

2009 Michigan State University Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Michigan State University (MSU), the state's land grant institution, is charged with generating research-based knowledge and educational programs people can access to make informed decisions to improve their lives. The mission of the Michigan Agricultural Experiment Station (MAES) is to engage in innovative, leading-edge research that ensures the wise use of agricultural, natural and community resources and enhances the quality of life in Michigan, the nation and the world. MAES 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 MAES continues to be one of the most successful agricultural experiment stations in the country.

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 success and accomplishments of the MAES 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.

It is important to note that this report reflects only a portion of MAES and MSU Extension and not the whole breadth of research and educational initiatives. MAES' total budget for FY 2009 was \$114.42 million, with this report representing \$4.47 million in federal Hatch dollars and equivalent match.

MAES Research 2009 Quick Facts:

135 Hatch-funded researchers representing 89.5 FTEs

255 active projects

70 patent applications submitted

29 patents awarded

318 peer-reviewed publications

Key research accomplishments for FY 2009 include:

Breeding Bug-resistant Soybeans -- Soybean aphids have become the most damaging soybean pest in the north central United States. Thanks to MAES research, two aphid-resistant germ plasms -- E06902 and E07906-2 are now available and being used in commercial variety development. E07906-2 also shows resistance to Japanese beetle, another pest eating away at grower profits.

Eradicating BVDV One Herd at a Time -- Bovine Viral Diarrhea Virus (BVDV) is the most costly viral disease in today's U.S. cattle herds, costing about \$2 billion per year. MAES researchers have launched the Michigan Upper Peninsula BVDV Eradication Project, the first of its kind in the nation. To date, the number of verified BVDV -free animals tested through the program has reached approximately 20,000, and other states have already shown interest in this program.

Putting Freshwater Resources on the Map -- In addition to five Great Lakes, Michigan is home to more than 10,000 freshwater lakes larger than 5 acres, 30,000 miles of streams and almost 10,000 square miles of wetlands. MAES researchers are creating innovative tools for water managers in a landscape context so that their solutions consider interactions that take place at all scales, instead of looking at just one ecosystem. Tools developed to date include an inland lake classification system and statistical models for lake monitoring and assessment, and a landscape-based model to set standards for nutrient levels in lakes and streams.

Sorting, Scanning, Sniffing the Way to Less Chestnut Decay -- As demand for chestnuts increases, MAES scientists are helping the industry scale their production practices up from boutique to commercial. Research has found that CT scanning appears to give the most reliable information about internal chestnut structure, quickly and accurately informing producers as to whether a chestnut is good or rotten.

Jumping Genes Pack a New Look at Plant Evolution -- MAES researchers are studying transposable elements in plants -- known as jumping genes -- which have the ability to move around in the genome, potentially causing either beneficial or disruptive gene function. A specific type of jumping gene, known as a Pack-MULE is being studied in Arabidopsis, where it seems to promote flowering. This discovery could be used to regulate the growth of plants like petunias. Activating the Pack-MULE would allow growers to start plants later in the season, so greenhouses wouldn't have to be heated as long and growers would save money.

Using Bacterial Matchmaking to Create Fuel Cells -- MAES research has found that a specific bacterium, *Geobacter sulfurreducens* -- which lives in environments full of metal-- can produce electricity from waste fermentation products. To make this reaction larger, the *Geobacter* was paired with another type of bacterium that breaks down agricultural waste.

Using this couple, researchers designed a palm-sized microbial fuel cell that converts plant biomass into electrical power and produces cellulosic ethanol. They are now working to scale up the process.

Attracting More Sustainable Apple Production -- Fruit growers are increasingly battling the destructive codling moth pest through the use of mating disruption. Years of laboratory testing and analysis were expanded into a large, field-based test using 20 large cages built in an abandoned Michigan apple orchard. The lab-developed framework was validated and the result is two simple algebraic equations of attraction and competitive attraction that can be used by growers and their industry partners to tailor mating disruption products.

Getting to the Root of Plant Metabolism -- MAES researchers are working in collaboration with two biotech companies on a larger scale to try to improve oil production and overall yields in corn. Right now, corn seed oil content is about 5 or 6 percent. It is hoped that recent research findings can be used to increase oil seed production to 20 or 30 percent, which would translate into a multi-billion dollar economic shot in the arm for the Midwest.

Reining in Exercise-induced Pulmonary Hemorrhage in Horses -- MAES research into exercise-induced pulmonary hemorrhage (EIPH), a poorly understood respiratory disease that affects the health and performance of up to 80 percent of horses worldwide, has shown that pulmonary vein hypertension is the driving force behind the changes in the lung that leads to EIPH. These findings will ultimately allow researchers to intervene in creative ways to prevent EIPH from occurring in these horses and will also provide equine veterinarians and horse owners with a better understanding of the condition.

Helping Youths Cope with a Parent's Psychiatric Illness -- A multi-disciplinary research team developed an intervention program for at-risk youths whose parents suffer from a psychiatric illness. The program, Youth Education and Support (YES!), targeted middle school youths between the ages of 11 and 15 and consisted of six weekly, two-hour sessions that educated participants about mental health disorders and taught coping skills. The team also worked with community mental health agencies in Michigan to run pilot tests with participants. The ultimate goal is to create an evidence-based program that will be a part of mainstream mental health services for youth.

Making Child's Play of Food Advertising with Online Games -- Evidence that marketing to kids does shape their food choices and contributes to childhood obesity led an MAES researcher and several of her colleagues to study online games that incorporate branded food products, dubbed "advergames." The study found that almost all the foods featured were high in fat, salt and sugar -- about 84 percent of advergame products were classified as low-nutrient foods and that very few advergames educated children about nutrition and health issues. Ultimately, researchers want to understand how the games work and see if the same techniques can be used to promote healthy eating habits.

MSUE 2009 Quick Facts:

298 educators/specialists representing 220 FTEs of MSUE's total FTEs of 737 were funded by federal formula funds or match.

It is important to note that this report reflects only a portion of MSUE funds and not the whole breadth of research and educational initiatives. MSUE's total funding in FY 2009 was over \$89 million, with this report representing approximately \$10 million federal formal dollars and equivalent match. Overview of all outputs are:

140,856 adults were educated with approximately 25% represented in this report
212,706 youth were educated with approximately 25% represented in this report
27,256 volunteers assisted MSUE in educating youth and adults

It is also important to note that the report does not reflect specifically any of the five new NIFA priorities, although our analysis suggests that approximately 30% of the effort in this report could fall under one of the five priorities. Due to inability to report specific outputs and outcomes to these new plans, we have not included them and are preparing to report on them next year.

Examples of MSUE Impacts:

Floriculture Area of Expertise Team Improves Ag Production -- MSU Extension educators submitted 78 plant samples of Floriculture crops to MSU Diagnostic Services for identification and subsequent management recommendations to solve a production problem, resulting in an estimated market value of \$500,000 in crops that could be sold.

Dairy Area of Expertise Team Improves Ag Production -- The MSU Dairy Team, with support from the FIRM Team, developed and planned nine meetings statewide entitled, "Feeding the Herd when Feed Costs go Sky High!" in response to increased feed prices. Over 190 producers attended, representing an estimated 31,000 cows. As a result of attending, 87% indicated on an evaluation that they planned to implement changes based on what they learned. Sixty-three percent anticipated that those changes would have a significant economic impact on the largest cost category of production - feed.

Michigan Garden Plant Tour -- A two-week tour that involved a partnership between the MSUE, MSU and seven greenhouse propagators. Over 1480 individuals from 10 states attended this self-guided tour to see new varieties of plants

that they could include the following year in their stores, retail greenhouse, landscapes or commercial sites. As a result of attending the 2008 Michigan Garden Plant Tour, attendees responding to an MSU Extension evaluation that found 39.7% would be offering for purchase one to five new plants in 2009, 44.1 % would be offering six to 16 new plants, and 16.2 % would offer 17 or more new plants. The increase in revenue was estimated by participants who responded to the survey at \$286,000. This effort helped Michigan greenhouse plant propagators maintain their position in the industry nationally.

Master Citizen Planner -- The 1,620 Master Citizen Planner graduates as part of their capstone project and community service volunteered about 6 hours each per month for a total of 116,640 volunteer hours per year. At a volunteer rate of \$18/hr., this volunteer time equates to \$2,099,520 per calendar year. Volunteers educated the public on alternative land use, the use of technology and resources available to help in the decision making process.

Farm Bill Training -- An evaluation of a training on how to plan for the effects of the Farm Bill found it impacted over 31,139 acres and increased profit by \$387,000. Training topics also included: how crop insurance, target prices, and decision dates work together to help you secure a good average price for your crop; understanding seasonal price fluctuations [long-term]; sizing up the market after harvest, and how to react to market fluctuations; using grain storage to your advantage; and the pros and cons of marketing tools including forward contracts, futures, hedge-to-arrive, puts, calls, etc.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	178.0	0.0	83.0	0.0
Actual	220.0	0.0	89.5	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, MAES research priorities and MSU Extension educational goals must remain fluid and flexible. Research goals are continually evaluated for relevance and impact at local, state and regional levels. Strategic priority areas address the research priorities of Michigan agriculture and natural resources industries, but are also linked to national and global goals and new initiatives. Through strategic planning with MAES-affiliated colleges, MSU Extension staff and key stakeholder groups, priority areas and research activities are reviewed annually. This process involves industry experts, university faculty members, MSU Extension and MAES Council members, and includes 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 county 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 county and individual agents' plans. These goals and plans are also reviewed by state leaders and industry experts for quality and relevance and by MSU Extension and MAES directors who not only evaluate them but use them in their regional and statewide presentations to describe future plans. Jointly, MAES and MSU Extension address issues of concern in local communities with research and teaching by using a network of citizen advisory groups at the local and state levels. County 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 15 MAES field research stations. The MSU Extension and MAES Council serves as a liaison

among county councils, field station 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

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 is in the midst of a major restructuring effort to reinvent itself to better meet the challenges of the 21st century. MSUE staff participation was encouraged by: publishing weekly newsletters from 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 at various locations across the state to discuss the MSUE restructuring plan and solicit staff input to guide the plan and to identify and develop four new institutes within the MSU Extension framework -- Preparing Michigan's Children & Youth for the Future, Enhance Michigan's First Green Industry: Agriculture and Agribusiness, Improve Health and Nutrition for Michigan Residents, and Greening Michigan: Leveraging Natural and Human Assets for Prosperity. Further, numerous individual meetings were held with staff, stakeholder advisory groups and the MAES/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. Now that the framework for the redesign and the four institutes have been established, a comprehensive needs assessment -- AdvanceMichigan -- is being 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. The development of the survey instrument and communications campaign have been in process since Fall 2009. The survey will be launched in April 2010 and run through June 2010. Survey results will then be compiled and used to develop a logic model for specific program priorities in each institute and a statewide plan of work.

As mentioned in previous plans of work, MSU Extension contracted with the Institute for Public Policy and Social Research (IPPSR) to include questions related to MAES and MSU Extension programmatic priorities on its State of the State Survey (SOSS) for three years (2007 to 2009). In 2009, survey questions were posed related to perceptions about entrepreneurship. In addition, targeted surveys to collect information on the Michigan equine industry, the Michigan dairy industry and trends in farmers perspectives on MSU Extension were also conducted. The results of these surveys are included in the "What you Learned from Your Stakeholders" section of this executive summary.

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 generate knowledge through strategic research to enhance agriculture, natural resources, and families and communities in Michigan, MAES has an extremely broad and long list of stakeholders. In reality, every Michigan citizen is an MAES and MSUE stakeholder. Using the methods checked above, the emphasis is on keeping up-to-date on key internal and external stakeholders, 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 online issues identification process being initiated (and the previous Strengthening Michigan's Economy process) and ongoing efforts offer multiple ways for people in various roles and locations to help identify the issues and opportunities for MAES research priorities and MSUE educational programming during the years ahead.

Statewide telephone surveys for the State of the State Survey (SOSS) and citizen focus groups are used to identify the major issues and opportunities in Michigan and assign a priority ranking to each.

Community-based discussions in all Michigan counties, involving the local MAES advisory committees, MSUE councils and others are held to discern what issues and opportunities stakeholders believe should be addressed related to research and programming. Community groups, commodity and producer groups and other state and local partners are periodically asked what specific issues and opportunities should be addressed.

Faculty focus groups, with representatives from MSU colleges and units, are held as needed to glean faculty perceptions on emerging Michigan issues and opportunities and identify ways that MSU science might address them. MSU faculty and MAES/MSUE 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 MAES field station managers, synthesize and submit local priorities identified by local MSUE councils and MAES advisory committees.

Area of Expertise (AoE) teams synthesize and prioritize content-specific program and research needs generated from the input of their advisory bodies and continue to fine tune these needs 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.

For FY 2009, several methods were used to collect stakeholder input:

MSU Extension is in the midst of a major restructuring effort to reinvent itself to better meet the challenges of the 21st century. MSU Extension staff participation was collected via the MSU Extension portal, five Town Hall meetings at various locations across the state, numerous individual meetings with staff, stakeholder advisory groups and the MAES/MSU Extension State Council. Meetings were also held with the Association of Counties and state legislators. A comprehensive needs assessment -- AdvanceMichigan -- 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 will be launched in April 2010 and run through June 2010. Survey results will then be compiled and used to develop a logic model for specific program priorities in each institute and a statewide plan of work.

As mentioned in previous plans of work, MSU Extension contracted with the Institute for Public Policy and Social Research (IPPSR) to include questions related to MAES and MSU Extension programmatic priorities on its State of the State Survey (SOSS) for three years (2007 to 2009). In 2009, telephone survey questions were posed related to perceptions about entrepreneurship in Michigan.

Targeted surveys to collect information on the Michigan equine industry, the Michigan dairy industry and trends in farmers perspectives on MSU Extension were also conducted to collect data from these selected individuals and groups.

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.

Stakeholder input provides the foundation for the research and educational programs developed by MAES and MSUE. Stakeholders help decide the future direction for MAES through programs such as Project GREEN, the Animal Agriculture Initiative, Families and Communities Together, commodity advisory teams and the Area of Expertise teams. Due to stakeholder input, MAES has focused more sharply on biobased products that can help boost the Michigan economy, including fuels, chemicals, nutraceuticals and food products; the environment, land use issues and biotechnology. Stakeholder input has changed the direction of youth programming to focus on job readiness and health, which have not been traditional program areas.

More specifically for FY 2009:

MSU Extension Restructuring: Town Hall meetings, individual meetings, feedback via e-mail, blogs and surveys and the upcoming AdvanceMichigan online needs identification are all being used to inform the restructuring framework, including identification of the four new institutes and the priorities that should be set under each of the institutes.

State of the State Survey: These results provide a step toward providing benchmarks for communities wishing to employ policies that encourage a shift in entrepreneurial culture. SOSS surveys will continue to be used to identify major issues and opportunities in Michigan to inform research priorities and programming.

Michigan Dairy Industry Survey: These findings are being used to update research and Extension priorities related to this important sector.

Horses Count in Michigan Survey: MSU faculty members will use the results to inform educational programs, research and Extension efforts. The information will also help government officials make decisions and policies about zoning and land use, trail access, tax laws and other issues affecting equine owners. Veterinarians and others who monitor equine health will also find this information helpful.

Trends in Farmers Perspectives on MSU Extension: These findings are being used to guide research and Extension priorities especially related to the identification of strategies for optimum impact of MSU Extension programs and activities with increasingly limited resources.

Brief Explanation of what you learned from your Stakeholders

State of the State Survey: Perceptions about Entrepreneurship - Results showed that attitudes toward entrepreneurship vary by region. Regions with a greater proportion of the workforce in ag occupations, a higher average level of education, and high unemployment tend to be more closed to entrepreneurship. Regional proportions of Hispanic residents, median family incomes and rurality tend to be associated with openness to entrepreneurship. Of the five survey questions asked, the respondent's willingness to "encourage a young person" to become an entrepreneur (vs. working for someone else) yielded the best overall fit.

Michigan Dairy Industry Survey--Two separate questionnaires were sent to 2,237 dairy farms and 480 allied industry professionals to identify and rate industry priorities. 23.4% of the dairy farmers and 28.1% of the allied industry professionals surveyed returned usable questionnaires. Highest rated issues for farm owners/operators: ensure the continuation of the Right to Farm program; increase legislators' knowledge of agriculture; communicate to consumers about the safety of milk products and technologies used; promote the value of the dairy industry in Michigan's economy, and maintain adequate access to water resources in ag. Highest rated issues for allied industry professionals: dairy farmers demonstrating environmental stewardship; communicate to consumers about safety of milk products and technologies used; improving public understanding of animal welfare; ensure continuation of Right to Farm Program; public image of ag; and science-based environmental regulations.

