2010 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 that people can access to make informed decisions to improve their lives. The mission of AgBioResearch is to engage in innovative, leading-edge research that combines scientific expertise with practical experience to generate economic prosperity, sustain natural resources and enhance the quality of life in Michigan, the nation and the world. AgBioResearch strives to maintain a balance between basic and applied research and relies heavily on the input of its constituents in identifying research priorities. The accomplishments and discoveries outlined in this report are reflective of the reason why AgBioResearch continues to be one of the most successful entities of its kind.

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

The success and accomplishments of AgBioResearch and MSU Extension are fueled by close ties with each other as well as linkages to state agencies, commodity groups and other stakeholders, and outstanding legislative support.

Further, responsible investing for Michigan for Michigan's success in the past year has resulted in:

- **Leverage:** Every dollar the federal government invests in MSU AgBioResearch (formerly the Michigan Agricultural Experiment Station) and MSU Extension leverages an additional **$13.30** in external contracts, grants and other revenues that serve the state's residents. Every federal dollar is leveraged by **$4.20** of state appropriations. Michigan investments in AgBioResearch and MSUE leverage an additional **$139.3 million** in external contracts, grants and other revenues that serve Michigan residents.
- **Community Benefits:** Federal investment extends the reach of MSU AgBioResearch and MSUE programs that generate as much as **$388 million** in benefits to Michigan and the nation. For every federal dollar invested, MSU AgBioResearch and MSUE programs generate as much as **$25.40** of benefits to the state and nation.
- **Economic Stimulus:** Federal investment in MSU AgBioResearch and MSUE and leveraged funds generate economic impacts that total **$492 million.** Every federal dollar invested in these programs generates another **$1.81** in state economic activity through standard economic multiplier effects.
- **Benefit/Cost Ratio:** When state funds, community benefits and economic stimulus are combined, the estimated benefits to Michigan residents and the nation exceed the initial federal investment 71:1.

It is important to note that this report reflects only a portion of AgBioResearch and MSU Extension and not the whole breadth of research and educational initiatives. AgBioResearch's total budget for FY 2010 was $123.36 million, with this report representing $4.66 million in federal Hatch dollars and equivalent match.

AgBioResearch 2010 Quick Facts:

108 Hatch-funded researchers representing 77.1 FTEs
267 active projects
23 patent applications submitted

8 patents awarded
291 peer-reviewed publications

Key research accomplishments for FY 2010 include:

Fighting Big, Bad Bugs - Each year, about 76 million people in the United States get sick from contaminated food. Using the only pilot plant-scale processing line for leafy greens in the country, an MSU AgBioResearch scientist is helping companies in the leafy green industry control bacterial transmission. The overall goal of the study is to develop strategies to enhance the safety, quality and shelf life of ready-to-eat foods, especially related to the transfer of E. coli O157:H7 during commercial-scale processing of leafy greens. Current data shows that washing lettuce in tap water containing commonly used commercial sanitizers will remove only 90 to 99 percent of the contamination, which is not sufficient to ensure end product safety.

Putting a Premium on Information Sharing in the Global Market - Specialty and premium food products are one of the fastest growing sectors of the food market. U.S. sales of organic foods and beverages alone have grown from $1 billion in 1990 to $24.8 billion in 2009. An AgBioResearch agricultural economist is exploring ways to organize food supply chains that create more effective market and communication channels. His findings on fresh eggs show that the individual attributes of organic, welfare-managed and nutritionally enhanced eggs carry price premiums equal to 16.5 cents, 3.57 and 2.30 cents per egg, respectively, over a base egg price of 7 cents. This type of information will help producers maximize their profits and receive the price premiums they deserve, while providing customers with the specialty products they desire.

Untangling the Web of Disease Resistance in Plants - The work of an AgBioResearch plant pathologist and his research team was the first to show that the actin cytoskeleton plays a role in resistance to bacterial pathogens in plants. Building on this research, a project in collaboration with researchers at other universities is analyzing the function of all the proteins that regulate the actin cytoskeleton. This disease resistance work will ultimately provide a template for other plant systems.

Converting Wastes to Resources, Naturally -MSU AgBioResearch scientists working at the new MSU Anaerobic Digester Research and Education Center are trying to make waste an asset instead of a burden on the environment by advancing the efficiency and cost-effectiveness of anaerobic digesters. There are now about 150 on-farm manure digesters operating across the country, and about 8,000 farms are good candidates for capturing and using biogas. If all 8,000 farms were able to implement biogas systems, methane emissions would be reduced by more than 34 million metric tons of carbon dioxide equivalent per year, which is roughly equal to the annual emissions from 6.5 million passenger vehicles. In addition, these projects could generate more than 1,500 megawatts of renewable energy, making this research both timely and critical.

