent of the re-emerging bovine tuberculosis, a disease predictor model was developed and used on blood samples obtained from 48 cattle of known infection status, 20 cattle infected with TB and 28 cattle not infected but showing false positive reactors on diagnostic tests for bovine TB. The sensitivty of the model was 93% for detection of infected cattle, and the specificity was 95% for correctly identifying non-infected cattle that had been classified as suspect reactors.

• Sage, alfalfa and sourwood honey were compared to sucrose, high fructose corn syrup and inulin as to their ability to support growth, activity and viability of traditional yogurt cultures and probiotic organisms. It was found that all the sweeteners studied are suitable to produce yogurts with adequate numbers of viable organisms consistent with the recommended doses for ingesting probiotics to receive their health benefits.

• Research on dietary zinc and its effect on the immune reposnse continues to demonstrate a role for hormone and hormone-like molecules in forms of malnutrition such as zinc deficiency and protein calorie deficiency. Leptin, which controls feeding behavior, was found to be high in malnutrition being also essential for the development of lymphocytes, neutrophils and moncytes in the bone marrow. The latter is an important and novel new finding offering therapeutic possibilities.