Horses Count in Michigan Survey -- This survey was done to estimate the number of horses, ponies, donkeys and mules in Michigan, and to determine their locations, ages, breeds and uses. Results show that the number of equines has risen by more than 20 percent over the past 11 years. Most popular breeds are American Quarter Horse, American Paint, Arabian and Standardbred. The greatest numbers of equine animals are in Oakland, Washtenaw and Livingston counties, and 44,000 acres of land is devoted to equine operations. Thirty-seven percent of Michigan's equines are used for recreation/pleasure. The total value of assets is nearly \$4.4

billion.

Trends in Farmers Perspectives on MSUE -- A study was conducted in 2008-2009 to determine the trends in Michigan ag producer MSUE awareness, the types of programs used by the ag community, their importance, major educational needs, and information sources used. The survey was sent to 1,600 agricultural users and 56% returned usable questionnaires. Results showed that farmers and agribusiness operators are very well aware of MSUE and are extensively participating in its educational programs, and that the educational needs for this group are changing. In 1996, the marketing of ag products and agri-chemical use were the major areas of educational need for Michigan farmers. Although these two areas are still a priority, 2008 respondents indicated a need for more educational materials related to farm management, production skills, environmental issues, sustainable ag, biotechnology, and small farm management.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
8512523	0	5641956	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	10440595	0	5548158	0
Actual Matching	10440595	0	5538139	0
Actual All Other	0	0	54630001	0
Total Actual Expended	20881190	0	65716298	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from				
Carryover				
	5925099	0	0	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Human Health, Environment, Family, Youth, Society and Community
2	Soil, Water and Natural Resources
3	Plant Sciences
4	Food and Non-Food Quality, Nutrition, Engineering and Processing
5	Economics, Marketing and Policy
6	Animal Production and Protection

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	3%		10%	
703	Nutrition Education and Behavior	5%		3%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	2%		2%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	5%		5%	
721	Insects and Other Pests Affecting Humans	1%		5%	
723	Hazards to Human Health and Safety	7%		12%	
724	Healthy Lifestyle	11%		15%	
802	Human Development and Family Well-Being	12%		8%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	3%		10%	
805	Community Institutions, Health, and Social Services	4%		10%	
806	Youth Development	47%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	75.0	0.0	12.0	0.0
Actual	111.2	0.0	12.5	0.0

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

Extension		Research	
Smith-Lever 3b & 3c 3163763	1890 Extension 0	Hatch 654683	Evans-Allen 0
1862 Matching 3163763	1890 Matching 0	1862 Matching 653500	1890 Matching 0
1862 All Other 0	1890 All Other 0	1862 All Other 6446340	1890 All Other 0

V(D). Planned Program (Activity)**1. Brief description of the Activity**

Research to: Determine the relationship between family lifestyle factors/education and food choices, and general health and well-being. Develop methods to assess the allergen-causing potential of foods. Understand how environmental pollutants, especially ozone and endocrine disruptors, affect human health. Increase understanding and develop more effective environmental management systems. Develop better models for the 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. Teach 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 health 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 the knowledge and skills needed for life and employment. Enhance the physical, social, emotional and cognitive health and well-being of youth. Improve tribal governance in Michigan.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	3800	7600	4400	6600
Actual	5899	11798	7562	11343

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

Year: 2009
 Plan: 1
 Actual: 1

Patents listed

TEC2007-0105-01PCT, filed 7/9/2008, titled 'Value-Added Products for Improving Human, Animal and Plant Health.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	5	25	
Actual	5	39	44

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	Target	Actual
2009	28	37

Output #2

Output Measure

- Number of adult participants trained in healthy lifestyles.

Year	Target	Actual
2009	1449	1836

Output #3

Output Measure

- Number of youth participants trained in healthy lifestyles.

Year	Target	Actual
2009	1342	1918

Output #4

Output Measure

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

Year	Target	Actual
2009	1758	3352

Output #5

Output Measure

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

Year	Target	Actual
2009	845	786

Output #6

Output Measure

- Number of adult participants trained in community institutions, health and social services.

Year	Target	Actual
2009	138	356

Output #7

Output Measure

- Number of adult participants trained in youth development.

Year	Target	Actual
2009	491	711

Output #8

Output Measure

- Number of youth participants trained in youth development.

Year	Target	Actual
2009	2236	4858

Output #9

Output Measure

- Number of adults trained in topics that support tribal governance.
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 determine the relationship between family lifestyle factors/education and food choices/environmental influences/physical activity and general health and well-being.
2	Number of research programs to determine the biological mechanisms that affect the quality and safety of food products and/or food processing systems.
3	Number of research programs to develop new methods to reduce the transmission of food-borne pathogens.
4	Number of research programs to understand how environmental pollutants, especially ozone and endocrine disruptors, affect human health.
5	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.
6	Number of adult participants with increased knowledge about healthy lifestyles.
7	Number of youth participants with increased knowledge about healthy lifestyles.
8	Number of adult participants with increased knowledge of human development and family well-being.
9	Number of youth participants with increased knowledge of human development and family well-being.
10	Number of adult participants with increased knowledge of community insitutions, health and social services.
11	Number of adult participants with increased knowledge of youth development.
12	Number of youth participants with increased knowledge of youth development.
13	Number of native american adults with improved knowledge and skills in tribal governance.
14	Number of research programs to develop more effective environmental management practices and protocols related to natural and social systems, especially the wildlife-human interface and outdoor recreation-based activities.
15	Number of research programs that study the function of nutrients and other food components related to human health.

Outcome #1**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1	14

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 life-long. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity reports that overweight adolescents have a 70% chance of becoming overweight or obese adults, and this risk increases to 80% if a parent is overweight or obese. Further, obesity-associated coronary heart disease is now the No. 1 cause of mortality in the U.S. 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: determine which foods protect against diseases; discover health beneficial constituents in fruits, vegetables and generally regarded safe plants; identify and assess opportunities for Michigan farmers to pursue organic and place-based production and marketing strategies; determine the impact of phytonutrients on the absorption, distribution, metabolism and elimination of essential nutrients; generate information to make it easier for citizens to eat healthier and be physically active; provide resources, education and technical assistance to low-income households who wish to grow food in their backyards or community gardens to increase household food security and consumption of vegetables; and increase the safety of women and children who have undergone divorce in the context of domestic violence.

Results

Research examining current nutrition assessment protocols and dietary guidance indicated that the biggest barriers for pediatric nutrition screening during well child visits are time constraints and difficulty obtaining valid data on child food intake. To address these issues, a waiting room checklist for nutrition screening that caregivers complete while in the waiting room and 12 assorted nutrition tips and recipe cards for use in well child visit counseling were developed.

Eating diets with a low glycemic index, a low glycemic load and more than 25 grams per day of fiber helps normalize blood glucose, blood insulin and body weight. Findings showed that substituting dry beans for foods prepared from white flour will reduce the glycemic index of the diet by about two-thirds and the glycemic load by about 80%.

Extensive evaluations of the water extracts of select botanical dietary supplements (e.g., St. John's Wort, sweet and sour cherry extracts, leaf chickory) for lipid peroxidation, anti-inflammatory and human lung, stomach, colon,

breast and central nervous system tumor cell proliferation inhibitory activities have provided scientific support to the anecdotal health-beneficial claims associated with these plants/supplements.

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 determine the biological mechanisms that affect the quality and safety of food products and/or food processing systems.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of research programs to develop new methods to reduce the transmission of food-borne pathogens.

Not Reporting on this Outcome Measure

Outcome #4

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	Quantitative Target	Actual
2009	1	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Michigan residents are exceptionally vulnerable due to chronic exposure to complex mixtures of endocrine disruptors that include legacy environmental contaminants within the Great Lakes basin (e.g., dioxin, PCBs, DDT), numerous pesticides and herbicides from the diverse and intense agricultural activities within the state and the

broad range of industrial activities that contribute to the overall pollution burden.

What has been done

Research to study chronic respiratory diseases caused by air pollutants to better understand how nasal tissues and cells may respond to inhaled toxicants; explore the mechanistic linkages between molecular phenotype and toxicity outcomes; assess the toxicity of endocrine disruptor mixtures; close the gap that exists regarding the specific components of air pollution that influence pulmonary neoplasia; and evaluate the potential role of migrating waterfowl and shorebirds in the dispersal of highly pathogenic and low pathogenic avian influenza.

Results

Results of two research studies showed that: exposure to ozone or ambient ultrafine particles can enhance allergic airway diseases; and oxidants play a role in these adverse airway responses. Together, these results demonstrated that ozone exposure enhances allergic rhinosinusitis, and a common antioxidant supplement, gT, inhibits the ozone-induced exacerbation of this allergic airway disease. It has also been demonstrated that ambient particulate matter found in air pollution can act as an adjuvant for allergic sensitization.

4. Associated Knowledge Areas

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

Outcome #5

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	Quantitative Target	Actual
2009	3	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Healthy, vital communities with active citizenry are better equipped to address the challenges facing many of today's families. Whether the issue is economic development, youth, aging, family dynamics, demographics, or rural and urban security, better models for the human health and human services sectors are critical to human development and overall well-being.

What has been done

Research to: build one or more models of preventive and early intervention for children living with a family member with a serious mental illness; examine the relationship between the number of foster home placements for a youth

and the number of community connections as emancipated adults; develop healthcare packaging that is easier to access, particularly for aging consumers and people with disabilities; develop a curriculum model for ANR education that encourages Michigan's secondary schools to become more rigorous and relevant; identify ways to increase the safety of women and children who have undergone divorce in the context of domestic violence; and better understand the factors leading to well-regulated stress responses in young children.

Results

A 32-page annotated resource directory of books, films, Web sites and other resources for and about children who have a parent with a psychiatric illness was published and disseminated to the National Association for Mental Illness (an organization with more than 1,000 affiliate groups for family members and consumers from across the nation).

Change detection -- a tool from the field of cognitive psychology -- was used for the first time in a packaging study to evaluate the relative prominence of key label components. Results indicated that the warning was noticed significantly faster when printed in red than in black. Additional information about the attentional scan paths of consumers were also collected using this technology.

The launch of Great Lakes Echo -- <http://greatlakesecho.org> -- a news site covering environmental journalism of the Great Lakes region. The site currently averages 2,000 visitors per week.

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 #6

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	Quantitative Target	Actual
2009	1232	1615

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The number of people with diabetes is growing so rapidly that it is now considered by many to be an epidemic. Seventeen million people in the U.S. have this disease, and 16 million are thought to have pre-diabetes. Over the past decade, the number of Americans who have been diagnosed with diabetes has increased 61% and is expected to more than double by 2050. The Centers for Disease Control reported last year that one out of three

children born in the U.S. will be diagnosed with diabetes during their lifetime.

What has been done

One example -- "Dining with Diabetes," an education program for people with diabetes and their families -- was conducted in Gogebic County, Michigan and Iron County, Wisconsin, where 10.1% of the residents have diabetes, either diagnosed or undiagnosed. This number rises to almost 20% for citizens over age 65.

Results

Pre- and post-questionnaires tracked knowledge and behavior changes. Clinical testing (A1C and blood pressure), to monitor clinical improvements, took place at session one and at the three month follow-up. Fifty percent of the learners that participated in the pre- and post-A1C testing saw an improvement in their blood glucose levels. The average amount of improvement was one point. Fifty percent of the learners that participated in the pre- and post-blood pressure testing saw an improvement. In answer to "I know exactly how to take care of my diabetes", only 25% of the participants taking the pre-test agreed or strongly agreed, compared to 50% agreement on the post-test.

36.4% of the class members reported on the pre-test that they had participated in physical activity for at least twenty minutes, four or more times during the previous seven days; 63.6% of those on the post-test did so. When asked what changes they made, 45% said they lost weight; 73% increased physical activity, 64% increased the amount of fiber they ate, 64% increased the amount of fruits they ate, 73% increased the amount of vegetables they ate, 82% decreased the amount of non-nutritious ("junk") food they ate, 73% kept track of what they ate by counting carbohydrates or food selections, and 82% paid greater attention to portion sizes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

Outcome #7

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	Quantitative Target	Actual
2009	1141	1687

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

One example is the "Grow Your Kids" Grant Program in Wayne County ,where youth were taught about nutrition and healthy living.

Results

An evaluation using a pre-assessment at the beginning of the program and a mid-way assessment at three months into the six month program found that 88% of participants changed their behavior and preferred to buy healthy fruits and fresh vegetables with dip for nutritious snacks compared to 13% at the beginning of the program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

Outcome #8

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	Quantitative Target	Actual
2009	1494	2949

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The quality of parenting is highly correlated with children's outcomes that include academic, social, emotional, physical and intellectual development.

What has been done

A program called "Parenting with Purpose Program" in Muskegon County was designed to help parents adopt a more positive attitude toward parenting and practice more acceptable disciplinary techniques.

Results

An evaluation of 260 parents found that parents reported more positive child behavior after participating in the program in communication (71%), choices (57%) and cooperation (25%). Participants also reported a better understanding of their child/children: 90% have a deeper understanding of their child/children; 77% enjoy their children more; and 88% give more appropriate choices for their child's age. Finally, participants reported an increase in their use of positive discipline techniques after participating in the program: 98% reported an increase understanding how discipline affects their child's self-esteem as well as about reasons for child misbehavior; 88%

reported that they learned new discipline methods; and 82% reported using alternative discipline strategies other than spanking.

4. Associated Knowledge Areas

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

Outcome #9

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	Quantitative Target	Actual
2009	719	4275

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The local situation is that, as early as K-3rd grade, far too many children are exposed to bullying behaviors, cheating in school, being dishonest and showing disrespect to authority figures. Peer pressure to misbehave among elementary aged children often is considered "cool." The local need is to teach these K-3rd graders as soon as possible that "cool behavior" means modeling "good character" to hopefully prevent them from getting into serious problems by middle and high school as a result of negative peer pressures. These issues not only play out in the school but in the home.

What has been done

Wayne County trained over 500 youth on the "Six Pillars of Character" to: teach elementary school-aged youth the "Six Pillars of Character"; have the elementary students demonstrate an improved attitude toward exemplifying "good character" through hands-on projects such as community service projects that show they have a positive attitude toward "giving back" to local 4-H clubs/classroom etc.; help elementary school-aged children develop skills in "exercising good character" such as in sharing, helping others, service learning projects (e.g., food drives for needy and community gardening/beautification projects; help elementary school-aged children aspire to use the skills that they learn in the "Six Pillars of Character," including aspiring to be caring, respectful, good citizens, honest, responsible and trustworthy.

Results

An evaluation of 389 youth found violence and gang-related behaviors were reduced among over 80% of students. Also, 93% of students wrote in post-test evaluations that they planned to practice making more moral and ethical decisions as compared to only 63% on the pre-test.

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 adult participants with increased knowledge of community insititutions, health and social services.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	117	313

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Families in Michigan have had a tremendous increase in home foreclosures and, as a result, an increase in homelessness. Not only are families impacted, but so are their communities and ultimately the state of Michigan. Often times, only MSUE staff are able to provide educational programming in the area of family resource management, including financial mangement for the general public, as well as limited-resource families. Moreover, no other agency typically is able to work with families on budgeting at no cost to the family. Additionally, there are often times no other agencies in the counties that provide MSHDA Homeowner Counseling.

What has been done

One example is a series of Consumer Education/Pre Purchase Education workshops that were conductd in Washtenaw County.

Results

An evaluation of 56 participants found that 72% attended the workshop to meet a requirement of a mortgage or down payment assistance program. Ninety five percent (95%) indicated that the class helped them determine if homeownership is right for them. Fifty-five out of 56 indicated that they understood how to prevent foreclosure and 53 out of 56 understood how to avoid predatory lending practices.

4. Associated Knowledge Areas

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

Outcome #11**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	Quantitative Target	Actual
2009	417	626

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Each year, Michigan 4-H Youth Development involves more than 25,000 adults in providing fun, hands-on learning opportunities to more than 200,000 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

Approximately 95% of the new adult volunteers trained showed competent levels of youth development at the end of the training.

4. Associated Knowledge Areas

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

Outcome #12**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	Quantitative Target	Actual
2009	1901	4275

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Each year, Michigan 4-H Youth Development involves more than 10,000 teens in providing fun, hands-on learning opportunities to more than 200,000 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.

4. Associated Knowledge Areas

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

Outcome #13

1. Outcome Measures

Number of native american adults with improved knowledge and skills in tribal governance.

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Number of research programs to develop more effective environmental management practices and protocols related to natural and social systems, especially the wildlife-human interface and outdoor recreation-based activities.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	4	6

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; explore information technology in planning vacations, nonmotorized transportation and consideration of wildlife risks by homeowners; and answer questions posed to researchers by industry and government agencies; assess the distributions and benefits of public parks and open spaces in various communities throughout Michigan and beyond; and better understand community capacity in the management and decisionmaking around natural resources, especially water and sanitation.