Going Green from Top to Bottom - An AgBioResearch scientist oversees green roof research on MSU buildings and has become one of the first to do long-term research in green roof technology. Data from the research has helped to identify plants that are best suited for green roofs and to analyze how much carbon the roof system's plants and soil are storing. As a result, the amount of green roof space, primarily on government and commercial buildings, in North America has been doubling each year since the research began.

Harvesting Fuel at the Smallest Scale - An MSU AgBioResearch scientist is part of a team studying some of the smallest organisms and working to refine them to help produce high-value bioproducts. The project involves exploiting a bacterium's potential to produce isobutanol that can be used as an automobile fuel. Isobutanol offers distinct advantages over ethanol as an automotive fuel, because it can be used as a direct substitute for gasoline. Isobutanol also has a high energy content - about 85 percent that of

gasoline - is an oxygenate to reduce emissions, has a relatively low volatility to reduce evaporative losses, and has a low tendency to retain water, so it can be easily transported and stored.

Producing Healthier Oil, Greener Fuel - MSU AgBioResearch scientists are studying oilseed crops to create plants that produce more oil or have oil with special properties to help farmers grow higher value crops and to give manufacturers alternatives to crude oil. The high viscosity of most plant oils prevents their direct use in diesel engines, so the oil must be chemically converted to biodiesel. Scientists have recently discovered a group of compounds called acetyl glycerides, or acTAGS that, because of their lower viscosity, could potentially be used as a direct-use biofuel for some diesel engines. The acTAGS also have potential in the food industry. Because they contain fewer calories than other vegetable oil, they may be able to be used as a reduced-calorie food oil.

Angling for Optimum Fish Populations -- The Great Lakes offer one of the most productive fisheries in the United States, providing an estimated 1.2 million licensed anglers with 6.9 million days on the Great Lakes in 2009. In order to maintain these fisheries, AgBioResearch scientists are developing computer models that can predict what will happen to key fish species and invasive species populations related to survival rates, feeding patterns and reproduction rates, when certain management decisions are made. This is providing fisheries managers with more effective ways to manage fish populations and to control destructive invasive species to help protect the Lakes' $7 billion dollar fishery.

Mapping the Cause of Tropical Disease Improves Lives -An AgBioResearch geographer and an interdisciplinary team of MSU researchers have developed ecological modeling and control strategies for a disease called African trypanosomiasis (sleeping sickness) in Kenya, which is spread by tsetse flies and occurs in both humans and livestock. Thirty-seven sub-Saharan African countries infested with tsetse flies are home to about 70 million people with exposure risk. Using climate projections and spatial simulation models, scientists are ultimately hoping to make accurate predictions about where the flies will be and then put traps in place before the first fly ever shows up, killing off an epidemic before it happens.

Solving the Allergen-based Disease Puzzle - An AgBioResearch scientist is conducting research to piece together how environmental metals, such as cobalt, affect biological systems by altering a family of proteins (known as hypoxia-inducible factors) that regulate the bodies' ability to adapt to low oxygen. Approximately 34 million Americans have been diagnosed with asthma alone, and expenditures for healthcare and lost productivity due to the disease are estimated at $20 billion annually. Scientists hope that this research ultimately leads to a test that can predict who is susceptible to asthma and other allergy-based lung diseases.

Building a Better Mouse Trap for Cancer Prevention - Lung cancer is the leading cause of mortality in the United States and worldwide. Almost 163,000 people in the United States and 1.3 million people worldwide die of lung cancer each year. An AgBioResearch scientist is studying the cancer-causing potential of vanadium oxide (an alloy additive to metal and steel) using three strains of mice. Results demonstrated that the most sensitive strain had highly significant amounts of inflammation and other early signaling events that appeared to correlate with high numbers of tumors in these mice. This research could provide a better understanding of how to intervene in and control carcinogenesis and other disease processes.

MSUE 2010 Quick Facts:

- 698 FTE's with 285 FTE's for educators, 138 FTE's for specialists and 151 FTE's for paraprofessionals
- 148,752 adults were educated with approximately 25% represented in this report
- 186,543 youth were educated with approximately 25% represented in this report
- 29,356 volunteers assisted MSUE in educating youth and adults

As previously mentioned, this report reflects only a portion of MSUE funds and not the whole breadth of outreach and educational initiatives. MSUE's total funding in FY 2010 was over $89 million, with this report representing approximately $9 million federal formal dollars and equivalent match.