Results

Research on wildland fire and fuel treatment alternatives and policies and incentives to influence homeowners attitudes toward adopting certain options identified defensible space -- a risk reduction effort to build homes with firesafe materials and landscape for wildfire mitigation -- as an attractive alternative to homeowners considering wildfire risk management options.

To help improve people's decision making capabilities related to environmental and related risks, a training module was developed for use by resource managers in developing countries. The module focuses on decision making for international development and includes specific tasks aimed at more effectively involving minority and marginalized communities and ways to include disenfranchised stakeholders and their concerns as part of the policy frameworks in developing areas.

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 #15**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	4	2

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

As we close the first decade of the new millennium, paradigms of an unfolding nutrition transition in many countries; an uncontrolled obesity epidemic gripping America; a double burden of malnutrition with hidden hunger; global acute malnutrition; prolonged food insecurity in many low-income countries; and charges to prevent early childhood stunting compel us to more fully understand the developmental (nutritional) origins of health and (chronic) disease that dominate the global public health nutrition agenda. By studying how individual food components are digested, absorbed, metabolized and utilized -- and their effects on genes, cells and organs -- the whole person can be understood. Deliberate manipulation of these food interactions can lead to improved health.

What has been done

Research to: 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 findings demonstrating the efficacy of tart cherry juice in treating arthritis has provided a good translational research paradigm that can be applied to inflammatory airway diseases.

First isolated from the bark of the Pacific yew in 1967, paclitaxel (known as the blockbuster cancer drug, Taxol), has since been made by synthetically modifying an intermediate substance isolated from yew needles using toxic solvents or by fermenting cell cultures. Research has shown that by using natural plant enzymes instead, pharmaceutical companies could reduce the steps involved in making Taxol while cutting chemical byproducts. Studies have verified that this natural enzyme process removes two steps from a previously established reaction sequence routinely used in industry to construct the pharmaceuticals, creating new-generation Taxol molecules. This discovery can lead to more effective drug variants and eventually better health care treatment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components

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.)
- Other (Redesign/restructuring)

Brief Explanation

Although requested to add the new national planned program priorities to our POW reports this year, the short notice and several significant factors on our end led us to keep our current planned programs for this reporting year. With the challenges posed by Michigan's economy, the continued uncertainty related to state appropriations for MAES and MSUE funding, the complete redesign of MSUE and the launch of a new, comprehensive five-year needs identification process in 2010 that will inform research and education projects and activities, we felt it prudent to wait to reconfigure our planned programs in next year's POW Update and Annual Report. We stand ready to make the required changes in the next reporting year. In the short term, a good number of the projects in this planned program will likely be migrated to the Childhood Obesity and Food Safety planned programs.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

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%		2%	
102	Soil, Plant, Water, Nutrient Relationships	19%		15%	
111	Conservation and Efficient Use of Water	12%		15%	
112	Watershed Protection and Management	15%		10%	
123	Management and Sustainability of Forest Resources	8%		7%	
131	Alternative Uses of Land	18%		10%	
132	Weather and Climate	1%		15%	
133	Pollution Prevention and Mitigation	12%		14%	
134	Outdoor Recreation	1%		1%	
135	Aquatic and Terrestrial Wildlife	5%		8%	
806	Youth Development	8%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	24.0	0.0	14.0	0.0
Actual	11.8	0.0	15.0	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
792688	0	1043054	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
792688	0	1041170	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	10270440	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; identify, prevent and control exotic invasive pests and diseases of forests.

Conduct educational programs to help farmers improve nutrient management and other practices to maintain and improve quality of groundwater and surface water; conduct educational programs with riparians and lake users to enhance their understanding of watershed management and inland lakes water quality issues; work with state agencies and local communities to encourage protection of community groundwater supplies through wellhead protection programs; educate and train health officials, consultants, engineers and riparians to improve onsite and decentralized wastewater treatment and design.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	5124	10248	3672	0
Actual	5404	10808	5209	0

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

Patent Applications Submitted

Year: 2009

Plan: 7

Actual: 4

Patents listed

TEC2007-0145-01, filed 7/18/08, titled 'Intraspecific Chemical Communication of Integration of Laboratory and Field Studies; TEC2007-0149-01, filed 1/15/09 and TEC2007-0149-01PCT, issued 1/15/09, titled 'Enzymology and Molecular Biology of Lignin-Modifying Enzymes of White Rot'; and TEC2006-0018-01US, filed 5/21/09, titled 'Microbial Ecology and Genomics of Soil.'

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
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Plan	0	30	
Actual	3	30	54

V(F). State Defined Outputs**Output Target****Output #1****Output Measure**

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

Year	Target	Actual
2009	40	44

Output #2**Output Measure**

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

Year	Target	Actual
2009	800	764

Output #3**Output Measure**

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

Year	Target	Actual
2009	234	534

Output #4**Output Measure**

- Number of adult participants trained in conservation and efficient use of water.

Year	Target	Actual
2009	767	1007

Output #5**Output Measure**

- Number of youth participants trained in conservation and efficient use of water.

Year	Target	Actual
2009	711	3381

Output #6**Output Measure**

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

Year	Target	Actual
2009	1151	1007

Output #7**Output Measure**

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

Year	Target	Actual
2009	1422	3381

Output #8**Output Measure**

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

Year	Target	Actual
2009	1352	1210

Output #9**Output Measure**

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

Year	Target	Actual
2009	445	431

Output #10**Output Measure**

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

Year	Target	Actual
2009	732	1120

Output #11**Output Measure**

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

Year	Target	Actual
2009	763	655

Output #12**Output Measure**

- Number of adult participants trained in pollution prevention and mitigation.

Year	Target	Actual
2009	322	1185

Output #13

Output Measure

- Number of youth participants trained in pollution prevention and mitigation.

Year	Target	Actual
2009	97	208

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 adult participants with increased knowledge of pollution prevention and mitigation.
12	Number of adult participants with increased knowledge of conservation and efficient use of water.
13	Number of youth participants with increased knowledge of conservation and efficient use of water.
14	Number of youth participants with increased knowledge of pollution prevention and mitigation.
15	Number of research programs that deal with fish population dynamics and the management of Great Lakes fisheries.
16	Number of research programs that deal with the security, stewardship and management of Michigan's water resources.
17	Number of research programs that analyze key soil characteristics to better assess their agricultural and environmental contribution.
18	Number of research programs to develop new recommendations, strategies or assessment tools to better manage soil, water or natural resource system outputs, such as greenhouse gas, carbon, nitrogen and phosphorus.

19	Number of programs to develop new land use models for Michigan communities.
20	Number of research programs that explore the occurrence, transport, fate/effect of organic contaminants, chemicals, pesticides, pharmaceuticals and particulates in soils.

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	Quantitative Target	Actual
2009	3	8

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 global warming potential, 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 the metabolism of such microbes drives many ecosystem level processes.

What has been done

Research to: determine how well the most promising candidate strains of cereal-adapted rhizobia perform as superior biofertilizer inoculants for rice and wheat when scaled up to full-size farmer plots; investigate novel cultivation strategies and cultivation-independent molecular techniques to advance our understanding of microbes and microbial communities in soil; and develop new technologies to control soilborne diseases.

Results

Large-scale field inoculation experiments during five growing seasons in the Nile delta to identify superior biofertilizer inoculants for rice production were completed, including sites that produced the world's record in rice grain yield. Inoculation with certain endophytic rhizobial strains significantly increased rice grain yield while reducing the need for N-fertilizer inputs in 19 of the 24 trials performed.

Improved computing technology was developed to alleviate the difficulty of color segmentation for digital image analysis of microorganisms in environmental samples. Performance of the color segmentation algorithm evaluated on 26 complex micrographs at single pixel resolution had an overall pixel classification accuracy of 99+%. Application of this technology has successfully resolved numerous challenges of complex color segmentation, allowing for new perspectives on the in situ ecology of microorganisms. The software and user support files for this application will soon be available on the MSU Center for Microbial Ecology Image Analysis System Web site, <http://cme.msu.edu/cmeias/>.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources

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	Quantitative Target	Actual
2009	978	948

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Results from the MAES/MSUE Issues Identification process found safe water as one of the top 10 priorities. Knowing water is contaminated provides residents with information to help them protect their health. Water screening raises awareness of possible groundwater contamination. Screening may also lead people to think more about protecting water quality by activities around their home site.

What has been done

The Michigan Groundwater Stewardship Program has been annually offering free well water screening for triazine pesticides, nitrates and nitrites during Ag Expo. The MSUE District Water Quality Educator organized Northwest Michigan and the Eastern U.P. water sample screening promotion and collection.

Results

MSU Extension offices in 12 counties collectively received 976 samples. This made up 34% of the samples from the entire state tested this year. It takes a truck to deliver the coolers filled with samples and ice packs to the Michigan Department of Agriculture's Geagley water testing laboratory in East Lansing. This year Leelanau County residents submitted the second highest number of samples (141), Grand Traverse, the 5th highest number (134) and little Benzie County had the 6th highest (132). One sample from Chippewa County contained triazine pesticide. Eight wells out of 976 had nitrates above the drinking water standard (10 parts per million), which indicates that drinking this water by certain segments of the population is risky. Seventy five samples from the twelve counties were between 5 and 10 ppm, prompting continued interest by the well owners. One Emmet County well was positive for nitrite, which suggests recent contamination. Since these samples are not randomly taken, one cannot say anything about water quality in the various counties except that not all water is potable and everyone should test their well water annually. The Groundwater Stewardship Program through the offices of MSU Extension provided approximately \$29,000 worth of free testing to the 976 well owners. Residents in Grand Traverse and Leelanau counties were provided with \$9,450 worth of free service.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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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	Quantitative Target	Actual
2009	1208	2976

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Studies have shown that fourth grade students in Michigan generally have little understanding of the Great Lakes and local water resources. At the same time, science education is a critical component of elementary education and Michigan teachers need programs that can help them meet state guidelines for science education while giving their students the chance to "get turned on" to science.

What has been done

Michigan Sea Grant Extension and MSUE 4-H offers fourth grade students the opportunity to experience the Great Lakes Education Program. The program introduces students to the unique features of the Great Lakes through a combination of classroom learning and hands-on experience. It is designed to stimulate interest in the Great Lakes and help students understand their role in protecting these vital freshwater resources.

Results

More than 60,000 students, teachers, adult chaperones and volunteers in southeast Michigan have participated in the Great Lakes Education Program since it began in 1991. An evaluation of the curriculum by school teachers rated the overall GLEP experience at 3.89 on a 1 (poor) to 4 (excellent) scale. The GLEP curriculum received an Excellent rating in the Great Lakes Fisheries Assessment and Summary of Needs published by the Great Lakes Fishery Trust.

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	Quantitative Target	Actual
2009	1149	1064

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Competing interests for uses and users of forest lands are apparent throughout the state. Local concerns wish to have a formal tool to use as a baseline for objectively discussing and resolving conflict among various land owners, land uses and public policy impacting forest lands.

What has been done

MSUE conducted meetings and workshops to introduce economic, ecological and social attributes affected by forest lands, introduce and discuss sustainability issues and terminology, and the use of a survey instrument to qualify community perceptions of the forest, and to incorporate that into measurements of sustainability. Stakeholders have involved MSUE Forestry Dept., USDA Ottawa Forest [Supervisor's Office], County Forest Staff, large and small land owners, school systems, Community Colleges, Soil Conservation representatives, business representatives, tourism interests, and tribal representatives.

Results

More than 3,000 people have participated in the Sustainable Forestry Education (SFE) program since the start of the program, which teaches forest ecology, silviculture techniques, forest water quality management and safety practices. Virtually every load of raw wood moved on Michigan roads will have been produced by an individual who has participated in MSUE's Sustainable Forestry Education program. Every industrial private landowner that MSUE reaches collectively represents 600,000 acres of forestland.

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	Quantitative Target	Actual
2009	1	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 and wildlife populations, communities and habitat.

What has been done

Research to: quantify ungulate-habitat relationships in forests and agricultural ecosystems at multiple spatial and temporal scales; quantify the effects of herbivory on the regeneration, stand characteristics and nutritional qualities of tree species and plant communities essential for providing wildlife habitat components and forest products; evaluate the effectiveness of ecosystem management and ecosystem-based management strategies to help maintain or restore biological diversity and ecological integrity; and develop systems models that integrate ecological and socioeconomic factors.

Results

A habitat suitability model and population viability model was developed to help natural resources managers in southwestern Michigan conserve the eastern massasauga rattlesnake. These tools have been provided to the Michigan Department of Natural Resources, Pierce Cedar Creek Institute, the Michigan Eastern Massasauga Working Group and the Eastern Massasauga Species Survival Plan Working Group to plan habitat management activities that may benefit rattlesnake productivity.

Estimates associated with deer population dynamics and quantitative descriptions of how landscape composition and structure of cover types and land ownership influence space use of deer have been provided by researchers to the State and other natural resource managers to help them plan effective management practices and set more ecologically effective harvest objectives for white-tailed deer.

4. Associated Knowledge Areas

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

Outcome #6**1. Outcome Measures**

Number of youth 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	Quantitative Target	Actual
2009	379	388

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

One of Michigan's greatest assets is forests, so it is critical that they be managed and maintained for future generations.

What has been done

One of the efforts that helps in this area has been volunteers from the Master Woodland Steward Program that are committed to completing a capstone project (approximately 30 hours) in their community that benefits woodland stewardship.

Results

A state park officer who took the Master Woodland Steward course developed a curriculum and program and gave under-privileged urban youth the opportunity to learn about Michigan forests. The program involved a two-hour outdoor program and walk. It was presented 10 times during the summer season. Feedback indicated 92% of the youth had a greater of the need to protect/manage the forests and 88% reported knowledge gains that included environmental stewardship, outdoor education, wildlife, and management of forests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
806	Youth Development

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	Quantitative Target	Actual
2009	622	986

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In February 2008, the Michigan Zoning Enabling Act, PA 110 of 2006, was amended by PA 12 of 2008. In March 2008, the Michigan Legislature replaced the Township Planning Act, the County Planning Act and the Municipal Planning Enabling Act, PA 33 of 2008. Local elected officials and planning and zoning board members needed to be educated on the changes.

What has been done

MSUE Land Use Area of Expertise Team conducted workshops across the state from the Fall of 2008 through the Spring of 2009.

Results

To measure the impacts and outcomes of the substantial investment of Land Use Team time to create and deliver the Planning Enabling Act workshops, a follow-up evaluation was conducted of all statewide participants in the workshop. More than 200 surveys were returned with the following results: the most common initial action taken to comply with amendments to the Michigan Zoning Enabling Act (MZEA) was to amend the zoning ordinance (26%), with 23% of respondents reported already being in compliance with the MZEA. The evaluation also asked respondents to rate the most significant barriers to responding to the new guidelines. Barriers included the overwhelmingly large amount of information to learn, followed by lack of money and resources, and planning commissions' resistance to change.

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	Quantitative Target	Actual
2009	681	672

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Accelerated fertilizer prices and environmental stewardship issues have encouraged livestock producers to seek better approaches to nutrient management. MSUE programming focused on educating and supporting decision makers in developing, implementing and improving nutrient plans.

What has been done

A field day was held at the MSU Beef Purebred and Beef Cattle Research Center during the first day of Ag Expo, July 21, 2009. The goal of this was to showcase environmental protection practices and how those same practices can also be cost-effective to the producer.

Results

Fifty-three of the 157 participants completed evaluation forms. Results indicated that 69% of the livestock producers increased their awareness of environmental impact of livestock production. Areas of planned changes were: 40% improve cattle handling practices, 32% improve hay and feed management/less wastage, 26% improve pasture management with fertilization and fencing and improved management of the animals, 15% consider limited access stream crossings, 12% improve watering systems in pastures for improved livestock performance and environmental stewardship, 12% improve vegetative treatment and or runoff, 11% learned ideas to decrease dollars, and 12% would try slurry or frost seedings.

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	Quantitative Target	Actual
2009	649	576

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Community members acknowledge that the success of the future depends upon today's youth and involving them in solving community issues.

What has been done

In an effort to equip youth with the knowledge and tools to make wise land use decisions in the future, MSU Extension partnered with several organizations and developed a Land Use Learning Series for upper elementary students (4th and 5th grades), as well as trained teachers in how to use the materials in their classrooms. The learning series was designed to be an interactive, educational experience for teachers and students to learn about land use planning and decision-making in their community. In addition, the Land Use Learning Series was tied to the Michigan Curriculum Framework standards established by the Michigan Department of Education.

Results

An evaluation found that 90% of the youth reported knowledge gains in understanding local issues and processes involved in making decisions about land use.

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.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	199	469

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Huron River Watershed is the largest watershed in Washtenaw County, supplying drinking water to over 150,000 people every day. According to the Huron River Watershed Council, three of the five identified water quality problems in the Huron River are related to land use. They include: impervious surfaces, non point source pollution, and soil erosion and sedimentation.