Key MSUE outreach and accomplishments for FY 2010 include:

The MSUE Agriculture and Agribusinesses Institute worked with a variety of commodity groups, stakeholders, policy makers and businesses to educate 43,057 adults and 66,949 youth (duplicated in the overall youth numbers below) in the following areas:

- Food production and marketing that concentrated on educating farmers and others about practices that produce safe, affordable and nutritious food.
- Environmental quality that conserved and preserved water, land and air while maintaining and enhancing aquatic habitats, ornamental plants and food production.
- Business management practices, that aided producers while encouraging entrepreneurship that helps to ensure that the agriculture sector continues to thrive.
- Bioproducts and bioenergy that maximized the productivity of farmland and marginal lands thereby lessening dependence on fossil fuels and increasing job opportunities and economic activity.
- Ornamentals, landscape and turf production that strategically positioned non-food agriculture to be competitive in a national and global environment while contributing to the growth of Michigan's economy.

The MSUE Children and Youth Institute provided education to 13,738 adults and 186,543 youth statewide with the help of 24,737 volunteers that focused on the following areas:

- Academic success through programs like 4-H that developed life skills; childcare-provider and parenting education; and an enhanced focus on skill development in science, engineering, technology and applied mathematics.
- Leadership and civic engagement through programs that exposed youth to the workings of our government at all levels, provided leadership opportunities and offered community service experiences.
- Career and workforce preparation through exposure to career options, financial literacy education, entrepreneurial training and career preparation.
- Capacity building for youth skill development through home visits, club programs, planned youth mentoring, after-school and out-of-school programs, technology and caregiver education.

The MSUE Greening Michigan Institute worked with individuals, private and public sector leaders and others in educating 37,187 adults and 34,133 youth (duplicated from above) in the following areas:

- Community food systems by working with growers, community leaders, volunteers and institutions to address the issue of hunger and food deserts and access to locally grown and processed foods.
- Community prosperity through initiatives with local, regional and statewide development groups in efforts to develop strategic plans, seek grants and promote cooperation that leads to sustainable growth.
- Financial, housing and energy resources that developed resources to support educational programs that will lead to future communities that have adequate housing for financially stable residents and model energy efficient technologies.

• Natural resources appreciation and stewardship that connected partners in conservation, local and state agencies, tourism and local government that worked together through education to ensure that the state's natural assets are sustainably managed.

The MSUE Health and Nutrition Institute educated 52,770 adults and 56,264 youth (duplicated from above) in the following areas:

• Increasing good habits in nutrition and physical activity through programs that teach healthy eating, the valueof exercise, breastfeeding basics and food budget management.
• Chronic disease prevention and management through training for people with diabetes and their caregivers in nutrition and self-care, support group development and distribution of research-based information.
• Social-emotional health and wellbeing through programs to promote anger and stress management and prevention of child abuse and neglect.
• Food safety through training for food service employees, farmers and food distributors; food preservation workshops.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	170.0	0.0	89.0	0.0
Actual	202.0	0.0	77.0	0.0

II. Merit Review Process

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

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

2. Brief Explanation

Because Michigan's agricultural and natural resources are in a constant state of transition, AgBioResearch priorities and MSU Extension educational goals must remain fluid and flexible. Research goals are continually evaluated for 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 AgBioResearch-affiliated colleges, MSU Extension staff and key stakeholder groups, priority areas are reviewed annually. This process involves industry experts, university faculty members, MSU Extension and AgBioResearch Council members, and includes scientific review by peers (local, national and international). MSU Extension uses several continuous processes that assist in setting priorities and evualuating 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 by MSU Extension and AgBioResearch directors

who not only evaluate them, but use them in their regional and statewide presentations to describe future plans. Jointly, AgBioResearch and MSU Extension address issues of 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 14 outlying AgBioResearch centers and on-campus facilities. The MSU Extension and AgBioResearch Council serves as a liaison among county councils, research center advisory groups and state agencies and organizations.

III. Stakeholder Input

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

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

Brief explanation.

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

MSU Extension just completed a major restructuring effort. This effort was underpinned by commitments to reducing administrative overhead, maintaining organizational agility and responsiveness, accountability to stakeholders and continued emphasis on focused, effective educational programming across the state. Throughout this process, MSU Extension staff participation was encouraged by: publishing weekly newsletters 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 MSU Extension 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 AgBioResearch/MSU Extension State Council related to the development of MSU Extension institute areas and what they should be. Meetings were also held with the Michigan Association of Counties and state legislators.

Following the establishment of the four institutes, a statewide needs assessment -- Advance Michigan -- was undertaken to seek input and direction from staff, internal and external stakeholders, and the general public on what the programmatic priorities should be within each of the institutes. The survey was launched in April 2010 and ran through June 2010. Survey results are now being compiled and will be used to develop a logic model for specific priorities in each institute and a statewide plan of work.

On the research side of the aisle, as of Jan. 1, the Michigan Agricultural Experiment Station

became MSU AgBioResearch. The new name was selected following a yearlong process that included a self-assessment of the organization's strengths, weaknesses and opportunities moving forward, as well as numerous discussions (phone and face-to-face) with both internal and external stakeholders about their perceptions of us and what we could do to better convey the value of our mission and to serve them. Final approval on the name change was given following several presentations to and discussions with AgBioResearch-affiliated colleges, the Provost's office and MSU President Simon. Stakeholders at all levels were incentivized by the fact that they rely on the research we do to address real-world challenges by providing practical solutions that generate economic prosperity, sustain natural resources and enhance the quality of life for Michigan residents.

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

1. Method to identify individuals and groups

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

Brief explanation.

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

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

The Advance Michigan statewide online issues identification process that was just completed (and the previous Strengthening Michigan's Economy comprehensive survey before it) and other ongoing efforts offer multiple ways for people in various roles and locations to help identify the issues and opportunities for AgBioResearch priorities and MSU Extension educational programming during the years ahead.

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

Faculty focus groups, with representatives from Michigan colleges and units, are held as needed to glean faculty perceptions on emerging Michigan issues and opportunities and to identify

ways that MSU science might address them. MSU faculty and AgBioResearch/MSU Extension staff surveys are used as needed to develop a better understanding of the university's ability to respond to issues identified in faculty focus groups.

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

Working groups within each institute (formerly Area of Expertise teams) sythesize 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.

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

For the AgBioResearch rebranding, the yearlong process included a SWOT analysis, peer conversations with faculty and extensive discussions (phone and face-to-face) with both internal and external stakeholders. "Our new name, along with the tagline 'leading innovation in food, natural resources and energy,' better conveys the breadth and relevance of the work we do while remaining true to our land-grant mission in support of Michigan agriculture." "Our new name, along with the tagline 'leading innovation in food, natural resources and energy,' better conveys the breadth and relevance of the work we do while remaining true to our land-grant mission in support of Michigan agriculture." "Our new name, along with the tagline 'leading innovation in food, natural resources and energy,' better conveys the breadth and relevance of the work we do while remaining true to our land-grant mission in support of Michigan agriculture." TDue to stakeholder input, AgBioResearch has focused more sharply on renewable energy and biobased products that can help boost the Michigan economy, including fuels, chemicals, neutraceuticals and food products, the environment, land use issues, and biotechnology.

For MSU Extension, Town Hall meetings, individual meetings, feedback via e-mail, blogs and surveys -- including the most recent statewide online survey -- Advance Michigan -- are all being used to inform the newly restructured MSU Extension, including the priorities that should be set under each of the four new institutes.

More specifically, the second half of 2010 was spent focusing on collecting input from county commissioners. A series of meetings was held with commissioners across the state. A task force

was then set up that included MSU Extension staff as well as county commissioners and administrators to help come up with a system of how the partnership could work. The task force met through November 2010 and then sent a mailing (that also included a url to a Web site with additional information) to all county commissioners, inviting them to participate in several webinars to discuss the new Memorandum of Agreement that was being put together to formalize the partnership. A survey was also sent out to all commissioners, laying out three alternatives as to how to approach the partnership. It provided them information either directly or gave them directions to a url and then they were asked a series of questions, two of which were, "Which of these approaches would you prefer?" "How would it be implemented to ensure that the right costs are allocated to the counties and to MSU Extension." Based on this feedback we made changes and continue to make changes. The MOU will be executed for FY2012.

3. A statement of how the input will be considered

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

Brief explanation.

Due to stakeholder input, AgBioResearch has focused more sharply on renewable energy and biobased products that can help boost the Michigan economy, including fuels, chemicals, neutraceuticals and food products; the environment; land use issues; and biotechnology. Food safety will also be an issue that will receive increasing attention and funding resources.

MSU Extension utlilized the stakeholder input in forming the four Institutes as well as the twenty-one workgroups with it. The input has been useful in setting priorities and focusing more with less resources.