What has been done

The Huron River Watershed Council has a tremendous volunteer

program that works to educate local citizens about the things they can do to improve local water quality. MSUE partnered with the Huron River Watershed Council to educate local youth about the importance of water quality and the things that diminish it.

Results

In 2009, over 2,000 youth were trained in soil, plant and water relationships, with with an evaluation suggesting 87% of the youth had knowledge gains and 92% had experiential opportunities to explore their local environment and learn first-hand about their local environment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
806	Youth Development

Outcome #11

1. Outcome Measures

Number of adult participants with increased knowledge of pollution prevention and mitigation.

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Number of adult participants with increased knowledge of conservation and efficient use of water.

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

Number of youth participants with increased knowledge of conservation and efficient use of water.

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Number of youth participants with increased knowledge of pollution prevention and mitigation.

Not Reporting on this Outcome Measure

Outcome #15**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	Quantitative Target	Actual
2009	5	6

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Urban, industrial and agricultural development have caused remarkable changes in the lakes' flora and fauna and associated habitats over the past 200 years. Today, the lakes have aquatic communities that are structurally and functionally volatile and that 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: determine how fish population dynamics are affected by the physical, chemical and biological environment; investigate how human activities bring about changes in aquatic habitats; develop models capable of predicting response of fish to habitat alteration; and investigate critical areas of uncertainty for Great Lakes fishery management, particularly sea lamprey control and salmon stocking.

Results

The U.S. and Canadian governments spend about \$10 to \$15 million on sea lamprey control annually, mainly relying on TFN, a larvae-killing compound used in freshwater streams. To address environmental concerns about adding the chemical to streams and the potential for lamprey resistance to TFN, researchers have developed a synthetic pheromone that is proving very effective in field experiments in 10 Michigan streams that mimic actual spawning situations -- baited traps are catching 70% to 80% of the females. The tool is also environmentally friendly. The Great Lakes Fishery Commission is considering the adoption of this innovative tool.

Studies investigating the effects of spring fishing and habitat characteristics on the nesting success of individual black bass has allowed researchers to identify the nest from which each fall 'recruit' was produced. This, in turn, allows for the comparison of the relative contribution of nests to recruitment and the ability to determine if the magnitude of each nest's contribution correlates to characteristics such as habitat quality, guarding males bass behavior, nest predator abundance, and/or amount of fishing experienced by the guarding male. Findings have been shared with and are being implemented by the Michigan Department of Natural Resources.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
134	Outdoor Recreation

Outcome #16**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	Quantitative Target	Actual
2009	5	9

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 over 15 million people. Holding about 20% 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: develop a landscape-based ecosystem management framework that integrates landscape ecology with natural resource management and policy; determine why sport fish populations, fish assemblages and lake food webs and their response to perturbation vary among lakes; help develop dynamic, interactive computer interfaces in resource-based recreation management; and understand the potential response of climate and water budget in the Great Lakes region to the common scenarios of global warming.

Results

Researchers are creating innovative tools for water managers in a landscape context so that their solutions consider interactions that take place at all scales, instead of looking at just one ecosystem. Tools developed to date include an inland lake classification system and statistical models for lake monitoring and assessment, and a landscape-based model to set standards for nutrient levels in lakes and streams.

Implementation of a regional climate change modeling framework to more accurately project water budget changes specific to the Great Lakes region has shown that during the past 3 decades, the average annual evaporation across the region is nearly always insufficient to account for the average precipitation in the region, which is partially compensated for by a net gain in moisture due to transport from the south. Research also shows that there has been an increase in evaporation in all seasons over the same time period, with the winter season having the sharpest upward trend. This is consistent with the warming trend over the region and the decreasing trend in winter season ice coverage over lake surfaces. These findings are being shared with natural resource and ag communities to help them make planning decisions that minimize the potential effects of climate change.

4. Associated Knowledge Areas

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

Outcome #17

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	6	6

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 climate, nitrogen management, soil absorption and other environmental interactions.

What has been done

Research to: study the characteristics of sands and high content soil blends used in athletic fields and golf putting greens; establish field studies for phosphorus and potassium; study relationships between plant characteristics, topography and soil properties with an emphasis on soil carbon and soil characteristics related to carbon sequestration; determine the resource value of various organic and inorganic waste residuals as beneficial amendments to cropland; and move toward diversification with cover crops to enhance nutrient cycling efficiency and rhizosphere traits for resilient, productive row crop systems.

Results

Studies using subsurface water retention technology (SWRT) processes is generating information that can be used to make sound economic investment decisions and economic improvements within regions containing predominantly droughty marginal sandy soils statewide, nationally and internationally. Installation and further testing of the SWRT process offers the potential to greatly improve water conservation, carbon sequestration and soil aggregation of the majority of marginal sandy soils across Michigan.

Turfgrass research showed that, within a 6-week period, more than 52 mm of high sand content root zone material can be added, greatly improving the soil properties and athletic field playability. Findings also show that existing turfgrass on an athletic field continues to grow, develop and improve with the topdressings, suggesting that facilities that adopt an aggressive topdressing program for several years can spread costs over time and greatly improve the performance of their facilities.

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 #18

1. Outcome Measures

Number of research programs to develop new recommendations, strategies or assessment tools to better manage soil, water or natural resource system outputs, such as greenhouse gas, carbon, nitrogen and phosphorus.

Not Reporting on this Outcome Measure

Outcome #19

1. Outcome Measures

Number of 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	Quantitative Target	Actual
2009	{No Data Entered}	6

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 reports indicate that by 2020, farmers will have only enough land to meet the nation's domestic food needs.

What has been done

Research to: use analytical geospatial methods, regional databases, simulation models and new sensor technologies to assess change in natural and managed ecosystems; use crop and crop stress models at regional scales and evaluate environmental databases for predicting the occurrence and severity of water, nutrient and disease stresses at regional scales; increase management capacity among agencies to better integrate biological and human dimensions of management in wicked problems, such as wildlife health management; and improve our understanding of the dynamics of agricultural land use changes under both socioeconomic and climatic drivers.

Results

Human-wildlife interactions are becoming increasingly important to manage as rural landscapes become more

urbanized. In Michigan, more than 60,000 deer-vehicle collisions are reported annually. Research findings show that only 53% of these collisions are reported, which means actual deer-vehicle collisions could be well over 100,000 each year. A targeted study found that 1 in 3 people in the study area had either been directly involved or had a family member involved in a deer-vehicle collision in the past 5 years. These and other findings are being shared with wildlife managers to help meet current and future challenges in this arena.

Demonstration sites were established on three farms in southern Michigan to evaluate the integration of swine and dairy manure with cover crops. It is clear so far that the integration of low-disturbance tillage with liquid manure and cover crops is very effective in capturing manure nutrients in the root zone and creating a dense vegetative cover to protect the soil from runoff. At one of the demonstration sites, researchers slurry seeded Daikon radish and forage turnip in wheat stubble to capture the manure nutrients for use in the 2010 corn crop. The slurry seeded radish yielded 3.6 ton/acre; the drilled radish yielded 1.2 ton/acre. The slurry-seeded forage turnip yielded 2.8 ton/acre; the drilled turnip yielded 1.2 ton/acre.

4. Associated Knowledge Areas

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

Outcome #20

1. Outcome Measures

Number of research programs that explore the occurrence, transport, 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	Quantitative Target	Actual
2009	{No Data Entered}	6

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 fuels 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.

What has been done

Research to: better understand soil-contaminant interactions and ways to manage and control the effects of contaminants once they enter the soil; better understand variation in the production and consumption of greenhouse gases by microbial communities in soils; develop soil test procedures to identify correlations with crop yield and plant nutrient content; determine the relationship between crop yield and estimate the impacts of weather and climate on representative crop production systems in Michigan; and control and convert rural waste to resources through animal waste management strategies, biological, chemical and physical treatment for nitrogen

and phosphorus control from crops, food processing, wastewater treatment, and stormwater best management practices.

Results

An investigation into the occurrence and fate of several commonly used veterinary pharmaceuticals (amprolium, carbadox, monesin and tylosin) at an animal farm in Michigan found that these substances were more frequently detected in surface runoff during non-growing season than during growing season. Further, those originating from post-harvest manure application appeared to be more persistent than those from spring application. High concentrations of pharmaceuticals in soils were generally observed in the sites where the respective concentrations in surface water were also high. These findings are being shared with natural resource managers and the ag industry.

Research related to rural sustainable environmental management resulted in the development of a GIS Web-based inventory to estimate waste biomass from farms and several other facilities (<http://MiBiomass.regis.msu.edu>).

Research related to animal waste management strategies using anaerobic digestion continues. Anaerobic digesters have been proven to be biologically sound and have excellent odor control. There are currently six on-farm and three food processor digesters in Michigan, with several additional projects under construction or planned. An Anaerobic Digestion and Education Center is under construction.

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

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.)
- Other (Restructure/redesign)

Brief Explanation

Although requested to add the new national planned program priorities to our POW reports this year, the short notice and several significant factors on our end led us to keep our current planned programs for this reporting year. With the challenges posed by Michigan's economy, the continued uncertainty related to state appropriations for MAES and MSUE funding, the complete redesign of MSUE and the launch of a new, comprehensive five-year needs identification process in 2010 that will inform research and education projects and activities, we felt it prudent to wait to reconfigure our planned programs in next year's POW Update and Annual Report. We stand ready to make the required changes in the next reporting year. In the short term, some of the projects in this planned program will likely be migrated to the the Global Food

Security and Hunger, Climate Change and Food Safety planned programs, with the balance remaining in this program area.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

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%		16%	
202	Plant Genetic Resources	6%		5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	7%		7%	
204	Plant Product Quality and Utility (Preharvest)	5%		5%	
205	Plant Management Systems	30%		17%	
206	Basic Plant Biology	3%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	3%		12%	
212	Pathogens and Nematodes Affecting Plants	15%		12%	
215	Biological Control of Pests Affecting Plants	3%		5%	
216	Integrated Pest Management Systems	20%		10%	
806	Youth Development	3%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	32.0	0.0	20.0	0.0
Actual	29.4	0.0	29.0	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
1968860	0	1631158	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1968860	0	1628213	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	16061221	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, Christmas tree and forestry crops that use the lowest possible inputs of resources and improve yield and quality, while minimizing environmental effects, such as leaching and run-off; develop cultural, management and insect and disease control strategies for crops that meet USDA certified organic standards so Michigan growers can take advantage of this growing market, if they choose to do so; continue to develop biological controls for pest insects and diseases to minimize effects on the environment; continue variety trials for crops important to Michigan, including wheat, corn, soybeans and forages; conduct educational programs to help farm producers control weeds and more effectively manage high-cost fertilizer inputs while optimizing crop production; develop plant disease prediction models; conduct educational programs to help plant producers control disease caused by pathogens and nematodes and teach integrated pest management methods; provide green industry professionals and homeowners with scientifically sound information to enable them to safely and effectively manage their turf, landscapes and gardens, improving efficiency of resources and controlling pests, while reducing pesticide and fertilizer use; train Native American adults in sustainable agriculture.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	7992	15984	1717	0
Actual	10653	21306	3068	0

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

Year: 2009

Plan: 12

Actual: 36

Patents listed

TEC2000-0006-01DIV2, filed 7/14/2008; TEC2000-0006-01DIV1, filed 7/29/08; TEC2008-0056-01Prov, filed 12/18/08; TEC2008-0057-01Prov, filed 9/15/08; TEC2008-0076-01Prov, filed 7/22/08; TEC2008-0076-02Prov, filed 1/31/08; and TEC2008-0076-03Prov, issued 7/31/08, titled 'Regulation of Lipid Metabolism in Plants and Algae.' TEC2008-0059-01PVP, filed 1/21/09, titled 'Breeding and Genetics for the Improvement of Potato; TEC2003-0001-01PVP-UA, filed 11/24/2008; TEC2003-0002-01PVP-UA, filed 11/24/08; TEC2003-0010-01PVP-UA, filed 11/24/08; TEC2009-0036-01PP, filed 4/15/09, titled 'Genetic Improvement of Strawberries and Blueberries.' TEC2008-0075-01Prov, filed 1/28/09, titled 'Molecular Biology of Plant-Bacterial Interactions.' TEC2006-0146-01PCT, issued 2/23/09, titled 'Recovery of Sugars and Pectic Polysaccharides from Plant Materials.' TEC2007-0154-01, filed 10/31/08, titled 'Functional Genomics of the Arabidopsis Chloroplast.' TEC2007-0144-01, filed 11/19/2008, titled 'Chemical Catalysis and Processing for Advanced Biofuels and Biochemicals.' TEC2000-0006001DIV2, filed 7/14/08; TEC2002-020-02US-DIV, filed 10/7/08; TEC2008-0054-01Prov, filed 7/18/08, titled 'Genetic Engineering of Oilseed Crops.' TEC2008-0034-01PCT, filed 4/14/09, titled 'Baculovirus Biotechnology.' TEC2009-0050-01Prov, filed 12/5/08, titled 'Elimination of Airborne Ascospore Inoculum as a Control for Fungal Diseases.' TEC2008-0077-01, filed 10/17/08; TEC2008-0015-01, filed 10/17/08; TEC2008-0015-02, filed 10/17/08; TEC2008-0015-03PCT, filed 10/17/08, titled 'Management of Turfgrass Diseases.' TEC2009-0069-01Prov, filed 5/1/09; TEC2009-0049-01Prov, filed 12/11/2008, titled 'Evaluation of the Specificity and Structure/Function of Taxol Biosynthesis.' TEC2007-0081-01, titled 'Mechanisms of Fungal Pathogenicity.' TEC2005-0057-01CIP1, filed 10/30/2008; TEC2005-0057001DIV1, filed 11/26/08; TEC2005-0057-01TMark, filed 1/15/2009, titled 'Galectins and Pre-mRNA Splicing.' TEC2005-0057-01CIP1, filed 10/30/2008; TEC2005-0057-01DIV1, filed 11/26/08; TEC2005-0057001TMark, filed 1/15/09, titled 'Genetic Improvement of Soybean for Food Value, Yield and Pest Resistance.' TEC2007-0154-01, filed 10/31/08, titled 'A Proteomics Study of Self-Incompatibility.'

3. Publications (Standard General Output Measure)**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	60	
Actual	1	110	111

V(F). State Defined Outputs**Output Target****Output #1****Output Measure**

- Number of research projects on plant sciences.

Year	Target	Actual
2009	65	82

Output #2**Output Measure**

- Number of adult participants trained in plant management systems.

Year	Target	Actual
2009	3996	4947

Output #3**Output Measure**

- Number of youth participants trained in plant management systems.

Year	Target	Actual
2009	1717	3068

Output #4

Output Measure

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

Year	Target	Actual
2009	1332	3180

Output #5

Output Measure

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

Year	Target	Actual
2009	2664	2526

Output #6

Output Measure

- Number of native american adults trained in small scale sustainable agriculture.
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 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 native american adults with increased knowledge in sustainable agriculture.
12	Number of research programs to develop weed control methodologies, protocols and practices.
13	Number of research programs to develop controls for pathogens and nematodes affecting plants.
14	Number of research programs to develop production protocols and environmental and cultural strategies for the floriculture/nursery industry.
15	Number of research programs to develop more effective post-harvest protocols and practices to minimize loss and enhance quality.

Outcome #1**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1459	2679

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

In math and science, U.S. students are being outperformed by the majority of their peers around the world. This is evident in Michigan students where 34% of 8th graders scored below basic levels. A solid foundation of math and science literacy is increasingly important for the future of our youth and society as a whole. Science and math literacy will increasingly impact future adults' ability to understand and make many important decisions at personal, professional and political levels.

What has been done

MSUE developed the Junior Master Gardener program to help students not only learn about math and science, but relate it to plants and gardens and provide an opportunity for community service.

Results

An evaluation of the Wayne County Junior Master Gardener program of 3rd through 5th graders found 75% learned the six things that plants need to grow; 55% could name an insect that was beneficial to the garden; and 53% identified how they planned to volunteer and improve their community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
806	Youth Development

Outcome #2**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1132	2895

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Fruit production is a high input and high value system. Perennial cropping systems such as tree fruit require enormous investment and inputs to maintain current market standards. IPM strategies can: decrease pesticide inputs, slow or prohibit pathogen resistance development, increase fruit quality, decrease industry reliance on pesticides, increase grower profitability, and mitigate the environmental impacts of some agricultural practices.

What has been done

MSUE conducted several programs for fruit growers in the Midwest region of the United States (generally 25% from outside of Michigan). The program included a plant pathologist from Virginia Tech, an entomologist from Washington State University and a plant pathologist from the Ontario Ministry of Agriculture, as well as experts from the Fruit AoE Team.