Brief Explanation of what you learned from your Stakeholders

Things AgBioResearch learned from its stakeholders (particularly during the renaming process):

• The name -- Michigan Agricultural Experiment Station -- is out-of-date and not expansive enough to fully describe what it does.
• Words such as 'natural resources' and 'environment' need a greater presence in the organization's description.
• It's critical to make sure that research activities and MSU stay current and include newer technologies. The organization needs to continue to build and maintain strong partnerships both within and outside of MSU.
• Solutions and innovations that come from AgBioResearch will be even more critical in the future for MSU, Michigan and the world.
• It's going to take the efforts of all of us, working together, to be successful.

Things MSU Extension learned from its stakeholders:

MSU Extension recently completed a strategic examination of its priorities and programmatic themes. This effort culminated in a major restructuring that is enabling the organization to help people in every community improve their lives through applicable science-based, university-generated knowledge. MSUE is committed to serving people in every county with focused, need-

based information around four key topic areas:

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

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
8855613	0	5838943	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	9454879	0	12453584	0
Actual Matching	9454879	0	5981487	0
Actual All Other	0	0	92266048	0
Total Actual Expended	18909758	0	110701119	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	4338990	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

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

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	70.0	0.0	10.0	0.0
Actual	71.4	0.0	11.0	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**
3340724	0	838222	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
3340724	0	837408	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	6798551	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

• Develop an understanding of how n-3 polyunsaturated fatty acids affect human health and disease, especially cardiovascular disease and inflammation.
• Determine the relationships between obesity and family meals/lifestyle factors; family lifestyle factors/education and food choices and general health; and environmental influences and obesity/general health/physical activity.
• Increase understanding about how environmental pollutants, especially ozone and endocrine disruptors affect human health.
• Identify the nutritional determinants of allergic immune disorders.
• Establish new programs and policies to help young people move successfully from foster care to independent living after they are too old for foster care.
• Analyze the relationships among social support, public policy and family characteristics and how they affect the function and well-being of rural low-income families.
• Increase understanding and develop more effective environmental management systems.
• Develop better models for the human health and human services sectors.

Educational programs to:

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

- Improve better 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

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5832	11664	15173	15173

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

Patent Applications Submitted

Year: 2010

Actual: 1

Patents listed

MICL01680-Value-added products for improving human, animal and plant health-PTEC1998-0034-01BR;PI9906950-4; 1/12/2010

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	1	41	42

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	39

Output #2

Output Measure

- Number of adult participants trained in healthy lifestyles.

Year	Actual
2010	1960

Output #3

Output Measure

- Number of youth participants trained in healthy lifestyles.

Year	Actual
2010	3811

Output #4

Output Measure

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

Year	Actual
2010	1960

Output #5

Output Measure

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

Year	Actual
2010	2505

Output #6

Output Measure

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

Year	Actual
2010	148

Output #7

Output Measure

- Number of adult participants trained in youth development.

Year	Actual
2010	2359

Output #8

Output Measure

- Number of youth participants trained in youth development.

Year	Actual
2010	8857

Output #9

Output Measure

- Number of adults trained in topics that support tribal governance.

Year	Actual
2010	72

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 understand how environmental pollutants, especially ozone and endocrine disruptors, affect human health.
3	Number of research programs to analyze the relationships among social support, public policy and family characteristics and/or develop better models for the human health and human services sector.
4	Number of adult participants with increased knowledge about healthy lifestyles.
5	Number of youth participants with increased knowledge about healthy lifestyles.
6	Number of adult participants with increased knowledge of human development and family well-being.
7	Number of youth participants with increased knowledge of human development and family well-being.
8	Number of adult participants with increased knowledge of community insititutions, health and social services.
9	Number of adult participants with increased knowledge of youth development.
10	Number of youth participants with increased knowledge of youth development.
11	Number of native american adults with improved knowledge and skills in tribal governance.
12	Number of research programs to develop more effective environmental/natural resources management systems.
13	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
2010	12	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overwieght people are at serious risk for cardiovascular disease, diabetes and some forms of cancer, and the risk is lifelong. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity reports that overweight adolescents have a 70 percent chance of becoming overweight or obese adults, and this risk increases to 80 percent if a parent is overweight or obsese. 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: discover health beneficial constituents in fruits, vegetables and generally regarded safe plants; determine the impact of phytonutrients on the absorptions, metabolism and elimination of essential nutrients; determine which foods protect against disease; identify and assess opportunities for farmers to pursue organic and place-based production and marketing strategies; 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
Advice was provided to the Heinz Company Foundation regarding the development of a bean paste for the rehabilitation of severely malnourished children.