Results

Sixty-seven (67%) of the participants stated they planned to minimize pesticide inputs, thereby decreasing negative environmental and social impacts associated with some conventional pest management strategies. In addition, 61% believed the change would increase their profitability on their farms.

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	Quantitative Target	Actual
2009	2264	2021

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

In order to utilize restricted use pesticides (RUPs), applicators must be certified by the Michigan Department of Agriculture. Many applicators requested assistance in becoming or staying certified. Applicators may renew their certification by attending educational programs that qualify for renewal credits issued by the MDA.

What has been done

MSUE provided training and study manuals for the tests. Extension agents were the primary resource for the development of a new core manual that was introduced in 2008 and used throughout 2009.

Results

An evaluation of 181 participants regarding the training (besides becoming a certified pesticide applicator) found:

#1 - 74% were more knowledgeable about pesticide & pest control laws & regulations

#2 - 68% practiced better personal safety

#3 - 49% said there was less chance for environmental contamination

#4 - 39% kept records of pesticide applications

#5 - 30% said they had more effective pest control

The wide majority felt that laws & regulations were the most difficult part.

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	Quantitative Target	Actual
2009	2	2

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

American organic farms represent only 1% of the total U.S. farms, with 14,540 farms out of 2.2 million total, and 4.1 million acres of land out of 922 million acres used by all U.S. farms. Despite their small numbers, these farms generated \$3.16 billion in 2008. Michigan has 230 organic farmers and just under 50,000 certified organic acres. As this only represents about .45% of total farmed acreage in Michigan, additional ways to increase production and marketing efficiencies is important if organic growers are to remain economically viable. Further, to ensure organic growers continue to be a contributor to this \$10 billion market, they need pest control methods that conform to organic standards and allow them to produce plentiful, pest-free crops.

What has been done

Passive solar greenhouses were built on farms in three locations where farmers in the study were already selling produce at the same farmers' market in each location. The objective was to measure the economic impact of season extension on farm income and the farmers' market. Yield data were also collected for a similar passive greenhouse located on an organic teaching farm.

Results

Real time digital video identification (RTVI) of pollinators and mummy berry vectors in organic and conventional blueberries suggests that native bees and flies may share equal responsibility for transferring mummy berry, a fungal disease of major importance in Michigan and the northern and southern highbush blueberry regions, where it causes considerable damage to the fruit. It was previously believed that honey bees were the major mover of the pathogen. These findings will be used to develop best management practices to maximize pollination and minimize pathogen transfer for both organic and conventional growers.

RTVI of dogwood borer, lesser peachtree borer, codling moth, Oriental fruit moth and grape berry moth -- all economically important pest species -- show that all respond differently to varying dosages of pheromone. As the use of pheromones is now the foundation of most pest management practices related to these species, this information will be used to develop more effective mating disruption strategies for the industry, especially organic growers.

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	Quantitative Target	Actual
2009	3	9

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

Research conducted at 5 different locations over a period of 6 years to investigate the efficacy of Imidacloprid applied each spring as a basal soil drench to protect against emerald ash borer showed that these drenches gave complete protection of ash trees for 3 years. At 3 sites where the size of trees ranged from 23-37 cm dbh, researchers successfully protected all ash trees with less than 60% canopy trimming. Analysis showed that tree size explains 46% of the variation in efficacy of the drenches. The smallest trees (<30 cm dbh) remained in excellent condition for 3 years, while most of the largest trees (>38 cm dbh) declined to a weakened state and undesirable appearance, suggesting the need to increase treatment rates for larger trees.

Research results from the past 3 three years document a 55% reduction in Japanese grubs from October to April, where *Ovavesicula* is active. In addition, infected females do not produce as many eggs. This combined impact gives an average population reduction of 64% per year due to *Ovavesicula*. This level of sustained natural biological control has reduced populations of Japanese beetles in the Kalamazoo and Battle Creek areas to the point where very little feeding damage is now found on Linden trees or to turfgrass in fairways.

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	Quantitative Target	Actual
2009	5	5

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 more than 200 commercially grown commodities.

What has been done

Research to: determine the effects of nitrogen deposition and cropping treatments on the ecology and evolution of the legume-rhizobium mutualism; decrease reliance on conventional crop protection practices by using low environmental impact fungicides in combination with host resistance; increase the environmental and economic sustainability of small fruit production in Michigan by integrating various disease control options; and collaborate on innovative orchard management strategies and technologies.

Results

Dry bean plots in Frankenmuth, MI had an epidemic of common bacterial blight (CBB) and white mold due to high rainfall in June/July. As a result, researchers were able to identify high levels of CBB resistance in several market classes. The highest-yielding entries had the highest levels of CBB resistance. Yields averaged 24-31 cwt/acre and the best lines exceeded 35 cwt/acre.

Pinto lines under white mold pressure studied for inheritance of resistance showed the same line that has topped the trial for 3 years yielded 43.8 cwt/acre compared to the test mean of 34.8 cwt/ac. This represents a significant improvement that could permit the growing of pinto beans in narrow row management systems suitable for direct harvest.

Certified seed of 3 new MSU bean varieties (Zorro black, Santa Fe pinto and Fuji otebo) were produced.

Research investigating how nitrogen (N) deposition influences the ecological and evolutionary outcomes of the Trifolium-rhizobium mutualism showed that strains isolated from high N environments have evolved to confer fewer fitness benefits to plants than strains isolated from low N environments.

Research investigating high tunnel production system development for sweet cherries showed that temperature management remains a key factor for early covering of high tunnels, as some abnormal flower development was

present in those tunnels covered earliest.

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	Quantitative Target	Actual
2009	5	22

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

As the world population increases and the demand for food and fuel relies more heavily on agricultural products, efficient methods of plant transformation will be required. While 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 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: breed new varieties of blueberry, strawberry and cherry cultivars for Michigan that are resistant to a common array of biotic and abiotic stresses; better understand breeding and genetics for improvement of soybean and potato for food value, yield and pest resistance; determine how to enhance resistance to plant invaders; develop a novel transformation system that is suitable for large seeded legumes; and exploring ways to increase the amount of plant oil that can be produced and extracted from the seeds and tissues of certain crops.

Results

A germplasm field trial to test response to downy mildew resulted in several new, highly promising breeding lines with good yield under conditions in which most lines failed to produce fruit.

Research to develop late blight resistant advanced breeding lines in potato varieties resulted in 10 lines with late blight resistance that are being targeted for on-farm trials to test their agronomic performance. This late blight resistance breeding effort is leading variety development.

A new soybean germplasm with aphid resistance was released to the soybean industry in 2009. In addition, 41 soybean varieties from 14 seed companies were tested for resistance to Schlerotinia stem rot and their performance under disease pressure.

Experiments confirmed the efficacy of the experimental antibiotic Kasugamycin for blossom blight control under Michigan conditions. Control levels were similar to those of streptomycin, the industry standard.

Dry bean experiments have led to the identification of a novel transformation system (electrotransformation)-- a promising method of plant transformation that will enable the modification of dry bean and perhaps other species.

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	Quantitative Target	Actual
2009	3	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 move them from one plant to another.

What has been done

Research to: determine foliage thresholds based on the assimilation and storage of carbon; test remote sensing techniques and stress response detection; understand the genetic mechanisms by which plants tolerate environmental stresses; determine how to enhance resistance to plant invaders; and examine plant-microbe interactions.

Results

Research demonstrated that depolymerization of the actin cytoskeleton (allows movement of cells and cellular processes) is required for full activation of resistance in Arabidopsis following perception of the *P. syringae* bacterium. This finding has allowed for the development of "in planta" methods to visualize the actin cytoskeleton, in real time, following pathogen infection. This work has numerous applications, both in general cell biology and plant-pathogen interactions.

Researchers investigating petunia development rate at low temperatures identified wild relative species of the cultivated petunia that exhibited faster development rates than modern cultivars and could serve as useful genetic sources to develop cultivars with decreased production time.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	6	18

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 more than 1 million jobs. Michigan is also one of the most diverse agricultural industries in the U.S., growing more than 200 commodities. 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. Developing improved crop varieties is critical to sustaining an economically viable agriculture industry.

What has been done

Research to: test new strategies for sustainable vegetable production; develop management practices for improving grain yield and profitability in corn and soybean production systems; improve soft white and red winter wheat varieties adapted to Michigan and the surrounding region; characterize and identify the genes responsible for conferring mutant phenotypes during fruit development and ripening of tomato; determine the biochemical mechanisms that cause self-incompatibility in sweet cherry; and develop a data driven protocol for cultures of juice grape cultivars (Concord and Niagara) in Michigan that will produce maximum annual sustainable yields under highly variable annual growing conditions.

Results

A new highbush blueberry cultivar, Huron, was offered to propagators in 2009. It is a productive, early ripening cultivar with very high fresh market quality and a long storage life.

Research results showed that high tunnel environments double or triple raspberry yields (compared to field plantings), increase berry size and reduce berry rot by 70% to 80%.

An MSU line of soft, white wheat earned the highest ratings of its class in a Soft Wheat Quality Council quality evaluation. The wheat line (D8006W) scored highest because of its moderate resistance to viruses such as stripe rust and wheat spindle streak mosaic virus, and its superior milling and baking properties. Two wheat cultivars, Red Amber and Coral, were also commercially released in 2009 based on exceptional performance trial results.

197 soybean varieties from 19 seed companies were tested at 7 locations throughout Michigan for agronomic performance and seed quality. The performance data of each variety were distributed to Michigan soybean growers.

Research to determine the juice grape crop range that could be matured over a variety of growing season types, while maintaining the vine's capability to return with a full crop potential the next season, resulted in the development of a tool that can be used to anticipate final crop and then adjust crop load accordingly to reach the fruit quality target.

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	Quantitative Target	Actual
2009	3397	6947

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Michigan needs new opportunities for small business and citizens to create new products and/or reach new markets for improving the economy and resources to the local communities.

What has been done

A two-week tour that involved a partnership between the MSUE AOE team, MSU and seven greenhouse propagators had over 1480 individuals from 10 states attend this self-guided tour to see new varieties of plants that they can include the following year in their stores, retail greenhouse, landscapes or commercial sites. The audience was comprised of greenhouse retailers, wholesalers, landscapers, garden managers and sales staff. A brochure developed by MSU went to over 5000 businesses.

Results

As a result of attending the Michigan Garden Plant Tour, attendees responding to an MSU Extension evaluation using Survey Monkey.com (n=62 responses) found 39.7% would be offering for purchase one to five new plants in 2009, 44.1 % would be offering six-16 new plants, and 16.2 % would offer 17 or more new plants. The increase in revenue was estimated by participants who responded to the survey at \$286,000. This effort helped Michigan greenhouse plant propagators maintain their position in the industry nationally.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #11

1. Outcome Measures

Number of native american adults with increased knowledge in sustainable agriculture.

Not Reporting on this Outcome Measure

Outcome #12

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	Quantitative Target	Actual
2009	4	6

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 also may 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 the North Central Region. It is estimated that losses due to weeds left uncontrolled exceed \$7.5 billion in the U.S.

What has been done

Research to: understand the degree to which weeds affect crop establishment and production in traditional and emerging cropping systems; determine the mode of action and basis for selectivity and fate of new or potentially new herbicides for weed control in agronomic crops in Michigan; help define management strategies that address shifts in weed populations; and identify effective and safe herbicides for weed control in fruit, vegetable and ornamental crops.

Results

Experiments to determine weed control efficacy and crop injury of new herbicides on apples showed that: Flumioxazin applied in the fall at .383 lb/acre plus glyphosate provided 100% control of all weeds until June 1, after which horseweed, white clover, wild carrot and perennial ryegrass emerged; Saflufenacil applied at .045 lb/acre in mid-April gave good control of horseweed and other broadleaves until August 1, but was weak on curly dock, dandelion and mustards and did not control grasses. Rimsulfuron applied at .064 lb/acre in mid-April suppressed most broadleaves until early June, while application in early May and reapplied in early June maintained better weed control through September 1. Sulfentrazone applied at .375 lb/acre controlled common chickweed, knotweed and common lambsquarters. Mesotrione applied at .188 lb/acre in April suppressed all broadleaves through June 1, but didn't control grasses. Terbacil applied at 2.4 lb/acre in April controlled all weeds through July 1. None of the treatments caused visual injury to the apple.

Studies of the temporal seed dispersal and subsequent dormancy of naturally occurring populations of the winter annual weeds pennycress and common chickweed demonstrated that growing degree days are a good predictor of peak seed dispersal and dormancy release for field pennycress, but not for common chickweed.

4. Associated Knowledge Areas

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

Outcome #13

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	Quantitative Target	Actual
2009	4	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: 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; examine methods and problems associated with controlling disease in agriculture; and design and develop integrated management strategies for plant-parasitic nematodes that include consideration of environment and genetic variability.

Results

Research on the use of hypoviruses as agents of biological control of blight in chestnut populations in Michigan and West Salem, Wisconsin showed that cankers (dead sections of bark on branches or main trunks of trees) acquire hypovirus very rapidly, but the proportion of the canker with hypovirus reaches a maximum of approximately 43% within two years of treatment. Analysis of tree growth and mortality indicate that stem dieback is near certain for untreated trees, while nearly 40% main stems of trees treated with hypovirus remain alive for eight years or more. Twenty-one percent of untreated trees have died over the period from 2004 to 2009, while only 14% of the treated trees died over the same period.

Research on the development of low-impact, environmentally sound integrated pest management systems to control the plum curculio, apple maggot fly and cherry fruit fly shows that, in order for biopesticides to become a tool of choice for controlling this complex set of internal feeders, environmental alternations of the orchard understory are necessary. Microsprinklers and fabric ground cover created a microclimate modification that significantly enhanced control in fruit orchards by targeting pests in their soil-phase development cycle.

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 #14

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	Quantitative Target	Actual
------	---------------------	--------

2009 {No Data Entered} 7

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

The wholesale value of floriculture crops produced in Michigan is more than \$370 million annually. There are almost 700 floriculture companies in Michigan, with over half of them reporting wholesale sales of more than \$100,000. Total greenhouse cover is 48.2 million square feet with an additional 3,620 acres of open ground used for floriculture production.

What has been done

Research to: evaluate turfgrass species and mixes for their adaptation to athletic field turf and to assess the effects of cultural practices; investigate nitrogen fate in turfgrass; develop protocols that growers and retailers can use to produce and profitably sell perennials as new floriculture crops; promote the use of less utilized eastern hardwood species for interior and exterior applications where biological and physical deterioration is a limiting factor for their utilization; and evaluate several perennial semi-aquatic or aquatic plants for use in the phytoremediation of nursery runoff water.

Results

Studies to determine the effect of common landscape mulches (pine, hardwood, cypress, color enhanced ground pallets) on soil moisture, soil pH, weed control, and physiology and growth of landscape shrubs found that all mulches increased soil moisture compared to no mulch + weed control.

Conventional processes do not seem to provide a means to consistently treat red pine to achieve industry standards. An innovative co-extrusion process was developed to manufacture wood-plastic composite lumber with enhanced overall mechanical performance as well as improved resistance to biological agents and ultraviolet light when compared to composites made with a conventional extrusion process.

4. Associated Knowledge Areas

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

Outcome #15**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

Research to: elaborate temperature-dependent models for packaging of horticultural products in perforated and non-perforated packaging film materials and evaluate the impact of the differences in atmosphere on product quality; evaluate postharvest requirements of new and existing fruit varieties; develop fruit plant canopies and management systems that fit with advances in computer and mechanical technology to achieve maximum efficiency and sustainable practices that conserve energy and resources in producing quality fruit.

Results

A process to separate soluble pectic polysaccharides and sugars from the fibrous material in sugar beet pulp has been streamlined using a new solubilization protocol that liberates free sugars and derivatives them for separation at the same time. A patent has been issued for this process, opening the way for its commercialization.

Ongoing studies related to mechanical grape harvesters found that using the Oxbo 9000 to harvest several types of tart cherries, the most efficient vibration frequency was 1,000 RPM, and that lower RPM resulted in more fruit left on the tree. Fruit removal was most efficient at the highest vibration amplitude (distance of the tine-end travel) with the Oxbo 9000. It was also determined that 1.5 mph was the optimum speed of travel for these bush style canopy trees. Varieties and selections that were most accommodating for fruit removal by this machine had the most willowy growth habit as compared to those with a more "spur-type" growth habit. The machine was also tested on 4 acres of a commercial orchard and was very efficient in fruit removal.