Red lettuce shows higher antioxidant and anti-inflammatory activities than green lettuce, and also

contained anthocyanin, which can act as a powerful antioxidant.

The water extracts of hot peppers contained a number of compounds with activity similar to aspirin, ibuprofen and naproxen. Further, one of the compounds showed higher cyclooxygenase-2 enzyme inhibition similar to Celebrex, a prescription non-steroidal anit-inflammatory drug.

Following the investigation of several raspberry species and their antioxidant properties, an antioxidant assay was developed. This simple, fast and inexpensive assay is comparable to the lipid peroxidation inhibitory assay and can be mechanized to achieve high throughput.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3	7

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 diversie 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
Diabetic retinopathy is a common side effect of diabetes and the leading cause of blindness in young adults in the United States.
An AgBioResearch scientist has discovered the process that causes retinal cells to die, which could lead to new treatments that halt the damage.

In research studying the cancer-causing potential of vanadium oxide (an alloy additive to metal and steel) using three strains of mice, results showed that the most sensitive strain had highly significant amounts of inflammation and other early signaling events that appeared to correlate with high numbers of tumors in these mice. This research could provide a better understanding of how to intervene in and control carcinogenesis and other disease processes.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Number of research programs to analyze the relationships among social support, public policy and family characteristics and/or develop better models for the human health and human services sector.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual

2010	6	11

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: develop models and family-based interventions that advance the adjstment and well-being of National Guard soldiers and families post deployment to a combat zone; develop healthcare packaging that is easier to access, particularly for aging consumers and people with disabilities; 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 a curriculum model for ANR education that encourages Michigan's secondary schools to become more rigorous and relevant; and better understand the factors leading to well-regulated stress responses in young children

Results
A unique reintegration program was developed for returning National Guard soldiers and their families that uses other veterans to link the returning soldiers to counselors and other professional treatment. Additionally, the Buddy-to-Buddy program was created for returning Michigan National Guard members to offer these soldiers the opportunity to be paried with another veteran to confidentially discuss problems and issues.

Based on research findings, the Knowledge of Mental Illness and Recovery Scale was revised to be more consistent with public mental health conceptualizations of consumer recovery (e.g., consumer support, community involvement, work, stress management).

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Number of adult participants with increased knowledge about healthy lifestyles.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1100	1724

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. In one county, Berrien County's poverty rate is estimated at 13.8% (over 22,000), however there arecommunities, predominantly African American where the poverty rate is as high as 47%, with a school district with an average of 82% for free and reduced lunch/breakfast. Also more than 1/4 (over 8000) of Berrien Counties children live in poverty, and the well-being
of these children is getting worse (Kids Count in Michgan).

What has been done
In Berrien County, programs were developed in collaboration with The Department of Human Services (DHS), Berrien County Health Department
(BCHD), Lakeland Regional Health Systems (LRHS), the Capstone Family Center(CFC), Benton Harbor Area Schools (BHAS), Berrien County Intermediate School District(BCISD). Through these partnerships the program was promoted regularly through a variety of settings serving low-income families. Specific populations are from WIC, DHS and
agencies and organizations with Spanishing-speaking audiences.

Results
To date 98% made a positive nutrition/dietary change, 81% practiced better food safety, 80% showed improved resource management, 52% started reading food labels, 51% more often planned meals ahead, 48% tracked their expenses, 44% more began using a grocery list, 40% increased their awareness of healthy food choices, 35% worried less about food, 32% practiced comparison shopping, 30% less often ran out of food by the end of the month, 30% more reported their kids ate breakfast daily and 28% improved their physical activity, while 16% reached the USDA goal for physical activity by exercising 60 minutes or more for more days of the week.

4. Associated Knowledge Areas

KA Code	Knowledge Area

724 Healthy Lifestyle

Outcome #5

1. Outcome Measures

Number of youth participants with increased knowledge about healthy lifestyles.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2125	3354

3c. Qualitative Outcome or Impact Statement

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

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

Results
In one evaluation during 2009, analysis using Independent Sample T-Test found significant improvements of 175 youth in: Youth reported washing their hands more frequently before eating or preparing food; More youth read the nutritional information on food labels; Youth said they more frequently ate breakfast everyday; More youth chose healthy snacks when they had a choice; and youth reported they think more about which foods are good for them when choosing what to eat.

4. Associated Knowledge Areas

KA Code	Knowledge Area

724	Healthy Lifestyle
806	Youth Development

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1494	1587

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In one example in Kalkaska County, over the last ten years, the county has consistently had rates of children involved in the Child Protective Service system that were higher than the Michigan average. In Kalkaska County 23.4% of children are confirmed victims of child abuse and neglect, as compared to the Michigan average of 11.4%. In addition, 7.7% of children in Kalkaska County are in out-of home care for abuse and neglect as compared to the state average of 6.6%. Overall, Kalkaska County ranks 79 out of 82 counties for substantiated reports of child abuse and neglect per capita.

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

Results

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

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2125	2129

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In one example, a needs assessment using the Search Institute survey of youth assets was conducted with teens in Leelanau County where they reported: * Only 28% report having positive family communication * Only 26% report a caring school climate * Only 42% report being able to resist negative peer pressure.

What has been done
In response to this need, MSUE in Leelanau County developed the Natural's Helpers program. The Natural Helpers program is based on the premise that within every school there is an existing network of people that naturally help others. Through the program, this network identified youth and adults to receive intensive training about how to help others with problems. The volunteers practiced listening skills, learnned not to give advice, help in assessing what problems require professional help as well as informed them of what help is available in the community and how to not get personally involved in your friend's problem. Seven high schools in the county were involved.

Results

Several examples demonstrate how important the program is in Leelanau County: * The schools feel the program is important enough that each year they have asked MSUE to create certificates to present to their graduating seniors at the June graduation ceremony (not many out-of-school programs get that kind of endorsement!). * Surveys show many teens feel empowered to make a difference in their school and have chosen to get more involved. In some of the schools, the Natural Helper teens have set up annual Health Days or an Awareness Day to encourage their fellow classmates to make healthy choices. These events are planned and facilitated by the Natural Helper students. Topics have included diversity, positive responsibility, personal wellness, healthy relationships, stress reduction, etc. * Each year the refresher teens have the opportunity to apply to be a Teen Trainer for the new participants. There is a competitive application and four teens are selected to work as part of the training team. We have plenty of applicants and the Teen Trainers comment that they learn the skills even better after being in the teaching role. * The counselors have appreciated that Natural Helpers is one program that brings together teens from all seven schools in a non-competitive event. In fact, they say that no one school could/would facilitate this program for all of the schools and they appreciate that MSUE takes on that role.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

Number of adult participants with increased knowledge of 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
2010	100	123

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
After hosting a CAT, it was determined that Newaygo County had a greatly under-developed tourism industry. MSUE then began investigating the possibility of hosting and facilitating leaders

from a five-county collaborative to work together.

What has been done
Newaygo County MSUE facilitated a representative group of tourism and economic development professionals from Lake, Manistee, Mason, Newaygo and Oceana Counties that surveyed visitors, residents and tourism businesses to create a baseline as well as provide information on issues and opportunities. An annual conference was initiated in 2005 and has continued every year since to update and keep local tourism businesses involved.

Results
The outcome has been a well-functioning regional collaborative group with active committees, by-laws, and a strategic plan, who have been invested in helping each other to increase visibility of the region and thereby improve tourism business for all. 60-80 business have been reached each year through the conferences and through expansion the group has joined a major effort "Pure Michigan" campaign in helping the local communities. It developed a web-site at:

http://www.michigansgreatoutdoors.org/

This site has helped in both communication as well as marketing.

4. Associated Knowledge Areas

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

Outcome #9

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
2010	1275	2123

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 #10

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
2010	1800	7971

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. Over 50% of the youth volunteers were involved in community service projects.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	4	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The need to develop economically and environmentally sound approaches to address environmental and natural resources challenges is increasingly important. Policies, practices and science-based knowledge must constantly evolve to promote stewardship and sustainability in light of new opportunities for increased productivity, resource-saving technologies, and threats to biodiversity. Research is needed to ensure that practices and policies have a stron, 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; 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
Development of Soil Water Retention Technologies to enhance production potential of marginal agro-ecological zones for use in environmental planning and public poicy formulation.

Dengue fever ? caused by a virus transmitted by mosquitoes ? threatens 2.5 billion people each year, and there is no vaccine or treatment. New research has found that a bacterium can stop dengue viruses from replicating in the mosquitoes. If there is no virus in the mosquito, it can't spread to people, so disease transmission can be blocked. Researchers are now working to understand how the Wolbachia bacterium stops the dengue virus from replicating in mosquitoes.