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

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.)
- Other (Redesign/restructure)

Brief Explanation

Although requested to add the new national planned program priorities to our POW reports this year, the short notice and several significant factors on our end led us to keep our current planned programs for this reporting year. With the challenges posed by Michigan's economy, the continued uncertainty related to state

appropriations for MAES and MSUE funding, the complete redesign of MSUE and the launch of a new, comprehensive five-year needs identification process in 2010 that will inform research and education projects and activities, we felt it prudent to wait to reconfigure our planned programs in next year's POW Update and Annual Report. We stand ready to make the required changes in the next reporting year. In the short term, a number of the projects in this planned program will likely be migrated to the Global Food Security and Hunger, Climate Change, Sustainable and Food Safety planned programs, with the balance remaining in this program area.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

Significant Reduction in Grub Problem: Research to Education to Evaluation

MAES and MSUE collaborated on an initiative to reduce a major grub problem in Kalamazoo, Eaton and Ingham Counties where faculty from the MSU Department of Entomology provided research-based information, consultation and jointly trained with the MSUE educators. Other collaborators included: Landscape Crop Advisory Team, Consumer Horticulture AoE Team, Advanced Master Gardeners, and area agribusinesses.

Approximately 100 lawn care companies (with a special effort in reaching minority owned companies were given information with field demonstrations on pesticide use and trained on topics of grub controlled that included when possible, organic control methods. The sessions were evaluated for the immediate impact in terms of knowledge and awareness gained by participants that found the majority (81%) planned to use information learned.

One example of a long term impact from this training found research results from the last three years document a 55% reduction in Japanese grubs from October to April, where *Ovavesicula* is active. In addition, infected females do not produce as many eggs. This combined impact gives an average population reduction of 64% per year due to *Ovavesicula*. This level of sustained natural biological control has reduced populations of Japanese beetles in the Kalamazoo and Battle Creek areas to the point where very little feeding damage is now found on Linden trees or to turfgrass in fairways.

Key Items of Evaluation

V(A). Planned Program (Summary)**Program # 4****1. Name of the Planned Program**

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

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
401	Structures, Facilities, and General Purpose Farm Supplies	3%		3%	
402	Engineering Systems and Equipment	6%		6%	
403	Waste Disposal, Recycling, and Reuse	6%		14%	
404	Instrumentation and Control Systems	11%		9%	
501	New and Improved Food Processing Technologies	18%		14%	
502	New and Improved Food Products	17%		15%	
503	Quality Maintenance in Storing and Marketing Food Products	18%		18%	
511	New and Improved Non-Food Products and Processes	16%		16%	
512	Quality Maintenance in Storing and Marketing Non-Food Products	5%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	10.0	0.0
Actual	1.2	0.0	8.0	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
84179	0	582556	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
84179	0	581505	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	5736150	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research to: connect Michigan industries with the research, education and entrepreneurial activity needed in the basic sciences, engineering, plant science and agriculture to provide the state with a foundation for vigorous development of a new biobased economic sector; identify and isolate beneficial plant compounds that can be used to make new functional foods; develop the processes and technologies to manufacture functional foods; pursue new artisan distilling process technology for raw material pretreatment, fermentation, distillation and aging; develop innovative processing that adds value to fresh or processed meat products; identify breeding and genetic improvements related to food quality, nutrition and processing; develop packaging systems to enhance food quality and shelf life; develop new biosensors and 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 Giardia; and train native american adults on energy crops and renewable resources.

2. Brief description of the target audience

Agriculture and natural resources industry representatives, crop and animal producers, biotechnology company representatives, state agency representatives, private citizens, small and medium-sized entrepreneurs, Native American growers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	30	50	0	0
Actual	38	75	0	0

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

Patent Applications Submitted

Year: 2009

Plan: 7

Actual: 13

Patents listed

TEC2006-0021-01, filed 9/27/08, TEC2007-0082-01, filed 11/26/08, TEC2009-0053-01Prov, filed 3/2/09, TEC2009-0053-2Prov, filed 5/14/09, titled 'Development of Nano-Structured Biosensors for Rapid Detection of Disease-causing Agents in Food and Water'; TEC2003-0059-01DIV1, filed 10/6/08, titled 'Aflatoxin B1 Biosynthesis in Aspergillus'; TEC2007-0144-01, filed 11/19/08, titled Bio-derived Fuels and Chemicals: Facilitating Development Through Property Systems Modeling; TEC2009-0021-01Prov, filed 3/7/09, titled Microbial Foodborne Disease; TEC2009-0023-01Prov, filed 12/12/08, TEC2009-0023-02-Prov, filed 1/16/09, TEC2008-0011-01, filed 8/29/08, TEC2008-0011-01PCT, filed 8/29/08, TEC2007-0155-01PCT, titled 'Characterizing Packaging Systems Through the Assessment of Mass Transfer and Degradability of Biopolymers'; and TEC2009-0160-01Prov, filed 5/4/09, titled 'Nanostructured Interfaces for Biocatalysis.'

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	28	
Actual	0	28	29

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research projects focusing on food quality, nutrition, engineering and processing.

Year	Target	Actual
2009	30	24

Output #2

Output Measure

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

Year	Target	Actual
2009	30	38

Output #3

Output Measure

- Number of native american adults trained in energy crops and renewable resources.
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 that focus on providing the state with a foundation for the development of a new biobased economic sector.
2	Number of research programs to develop the processes and technologies to manufacture functional foods.
3	Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E. coli, Salmonella, Listeria, Campylobacter, Cryptosporidium and
4	Number of adults with new and improved knowledge on non-food and bioeconomy related products and processes.
5	Number of native american adults with improved knowledge on energy crops and renewable resrouces.
6	Number of research programs to identify breeding and genetic improvement related to food quality, nutrition and processing.
7	Number of research programs to develop packaging systems to enhance food quality and shelf life.

Outcome #1**1. Outcome Measures**

Number of research programs that focus on providing the state with a foundation for the development of a new biobased economic sector.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1	2

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Michigan, along with many other states, is struggling to revitalize its economy. A critical component of the state's (and the nation's) revitalization effort is to decrease dependence on foreign oil, while creating jobs and encouraging further alternative energy investments. These efforts will have a significant impact on agriculture and manufacturing throughout the Great Lakes region and beyond as sustainable alternatives to petroleum-based products are developed to help boost the state's economy.

What has been done

Research to: develop innovative bioelectrocatalytic reactors that achieve mediated electron transfer to dehydrogenases and optimize the reactor's performance for coupled bioconversions having commercialization potential; and facilitate the development of bio-derived fuels and chemicals through property characterization.

Results

A process was developed for the recovery of succinic acid from fermentation solutions. Succinic acid has enormous global demand for everything from industrial solvents and biodegradable polymers to airport runway de-icers. Succinic acid is made from natural sugars, such as Michigan corn, and serves as a starting point for chemicals that can: lower the freezing point of water and thus be used to make safer engine coolants and jet runway de-icers; find uses in biodegradable industrial solvents that pose little threat of air pollution or ozone damage; or make biodegradable polymers for car parts such as dashboards.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
511	New and Improved Non-Food Products and Processes
512	Quality Maintenance in Storing and Marketing Non-Food Products

Outcome #2**1. Outcome Measures**

Number of research programs to develop the processes and technologies to manufacture functional foods.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	5	8

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Dwindling farm acreage, more expensive production and processing costs and increased consumer expectations have prompted research into creating new -- and enhancing existing -- processes and technologies that manufacture healthy, functional foods. More significant, perhaps, is the potential of functional foods to mitigate disease, promote health and reduce health care costs.

What has been done

Research to: identify, develop and/or apply technology to ensure that the Michigan fruit, vegetable and chestnut industries remain economically and environmentally sustainable; develop and process dairy foods that are consistent with the benefits of ingesting probiotics; develop improved methods for the design and operation of thermal processing systems for protein foods; develop technologies to support management systems for quality grains and oil seeds; evaluate the efficacy of processes and ingredients that impact known safety hazards in muscle foods; and pursue new process technology for raw material pretreatment, fermentation, distillation and aging related to artisan distilling.

Results

As demand for chestnuts increases, scientists are helping the industry scale their production practices up from boutique to commercial. Research has found that CT scanning appears to give the most reliable, information about internal chestnut structure, quickly and accurately informing producers as to whether a chestnut is good or rotten. This finding could lead to the development of lab sensors, also called electronic noses, that distinguish decayed from healthy chestnuts, and could increase scanning capability from several chestnuts per hour to 10 per second.

Research is proving that X-rays can kill bacterial pathogens such as E. coli 0157:H7 and salmonella on the most delicate vegetables, extending shelf life in the bargain. Irradiation from other sources has been used for years to protect ground meat and other products, essentially pasteurizing food without cooking it. Work to date has shown that X-ray technology is very effective in killing the bacterial pathogens without causing undesirable changes in product quality. Researchers are currently working to validate technology being commercialized by Rayfresh Foods Inc., of Ann Arbor, Mich.

4. Associated Knowledge Areas

KA Code Knowledge Area

501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #3

1. Outcome Measures

Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E. coli, Salmonella, Listeria, Campylobacter, Cryptosporidium and

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	3	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 U.S., 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: synthesize, characterize and evaluate nanostructured interfaces that enable molecular level investigations of systems of medical, scientific and technological interests; investigate using radio frequency identification (RFID) in tracking, tracing and security issues related to the movement of goods through the supply chain; and to combine the novelty of nanoscale transducing material and biosensing techniques to address the detection and diagnostic challenges in food and water safety.

Results

Because of its research leadership and expertise, the MSU Auto-ID Research and Testing Center is now the go-to source for Auto-ID and radio frequency identification procedures and development for the American Society of Testing & Materials and the International Organization for Standardization. The center is also a certified International Safe Transit Association test lab. In the past year, two international test standards from the lab were submitted and approved.

Research findings related to the bio-barcode DNA biosensor research project have demonstrated that bismuth film coating on the working electrode in the biosensor improved the peak current voltametry of lead, compared to a bare electrochemical surface, increasing sensitivity/detection potential. A "green" method to create some of the materials used to build biosensors has also been developed and verified. Instead of producing the particles traditionally using the standard chemical method, researchers have discovered a way to use the natural processes of bacteria to develop these materials, making this work more environmentally friendly.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	30	31

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Bioenergy is a hot topic with many different things happening in many different areas. Some basic and advanced training was needed to provide a baseline of knowledge for MSUE educators and community partners to be able to work in their communities in the bioeconomy.

What has been done

A bioenergy bus tour to Iowa and training was planned and implemented by the Field Crop AoE Team. Materials and a Web site were developed for bioenergy. The Web site has an RSS feed that allows communication with educators and partners about current happenings in the bioenergy area. Inservice trainings were also presented at North Region Ag Agents Retreat, the Bioeconomy Meeting with the MSU Product Center, and with the Biosystems Engineering Department which continues to help with both integration and multi-state activities for MSUE.

Results

Notecard after each stop on the tour was filled out asking participants to rate their increase in knowledge, with the average increase being 69.8% (changes ranged from 51.7 to 81.3 percent). A follow-up survey found participants planned to use knowledge gains to start new ventures that included: wind (n=15), utilizing agricultural wastes (n=14), anaerobic digestion (n=10), sustainable biomass production (n=11), cellulosic ethanol (n=9), corn ethanol (n=8), greenhouse gas reductions using bioenergy (n=7), biocomposites and solar (n=6 for both), and biodiesel (n=5).

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #5

1. Outcome Measures

Number of native american adults with improved knowledge on energy crops and renewable resrouces.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	5	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Genetic diversity is required to meet certain production needs in plant and animal agriculture to allow for sustained genetic improvement, and to facilitate rapid adaptation to changing breeding objectives. Recent efforts in gene discovery and functional genomics are providing the necessary understanding to develop and evaluate different approaches to manipulate phytochemical composition.

What has been done

Research to: better determine the metabolism and function of Vitamin A; assess the risk of foodborne trichothecenes to humans and ameliorate the risk by dietary intervention; understand the process of E. coli chromosomal DNA replication and its regulation at the biochemical level; identify protein markers that are indicators for soft wheat processing quality; limit human exposure to aflatoxin in food to help prevent liver cancer; determine the effects of dietary zinc on the immune response; characterize the role of hypoxia in metal-induced toxicity; better understand the pathogenicity factors of gram-negative bacteria; and developing innovative processing that adds value to fresh or processed meat products.

Results

Research results from investigating hot-boned turkey processing demonstrated that the rapid chilling of hot-boned muscle is important and required to prevent muscle softening, especially when the muscle was ground or macerated in industrial scales. Further, the results of finished products during 60 days of storage indicated that the hot-boned meat pieces were not only firmly bound in the beginning of storage but maintained firmness for the entire storage period compared to warm-boned and chill-boned samples.

Through reconstitution studies between two wheat varieties (Caledonia and NuHorizon), it was found that the starch fraction of wheat flour plays a dominant role in governing the texture of noodles, followed by water-soluble

fractions and the type of protein. These findings will be used to further enhance noodle quality.

Approximately 34 million Americans have been diagnosed with asthma, and treatments cost about \$19 billion annually. Understanding the etiology and progression of the disease is, therefore, important for our national health. Research established hypoxia inducible factor (HIF1)-mediated signaling as important factors in asthma-like pathology. More importantly, the data suggests that HIF1 might be a susceptibility gene for asthma.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

Outcome #7

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	2	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In packaging systems, chlorine dioxide gas used for vapor-phase decontamination in treating produce before packaging and sanitizing products inside their packages. Yet very little is known about its effects on packaging material properties and performances. In terms of containers themselves, use of a reusable plastic-based packaging system would greatly reduce the costs associated with packaging and address environmental issues.

What has been done

Research to: develop and use new types of packaging systems for fruits and vegetables; and promote the functional and sustainable package systems that optimize the utilization of raw materials.

Results

Research investigating the effect of vibration during transport on the shape and size of fresh-cut fruit packaged in various thermoformed plastic containers showed that vibration during transport accelerates aroma release and positive sensory attributes, and that certain container shapes enhance shelf life based on testing of quality attributes and sensory evaluation. These findings are being shared with leading retailers, such as Walmart, and fresh produce growers such as Dole, Driscoll, Tainamura & Antle to advance their sustainable packaging initiatives.

Each year, non-degradable plastic mulch covers more than 30 million acres worldwide and about 3 million acres in the U.S. Disposal of this mulch represents a huge cost to growers and also adds nearly 2 billion pounds of

waste plastic to landfills. Research has identified a viable biodegradable film in lab tests and is ready to test the film on a larger scale. The use of films that degrade and integrate into the soil could eliminate removal and disposal costs -- about \$100 per acre -- and reduce pesticide and herbicide use.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
503	Quality Maintenance in Storing and Marketing Food Products

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Although requested to add the new national planned program priorities to our POW reports this year, the short notice and several significant factors on our end led us to keep our current planned programs for this reporting year. With the challenges posed by Michigan's economy, the continued uncertainty related to state appropriations for MAES and MSUE funding, the complete redesign of MSUE and the launch of a new, comprehensive five-year needs identification process in 2010 that will inform research and education projects and activities, we felt it prudent to wait to reconfigure our planned programs in next year's POW Update and Annual Report. We stand ready to make the required changes in the next reporting year. In the short term, a good number of the projects in this planned program will likely be migrated to the Sustainable Energy and Food Safety planned programs.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparison between locales where the program operates and sites without program intervention

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	20%		12%	
602	Business Management, Finance, and Taxation	12%		10%	
603	Market Economics	3%		7%	
604	Marketing and Distribution Practices	5%		5%	
605	Natural Resource and Environmental Economics	22%		14%	
606	International Trade and Development	3%		9%	
608	Community Resource Planning and Development	26%		12%	
609	Economic Theory and Methods	3%		13%	
610	Domestic Policy Analysis	5%		11%	
611	Foreign Policy and Programs	1%		7%	
	Total	100%		100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	28.0	0.0	11.0	0.0
Actual	43.6	0.0	10.0	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
2920554	0	593653	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2920554	0	592581	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	5845410	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; identify and evaluate the policy, technology and marketing issues faced by Michigan organic growers and develop responses; 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; local, state and federal elected officials.

V(E). Planned Program (Outputs)**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	4717	9434	0	0
Actual	5210	10420	0	0

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

Year: 2009

Plan: 1

Actual: 7

Patents listed

TEC2005-0028-01US, filed 6/22/09; TEC2005-0030-01, filed 8/8/08; TEC2006-0131-01US2, filed 10/27/08; TEC2007-0035-01, filed 8/21/08; TEC2007-0132-01, filed 10/3/08; TEC2007-0132-01PCT, filed 10/3/08; and TEC2009-0068-01Prov, filed 5/21/09, titled 'Regional Biomass Processing Centers for Sustainable Biofuels and Animal Feeds.'

3. Publications (Standard General Output Measure)**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	35	
Actual	1	35	36

V(F). State Defined Outputs**Output Target****Output #1****Output Measure**

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

Year	Target	Actual
2009	25	28

Output #2**Output Measure**

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

Year	Target	Actual
2009	861	890

Output #3**Output Measure**

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

Year	Target	Actual
2009	1734	1690

Output #4**Output Measure**

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

Year	Target	Actual
2009	512	1119

Output #5**Output Measure**

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

Year	Target	Actual
2009	1610	1511

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Number of adult participants trained in economics of agricultural production and farm management.
2	Number of adult participants trained in business management, finance and taxation.
3	Number of adult participants trained in natural resource and environmental economics.
4	Number of adult participants trained 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 of Michigan farm markets, greenhouses and other green industry retailers.
8	Number of research programs to identify and evaluate human resources management practices in Michigan agricultural and green industries.
9	Number of research programs to develop a framework to understand and analyze domestic and international trade policies and assess their impact on Michigan.
10	Number of research programs to develop models to estimate the demand for and value of recreational fisheries and wildlife resources.
11	Number of research programs to identify and evaluate the policy, technology and marketing issues faced by Michigan organic growers and develop responses.
12	Number of research programs to evaluate the competitiveness and marketing strategies and human resource management practices in Michigan agricultural and green industries.

Outcome #1**1. Outcome Measures**

Number of adult participants trained 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	Quantitative Target	Actual
2009	732	757

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

One example, the FIRM Area of Expertise Team, played a key role in organizing special in-service programs addressing the issue of the adverse economic climate facing the livestock industry that connected to the volatile biofuel industry.

What has been done

There were eight different locations of the workshop across Michigan. A key concept presented by the FIRM AoE was the Partial Budgeting powerpoint and the Partial Budgeting worksheet for participants. The objective for partial budgeting was to build skills and knowledge using this tool to consider the economic implications of comparing new methods and new technologies.

Results

There were 192 participants, with an average herd size of 190 cows and five FTE employees per farm. The results of the evaluation found: 66% learned new realities of feeding cows; 77% learned how to evaluate feed and feeding alternatives; 70% learned about the economics of milk replacer use; 51% learned new budgeting tools - using partial budgets; and 87% reported they would implement changes in their management based on the information obtained from the workshop.

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 trained in business management, finance and taxation.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1474	1437

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

One example, tax management, is a high priority that can save producers thousands of dollars. One of the benefits of the TELFARM system for producers is the offering of this educational program so producers can learn about new tax changes and how to best utilize these law changes to their advantage.

What has been done

A series of steps were established to plan for and schedule county-by-county appointments for individual farms to have a sit down meeting to review production and financial activity for 2008 and develop a year-end tactical plan that would help ensure the farm's profitability and that its income tax situation was managed.

Results

Each of the over 50 farms that participated in these sessions found that, as a group, over \$1,300,000 of income taxes were avoided for an average of over \$29,000 for each farm's investment in the two-hour session.

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 trained in natural resource and environmental economics.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	435	951

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Public awareness of, and access to, our natural resources is critical to Michigan communities. An important role is educating citizens about how natural resource and environmental quality play in fostering a healthier lifestyle while, at the same time, a viable local economy. Heightened awareness can serve to build community capacity to improve access to existing resources and develop future resource recreation opportunities.

What has been done

One example is where MSUE facilitated the development of a countywide Purchase of Development Rights Program, as well as provided information about the importance of maintaining a critical mass of undeveloped, productive farmland to retain the vitality of the county's agricultural economy.

Results

On December 15, 2009, the St. Joseph County Board of Commissioners accepted a donation of agricultural conservation easements totaling 953 acres. The farmland was the first to be preserved by the County Farmland Preservation Program. The donation is also believed to be the largest agricultural conservation easement ever donated in the state. A second donation of 347 acres along the Portage River in Park Township held by the Southwest Michigan Land Conservancy, and 253 acres of agricultural conservation easement in Fawn River Township held by the Michigan Department of Agriculture, brought the total acreage of permanently preserved farmland on this initiative up to 1,553 acres with an estimated value of \$1,333,000. The preservation of over 1,000 acres of farmland and open space is an important milestone that marks the culmination of nearly four years of work with landowners and local boards and commissioners.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #4**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1368	1284

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Regional consumers express increased interest in purchasing local farm goods. In addition, urban food markets have struggled during the difficult economic times and have started new renovations and management upgrades

as well encouraging increased entrepreneurship.

What has been done

MSUE and the MSU Product Center collaborated with Detroit's Eastern Market to assist more than 50 entrepreneurs in the development of food products in Southeast Michigan. This initiative connected regional consumers with new food products through existing vendors and merchants at the Eastern Market. In addition, training was given to vendors to improve business management and assure compliance with laws and regulations affecting food businesses.

Results

Ten MSUE entrepreneurship clients sold product through a stall at Detroit's Eastern Market over a ten-week period. 87% of participants reported increased knowledge of how wholesale accounts affect business profitability; 75% reported an improved understanding of how farmers' markets fit their sales and marketing plan; 62% of participants reported improved skills in relationship-building related to marketing; and 50% of participants reported an interest in exploring a long-range business relationship with Eastern Market.

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	Quantitative Target	Actual
2009	2	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Public policy has taken on a 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: identify current and emerging key public policies that address trade, environmental, agricultural and food issues of particular concern to policy makers, taxpayers, consumers, business persons and producers; analyze alternative public policies as to their design, use of economic incentives, cost effectiveness, transaction

and administrative costs, incidence and consequences; and analyze alternative private responses and market-based responses (e.g., trading of pollution credits) to existing public policies.

Results

A study to analyze the economics of growing various crops for cellulosic ethanol found that corn stover (stalks and leaves) is the most profitable cellulosic biofuel crop in the Great Lakes region, across a range of likely prices. Although perennial crops offer more environmental benefits than corn, including lower amounts of greenhouse gases released, improved water quality and better wildlife habitat, without special subsidies, they don't match the profitability of corn unless biomass prices rise to more than \$90 a ton.

Economic surplus analysis of public investment in research and extension on IPM of soybean aphid in the North Central U.S. estimates a \$1.3 billion net benefit for a 124% internal rate of return over the period 2003-2017.

A field-oriented ration formulation model for feedlot beef cattle was placed into beta test. The model pays particular attention to the coproducts of bioenergy production, including the nutrient content of manure, as well as the impacts of feeds whose properties have been modified by unusual weather conditions. The model was tested with farmers, nutritional consultants to farmers and Extension field staff.

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	Quantitative Target	Actual
2009	5	9

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 U.S. agriculture and the costs of alternative strategies is critical to the long-term sustainability of the agrifood industry.

What has been done

Research to: identify the more important and critical tactical and operational decisions facing Michigan agricultural producers and conduct economic analysis; analyze farm business and financial risk profile and performance in a rapidly changing environment; evaluate and develop new analysis techniques that are appropriate for tactical and operational decisions; and develop improved conceptual and analytical frameworks for understanding, assessing, implementing, and empirically studying effective agriculture, food and natural resource firm and industry innovation.

Results

A 60-meter anemometer system was acquired and installed in the Upper Peninsula to encourage community wind projects that will have a larger economic impact. A community wind project with the city of South Haven was able to acquire 25 years of wind data at the 60-meter level from the Palisades Nuclear Power Plant, located just a few miles south. The findings were encouraging, and the city is now engaged in next steps to establish a wind energy project.

A small pilot-scale pyrolysis reactor was made operational in 2009 to characterize the chemical composition of the resulting product liquid. Based on the results, reactor modifications are being made to improve biomass feed and char characteristics, as intermittent flow and char blockage currently limit operations.

Completion of a new data portal -- <http://f65dev.mitreasury.msu.edu/> is expected to streamline local government fiscal data management for the Treasury Department, improve transparency and accountability, and inform local government and intergovernmental relations policies.

Thirty presentations were given to technical, community and student groups both in the U.S. and internationally to disseminate the concept of regional biomass processing centers and related research expertise.

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 of Michigan farm markets, greenhouses and other green industry retailers.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Number of research programs to identify and evaluate human resources management practices in Michigan agricultural and green industries.

Not Reporting on this Outcome Measure

Outcome #9**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	Quantitative Target	Actual
2009	3	5

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

The ability to understand the economic, cultural and political factors of domestic and international trade policies in order to determine the likely changes in these policies and their consequent market impact is critical to a competitive, sustainable Michigan economy.

What has been done

Research to: analyze factors that influence the global agribusiness environment; examine research from India related to buyer-supplier relationships to inform the development of a theoretical model of behavioral relationships between retailers and suppliers based on a firm's degree of market orientation; and better understand the entire supply chains of various horticultural products, thus covering every segment of the chain, from retail, food service, second stage processing, wholesale and other logistics and service providers.

Results

A mail survey of 6,000 Michigan households related to the economic valuation of ecosystem services found that recreational and water quality ecosystem services are the ones most highly valued through land prices. This complements a 2008 study which showed that Michigan farmers are willing to supply increased ecosystem services, such as no-till and water conservation measures, in exchange for payments.

Research on both temperate fruits and vegetables, and tropical products grown and/or consumed in Emerging Market countries shows that, tropical products -- like their temperate counterparts -- present an excellent opportunity for joint ventures by Michigan firms. The North Bay Coop in Michigan, for example, has entered a joint venture with Argentine and Chilean firms for temperate products on off-season and tropical products from joint venture partners in Brazil year round. This diversity of products is requested and desired by large retailers in the U.S. and elsewhere, and allows the North Bay Coop to be competitive by being a "one stop shop."

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 #10**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	Quantitative Target	Actual
2009	2	2

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

The natural beauty and outstanding recreation opportunities provided by Michigan draw more than 1 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 resource and wildlife managers to understand the recreational demands and economic benefits stemming from these important resources in order to protect, sustain and market them.

What has been done

Research to: develop and extend economic models for estimating the demand for, and value of, recreational fisheries and wildlife resources; develop economic models and methods for estimating the public's preferences and values, including non-user values for fisheries and wildlife resources; and applying economic models to resource management issues.

Results

A telephone survey of U.S. fisheries management agencies collecting human dimensions information from anglers revealed that, while most respondents ranked issues such as habitat degradation, access and facilities, and declining angler participation as very or extremely important for their state's fishery, the majority of respondents ranked information on angler demographics, attitudes, opinions and motivations, and general public attitudes and opinions as only moderately important to current fisheries management decision-making.

A study exploring the effects of a series of possible factors on people's intentions of maintaining forest on their Grain-to-Green Program (GTGP) land plots in China's Wolong Nature Reserve, found that, in addition to conservation payment amounts and program duration, social norms at the neighborhood level had significant impacts on program re-enrollment, suggesting that social norms can be used to leverage participation to enhance the sustainability of conservation benefits from these programs. Moreover, the results demonstrate that economic and demographic trends also have profound implications for sustainable conservation. Thus, social norms should be incorporated with economic and demographic trends for efficient conservation investments.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

Number of research programs to identify and evaluate the policy, technology and marketing issues faced by Michigan organic growers and develop responses.

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Number of research programs to evaluate the competitiveness and marketing strategies and human resource management practices in Michigan agricultural and green industries.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

U.S. produce industries are increasingly integrated with the global economy. U.S. buyers are able to meet their needs for a greater number of products from both domestic and imported goods. Similarly, U.S. producers seek access to a greater number of world customers. For these reasons, it is critical to understand the economic impacts of agricultural production and trade. Further, effective human resource management is the key driver in the overall success and sustainability of any industry.

What has been done

Research to: describe market structure and production trends in food industries, their regulation and implications for Michigan produce markets; analyze the use of trade policies in the global movement of food and food products; evaluate industry competitive strategies in response to real and/or perceived change in agrifood systems and marketing; and analyze human resource management practices in agriculture, including recruitment, selection, training, evaluation, motivation, compensation/benefit systems, discipline and termination, and safety and health in Michigan and beyond.

Results

Two separate questionnaires were sent to 2,237 dairy farms and 480 allied industry professionals in the state to identify and rate industry priorities. The highest ratings by farm owners/operators were: ensure the continuation of the Right to Farm program, increase legislators' knowledge of ag, food imports from less regulated countries, communicate to consumers about the safety of milk products and technologies used, promote the value of the

dairy industry in Michigan's economy, and maintain adequate access to water resources in ag. Issues receiving the highest ratings from allied industry professionals were: dairy farmers demonstrating environmental stewardship, communicate to consumers about safety of milk products and technologies used, improving public understanding of animal welfare, ensure continuation of Right to Farm Program, public image of ag, and science-based environmental regulations.

A conceptual framework for climate change assessments of international market systems that involve long-term investments was developed. Unlike most other sub-sectoral assessments, international trade is explicitly modeled in the proposed framework. Consequently, product movement can fill gaps in supply if production loss occurs due to short-term or long-term climate changes. Conversely, expansion of production within a region could decrease the need for product movement.

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

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.)
- Other (Redesign/restructuring)

Brief Explanation

Although requested to add the new national planned program priorities to our POW reports this year, the short notice and several significant factors on our end led us to keep our current planned programs for this reporting year. With the challenges posed by Michigan's economy, the continued uncertainty related to state appropriations for MAES and MSUE funding, the complete redesign of MSUE and the launch of a new, comprehensive five-year needs identification process in 2010 that will inform research and education projects and activities, we felt it prudent to wait to reconfigure our planned programs in next year's POW Update and Annual Report. We stand ready to make the required changes in the next reporting year. In the short term, a some of the projects in this planned program will likely be migrated to the Global Food Security and Hunger and Food Safety planned programs, with the balance remaining in this program area.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)

- Before-After (before and after program)
- During (during program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

Key Items of Evaluation

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	3%		10%	
302	Nutrient Utilization in Animals	5%		10%	
303	Genetic Improvement of Animals	2%		8%	
304	Animal Genome	4%		6%	
305	Animal Physiological Processes	5%		9%	
307	Animal Management Systems	41%		18%	
308	Improved Animal Products (Before Harvest)	1%		2%	
311	Animal Diseases	28%		20%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	4%		2%	
315	Animal Welfare/Well-Being and Protection	3%		12%	
605	Natural Resource and Environmental Economics	1%		2%	
806	Youth Development	3%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	18.0	0.0	18.0	0.0
Actual	22.8	0.0	15.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c 1510551	1890 Extension 0	Hatch 1043054	Evans-Allen 0
1862 Matching 1510551	1890 Matching 0	1862 Matching 1041170	1890 Matching 0
1862 All Other 0	1890 All Other 0	1862 All Other 10270440	1890 All Other 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; statistical models and experimental designs were developed to link phenotypic variation to genetic variation to enhance trait identification; development and testing of new cropping, grazing and feeding strategies for cattle, sheep and other ruminants for maximum profitability and animal health and minimal environmental impact; development and evaluation new nutritional management strategies for non-ruminant animals for maximum animal health and minimal environmental impact; development and evaluation of management tools and strategies for animal manure management that is cost-effective, easy to implement and exceeds stringent environmental standards set by the state; development and evaluation of management/training strategies for race horses to reduce injuries; research to better understand the molecular processes that influence growth and meat quality in food animals; improvement and integration of genetic maps to add to the understanding of various food animal genomes; understanding of the genetic and molecular processes that control/influence the immune system in food animals to create new disease detection and tracking technologies; development and evaluation of new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases, including BVDV, leptospirosis, bovine tuberculosis, Campylobacter jejuni, West Nile virus, and bovine spongiform encephalitis; research to better understand the environmental fate and biological effects of vaccines, steroids and other drugs fed to animals; beef producers were assisted with implementing the mandatory electronic identification system and shown how to use the system to sharpen management skills; livestock producers were provided with science-based information to help develop and maintain herd-health systems; animal industry was provided with up-to-date animal health information; farm-specific environmental stewardship protocols and best practices related to manure management, including developing whole-farm nutrient management plans, manure value, land use and neighbor relations were provided to producers; achieve better ethical understandings of animal welfare sustainability; and better understand sustainability related appropriate social and environmental goals for agricultural production systems, and food security, food availability and its role in developmental processes.

2. Brief description of the target audience

Michigan livestock producers, veterinarians, equine industry and horse owners, animal feed industry, agriculture and natural resource industry representatives, biotechnology company representatives, and state agency representatives.

V(E). Planned Program (Outputs)**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	1853	3706	4265	0
Actual	2067	4134	8024	0

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

Year: 2009
 Plan: 7
 Actual: 9

Patents listed

Patent application filed 11/10/08 - TEC2006-0134-01:Increasing the Efficiency of Somatic Cell Nuclear Transfer Cloning in Bovine; Patent application filed 11/10/08 - TEC2006-0134-01PCT:Increasing the Efficiency of Somatic Cell Nuclear Transfer Cloning in Bovine; Patent application filed 6/11/09 - TEC2008-0053-01:Increasing the Efficiency of Somatic Cell Nuclear Transfer Cloning in Bovine;Patent application filed 11/26/08 - TEC2007-0082-01: Diagnosis and Prevention of BVDV;Patent application filed 10/27/08 - TEC2003-0053-02: Impact of High Variation in Number of Oocytes on Ovarian Function;Patent application filed 9/02/08 - TEC2000-0017-02: Genetic Basis for C. jejuni-induced Pathotypes in the Host; Patent application filed 3/31/09 - TEC 2000-0017-02DIV3:Genetic Basis for C. jejuni-induced Pathotypes in the Host;Patent application applied for 7/21/08 - TEC20070089-01: Regulatory Role of the Oocyte in Control of Female Fertility in Cattle; Patent application applied for 10/27/08 - TEC 2003-0053-02:Regulatory Role of the Oocyte in Control of Female Fertility in Cattle.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	50	
Actual	1	46	47

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on animal production and protection.

Year	Target	Actual
2009	40	40

Output #2

Output Measure

- Number of adult participants trained in animal management systems.

Year	Target	Actual
2009	1483	1697

Output #3

Output Measure

- Number of youth participants trained in animal management systems.

Year	Target	Actual
2009	4265	8024

Output #4

Output Measure

- Number of adult participants trained in animal diseases.

Year	Target	Actual
2009	370	389

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 understand the genetic and molecular processes that control/influence the immune system in food animals.
10	Number of research programs to develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.
11	Number of research programs to understand the environmental fate and biological effects of vaccines, steroids and other substances fed to animals.
12	Number of research programs to develop and evaluate management/training strategies for horses to reduce injuries.
13	Number of research programs to add to the understanding of animal behavior and welfare.

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	Quantitative Target	Actual
2009	1260	1493

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Research has repeatedly shown that the prevalence of lameness of cattle on dairy farms runs 30-50%. Lameness is both an animal well-being issue as well as a profitability issue. A need was identified and an objective was set - to help dairy producers better understand the causes of lameness, ways to prevent lameness and the role of proper trimming. Commercial hoof trimmers were identified as partners, with Dairyland Hoof Care Institute used as an expertise resource.

What has been done

Four meetings were scheduled with Karl Burgi across Michigan during the week of December 16 for dairy producers. Six hoof trimmers cooperated by inviting their clients and, in some cases, sponsored them.

Results

A total of 218 attended the four workshops and 43% completed evaluations. From those evaluations, the following conclusions were drawn:

Participants indicated they intended to make changes based on what they learned.

* 92% stated at least one change they planned to make.

* 84% of those were specifically management practices such as lot scraping, wrap, trimming, bedding, foot bath, hygiene and standing time.

Participants reported they would monitor lameness much more closely than before.

* 90% listed at least one way that they would monitor lameness in the herd.

* 31% of those cited either locomotion scoring or watching for arched backs.

* 61% of those listing something mentioned increasing the frequency of monitoring or watching at certain times/locations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases

Outcome #2**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	3625	6419

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

The Junior Livestock Advisory group asked MSUE to offer training to help beginner youth and their parents learn more about livestock projects. The problem was that many youth and parents began a project without knowing the costs, housing, labor, etc. that a project entails. In addition, many newcomers were intimidated because they had never worked on a livestock project and did not know how to get help.

What has been done

MSUE developed workshops to introduce the process involved in a livestock project and work with youth who chose to do projects on record keeping, managing their animal, and learning about production costs. One county took a full day and highlighted different animals every 30 minutes.

Results

Approximately 80% of the youth who attended the introduction course started livestock projects, with some of these youth switching to a different species after learning about cost, space and time needed. An evaluation of 286 youth found 280 of the youth demonstrated competency in record keeping by completing a set of financial and production-related records on their livestock project.

4. Associated Knowledge Areas

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

Outcome #3**1. Outcome Measures**

Number of adult participants with increased knowledge of animal diseases.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	315	355

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

During the summer of 2007 representatives from: the MSU Veterinary School; the Diagnostic Center for Public and Animal Health; Pfizer Animal Health; the Michigan Department of Agriculture; producer representatives of the Michigan Upper Peninsula dairy and beef industry; and MSUE met and discussed the feasibility of conducting a BVD virus eradication program involving all of the approximate 750 cattle herds in Michigan's Upper Peninsula (UP). The UP is approximately 350 miles (560K) long and 150 miles (240K) wide, between the 46th and 47th parallel, is about 80% forested land with pockets of farming, is mostly forage production with primarily beef and dairy livestock enterprises.

What has been done

Pfizer Animal Health provided financial support that covered the testing procedures and some of the logistical costs of approximately \$50,000 per year, the DCPAH tested and managed the results that verified the testing outcomes, and MSUE provided BVDV program promotion and communication to UP producers and worked with MDA representatives in signing farmers up for the program.

Results

As of July 2009, in the western UP region 209 of 252 farms (83%) with cattle had signed up. Of these farms, 84% have submitted samples. This represented about 18,588 head of cattle or roughly 30% of the total estimated cattle herd in the UP. 10,421 notches have been submitted with 12 positive PI cattle identified with positive notch and

then follow up testing to confirm PI status. These 12 head were from six farms -- 2 dairy and 4 beef. It appears the dairy herds were infected by purchased cattle and the four beef herds have some common cattle showing experiences with causation being just speculation at this time. The producers have all either euthanized the young positive animals or salvaged the beef for human consumption voluntarily with no compensation. This project has the potential over time to eradicate BVDV in the Upper Peninsula of Michigan, which would have tremendous positive financial implications in the future for these farmers and communities.

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	Quantitative Target	Actual
2009	2	6

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% of the average American diet is dairy, and beef makes up about 10%. This makes these products an integral part of our lifestyle and our economy, thus 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; and investigate potential health effects of exposure to environmental contaminants in humans and animals, with an emphasis on reproductive performance.

Results

Through the use of genomics/genome sequencing tools, poor quality cow eggs and good quality cow eggs were compared to see what's different. Markers predictive of a bad quality egg were identified and are now informing the development of treatments that can be added during egg maturation so that more embryos can develop and be transferred to the cow. A protein molecule -- follistatin -- was also identified in the egg that influences its ability to proceed through embryonic development after fertilization. When follistatin was added back during the initial stage of embryo culture, embryos divided faster and generated more blastocysts. This new discovery will allow enhanced reproductive efficiency for in vitro production of embryos.

A comprehensive examination of mathematical modeling, spatial analysis and geographic information science has shown that the synthesis of these technologies can be used to enhance studies related to complex environmental issues coupled with social and political factors, such as the developmental and reproductive toxicity of environmental contaminants.

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.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	3	5

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 performance efficiencies in a way that is economically and environmentally sustainable, and that protects human and animal health.

What has been done

Research was conducted to: develop forage systems that will maximize the economic and energetic efficiency of dairy cattle; increase the efficiency of protein production in dairy cows; collect forages, grains and agriculture crop by-products and residue and other alternative feeds and determine their composition and nutritional value by standard analytical procedures; and to develop methods to enhance decision-making by dairy producers.

Results

The completion of a long-term study measuring the milk production of cows showed that calves grown more rapidly tended to produce about 4% more energy-corrected milk.

A study to examine the effects of dietary coconut oil (CO) on enteric methane emissions of cows showed that methane emission was reduced by as much as 46% by increasing the concentration of CO in the diet. Similarly, methane emitted per milk yield also declined as dietary CO concentration increased.

A greenhouse phytotoxicity study with borax- and octabor-treated swine manure use as fertilizer for agronomic crops established the maximum level of borax and octabor that can be used to treat swine manure to reduce hydrogen sulfide emissions without injurious effects on agronomic crops.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #6**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	2	3

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

As production costs rise, farms consolidate, environmental concerns increase and consumer expectations become higher, those involved in the agrifood industry are looking for ways to maximize reproductive and performance efficiencies in a way that is economically and environmentally sustainable and protects human and animal health.

What has been done

Research was conducted to evaluate the use of oligosaccharides in the diets of laying hens and their effect on egg production/quality and disease; determine the influence of fiber, potassium, copper and zinc sources and protein concentrations on fecal excretion in lactating sows; determine the influence of quantity of feed consumption during lactation and various fiber sources on daily fecal volume of swine; determine influence of zinc on the structural soundness and productivity of sows; and optimize protein and amino acid of swine and equine related to performance and efficiency of protein utilization.

Results

Research to achieve greater nutrient availability in swine diets while maintaining cost effectiveness and minimizing adverse environmental impacts has shown that the inclusion of phytase -- an enzyme that breaks down the indigestible phytate portion in grains -- increases the availability of phytate phosphorus in a corn-soy diet from 15% percent to 45%. As a consequence, the amount of supplemental phosphorus can be decreased by 50%, manure phosphorus excretion can be cut 40% to 60%, and less land is required for manure application -- all while meeting the dietary phosphorus requirement of the pig.

Studies on the effect of protein/amino acid ratios on animal performance and nitrogen output have shown that supplementation of essential amino acids, such as lysine, can decrease dietary protein by at least two-thirds, resulting in much less nitrogen given off as a byproduct. Further research is being conducted on performance levels and costs associated with this approach.

4. Associated Knowledge Areas

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

Outcome #7**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	2	2

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 efforts to discover and evaluate genetic factors that influence growth, carcass merit and meat quality of swine; characteristics of skeletal muscles associated with superior and inferior meat quality have been identified; and strategies for consistent production of high quality meat products have been developed.

Results

The recent sequencing of the pig genome is providing researchers with the information they need to develop new DNA-based tools to identify and select genetically superior pigs that resist infectious diseases, have larger litters and produce quality cuts of meats for consumers. Work is underway to produce an inexpensive, simple blood test that analyzes DNA to determine whether the gene combination for high quality meat and efficient production are present.

An increased understanding of epigenetic regulation in early embryonic development is paving the way for the development of better methods for selecting high quality embryos and procedures for enhancing embryo vitality. This will lead to reduced numbers of embryos transferred per cycle, reduced multiple pregnancy rates and healthier animals and people.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
308	Improved Animal Products (Before Harvest)

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	Quantitative Target	Actual
2009	1	6

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 enhance and integrate genetic and physical maps of agriculturally important animals for cross-species comparisons and sequence annotations; facilitate integration of approaches toward a better understanding of biological mechanisms underlying economically important traits; and to develop methods for producers and consultants to evaluate dairy herd performance.

Results

Research into increasing the efficiency of somatic cell nuclear transfer cloning in bovine has allowed scientists to describe the mechanisms involved in nuclear reprogramming in the bovine embryo and develop new protocols for the production of cloned embryos. A test that transferred 187 embryos using the protocols from this study resulted in 39 cows becoming pregnant and two healthy embryos being born.

Progress continues with the Biosecurity STOP Campaign. \$20,500 in funding from two grants provided the resources to complete and print campaign materials for producers to use to set up various farm gate biosecurity protocols and to develop and air a biosecurity visitor policy PSA. Fifty-one dairy and 21 beef producers have been recruited and trained to date to help administer the campaign.

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 understand the genetic and molecular processes that control/influence the immune system in food animals.

Not Reporting on this Outcome Measure

Outcome #10**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	Quantitative Target	Actual
2009	10	7

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Animal disease in the U.S. could seriously damage the livestock and poultry industries. For example, eradication of avian influenza in the U.S. 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: collect and screen for bacterial strains with antagonistic properties for foodborne pathogens and test their efficacy; develop a rapid, low-cost animal side biosensor for detecting cattle persistently infected with the bovine diarrhea virus; detect new or emerging infectious diseases in livestock and poultry; and how to improve immune recognition in order to protect against or eliminate viruses and cancers.

Results

The Upper Peninsula BVDV Eradication Project -- the first of its kind in the nation -- has made significant progress over the past year in testing the region's 700 cattle herds. Currently, testing is being conducted in the eastern part of the UP, with central and southern regions to follow in the next several years. The number of BVDV-free animals tested through the program has reached approximately 20,000. Although the project is still in progress, other states already have shown interest in this approach.

Efforts to reduce mastitis pathogens have shown promise. Currently, five herds were enrolled in on-farm demonstration and treatment economic analysis. Preliminary on-farm culture for treatment decision showed an 80% reduction in cows treated with antibiotics when mastitic milk was cultured before treatment.

Considerable progress has been made in characterizing the genetic relatedness of EHV-5 strains associated with equine multinodular pulmonary fibrosis (EMPH), with strains from asymptomatic horses that are carrying the virus. Preliminary data show that the two groups of viruses are distinguishable, which will enhance the ability to identify EHV-5 infections in possible cases of EMPH.

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 #11

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	Quantitative Target	Actual
2009	4	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Michiganders are an exceptionally vulnerable population due to their chronic exposure to complex mixtures of endocrine disruptors that 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 waste generated by these operations must be assessed.

What has been done

Research efforts to: develop analytical methods to measure inorganic and organic substances in a variety of environmental situations; identify the environmental transformations undergone by animal feed additives and determine their environmental fate; assess the potential of these substances to alter the immune response and cause severe disease symptoms in animals and humans; and develop multistage hierarchical models to facilitate greater efficiency of inference in general mixed model microarray experiments.

Results

In continuing to determine the immunology of core-antigen bacterins toward the protection against coliform mastitis, recently completed trials determined 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 body location. Additional studies are being conducted on the effect of Bovine Leukosis Virus status on the immune response in dairy cattle following immunization with J5 E. coli bacterin and two antigens. The results will help determine if cows in advanced stages of this disease have an impaired ability to produce antibody responses and/or lymphocytes cytokine response following immunization.

A dairy farm energy audit technical manual was expanded to include areas not previously covered -- irrigation, grain drying and electric motor efficiency. An energy audit manual was also developed for the greenhouse industry. Two energy auditor training sessions were conducted with 45 people participating, and several audits were completed.

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 #12

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	Quantitative Target	Actual
2009	{No Data Entered}	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; investigate ways to manipulate the equine diet to optimize skeletal health and improve the overall welfare of horses; improve the skeletal health of livestock and companion animals; and develop effective prevention/treatment strategies for exercise-induced pulmonary hemorrhage.

Results

Evaluation of the glycemic and insulinemic responses of horses to various feeds showed that high insulinemic responses are related to health problems such as osteochondrosis and laminitis.

Selection for rapid growth in turkeys has led to an increase in skeletal problems, like femoral spiral fractures. Research showed that slowing the growth of turkeys by feeding a diet of 60% of the energy and crude protein of the nutrition requirement (with all other nutrients meeting or exceeding requirements) significantly improved bone strength and bone quality without significantly altering bone length or ash content by the time birds reached market weight.

Researchers looking for the cause of exercise-induced pulmonary hemorrhage (EIPH) discovered that horses with this respiratory disease have chronic scarring around their pulmonary veins, causing pulmonary vein hypertension -- the driving force that leads to EIPH.

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 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	Quantitative Target	Actual
2009	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement**Issue (Who cares and Why)**

Our society has placed increased emphasis on the welfare of research and exhibit animals. U.S. law now requires attending to exercise requirements for dogs and the psychological well-being of nonhuman primates. Animal welfare without knowledge is impossible. Animal behavior researchers look at the behavior and well-being of animals in lab and field. Further developments in animal welfare will require input from animal behavior specialists. Improved conditions for farm animals, breeding of endangered species and proper care of companion animals all require a strong behavioral database.

What has been done

Research to: develop a wireless body-mounted sensor system to describe behavior, space use and resource use in non-caged laying hens; correlate the relationship of temperament, behavior, growth, carcass merit and growth in Angus/Limousin crossbred cattle; examine the impact of robotic milking on cow comfort during milking; and

analyze and collect data directed to the discovery and dissemination of findings on ethical issues in animal agriculture.

Results

Animal welfare assessment scenarios were developed for white-tailed deer, laboratory rats, meat goats and sheep.

A Web site was launched for the MSU Animal Behavior and Welfare Group at www.canr.msu.edu/animal_welfare to provide information and resources related to research and Extension activities in this area.

Three workshops were held as part of a first round discovery process related to ethical issues in animal welfare, sustainability in ag production and food security. One was held at Hamburger University (McDonald's Corp.) to find a way to synthesize and compare information on egg production systems and their sustainability. A second was held at the J. Craig Venter Institute to elicit input on ethical issues concerning synthetic biology from an elite group of stakeholders. The third was held on the MSU campus - more than 30 MSU researchers were brought together to deliberate on the ethical dimensions of food and agricultural standards.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- 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 requested to add the new national planned program priorities to our POW reports this year, the short notice and several significant factors on our end led us to keep our current planned programs for this reporting year. With the challenges posed by Michigan's economy, the continued uncertainty related to state appropriations for MAES and MSUE funding, the complete redesign of MSUE and the launch of a new, comprehensive five-year needs identification process in 2010 that will inform research and education projects and activities, we felt it prudent to wait to reconfigure our planned programs in next year's POW Update and Annual Report. We stand ready to make the required changes in the next reporting year. In the short term, some of the projects in this planned program will likely be migrated to the Global Food Security and Hunger and Food Safety planned programs, with the balance remaining in this program area.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)

- Before-After (before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}