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 #13

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
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As we begin the second decade of the new millenium, 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 foor insecurity in many low-income countries; and changes to prevent childhood stunting compel us to more fully understand the developmental (nutritional) origins of health and chronic disease that dominate the global public health nutrition agenda. By studying hoe 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 has shown that energy restriction (vis a vis caloric intake) prior to influenza infaction has negative impacts on the ability to recover from infection. Findings also show that restoration in body fat and body weight can improve the outcome to influenza infection. These findings are highly relevant to the lay population because they indicate that there is a distinct relationship between energy intake and recovery from a primary infection with influenza.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, funding reallocations, appropriations changes and competing public priorities. Attrition and faculty departures have also had an impact on outcomes. For example, in the last reporting year, we have gone from 135 Hatch-funded faculty (representing 89.5 FTEs) to 108 Hatch-funded faculty (representing 77.1 FTEs). Further, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised and, as a result, are skewed, significantly so in some cases. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were migrated into the new planned programs.

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

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Soil, Water and Natural Resources

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	1%		15%	
102	Soil, Plant, Water, Nutrient Relationships	19%		11%	
111	Conservation and Efficient Use of Water	12%		12%	
112	Watershed Protection and Management	15%		12%	
123	Management and Sustainability of Forest Resources	8%		5%	
131	Alternative Uses of Land	18%		15%	
132	Weather and Climate	1%		0%	
133	Pollution Prevention and Mitigation	12%		15%	
134	Outdoor Recreation	1%		5%	
135	Aquatic and Terrestrial Wildlife	5%		10%	
806	Youth Development	8%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	12.0	0.0	16.0	0.0
Actual	25.6	0.0	9.0	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**
1197618	0	7184760	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1197618	0	717778	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5827329	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

- Develop new land use models for Michigan communities.
- Offer education to planners, elected officials and citizens on how these new models will reduce sprawl and ensure that the desirable outcomes will become reality.
- Create new remediation strategies to clean up polluted soil and water. These strategies will be environmentally friendly, economically feasible and easy to implement with proper training.
- Discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.
- Develop a user-friendly computer program for nutrient management for Michigan crop and livestock producers to improve the management of fertilizer and manure nutrients on cropland to protect water resources and boost crop productivity.
- Develop management techniques for potato and vegetable growers that includes cover crops.
- Develop new nitrogen application recommendations for turf managers.
- Develop a management system for Michigan inland lakes that does not involve sampling the lakes.
- Develop Total Maximum Daily Load (TMDL) assessment tools for evaluation of Michigan watersheds.
- Determine how wildlife responds to ecosystem management decisions in forest and agricultural systems.
- Develop fish population/community computer models for species important to Michigan. These models will be used to evaluate different fishery management strategies.
- Develop web-based tools and models for natural resources managers so knowledge can be shared quickly and easily.
- Develop computer models to assess how habitat management affects species important to Michigan, including white-tailed deer, salmon, trout and perch.
- Identify, prevent and control exotic invasive pests and diseases of forests.

Extension programs to:

- 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/ecosystem managers, agriculture and natural resources industry representatives, state agencies, risk assessors, riparians, other researchers and academics and the interested public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5056	11012	5740	11480

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

Patent Applications Submitted

Year: 2010
Actual: 2

Patents listed
MICL01910 - Molecular biology of plant-bacterial interactions - TEC2008-0075-01; 12/695,605; 1/28/09.
MICL01907 - Elimination of airborne ascospore inoculum as a control for fungal diseases of plants - TEC2009-0050-01; 12/630,244; 12/3/09.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	45	45

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	33

Output #2

Output Measure

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

Year	Actual
2010	1449

Output #3

Output Measure

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

Year	Actual
2010	1237

Output #4

Output Measure

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

Year	Actual
2010	342

Output #5

Output Measure

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

Year	Actual
2010	1554

Output #6

Output Measure

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

Year	Actual
2010	719

Output #7

Output Measure

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

Year	Actual
2010	2354

Output #8

Output Measure

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

Year	Actual
2010	1199

Output #9

Output Measure

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

Year	Actual
2010	685

Output #10

Output Measure

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

Year	Actual
2010	1031

Output #11

Output Measure

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

Year	Actual
2010	895

Output #12

Output Measure

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

Year	Actual
2010	316

Output #13

Output Measure

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

Year	Actual
2010	115

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	6	5

3c. Qualitative Outcome or Impact Statement

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

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

Results
Research efforts successfully determined bacteria --Desulfovibrio, Anaeromyxobacter and Desulfosporosinus)promoted dissimilatory uranium reduction in the subsurface of a uranium contamination plume at the Oak Ridge Field Research Center in Tennessee. Remediation was achieved with a hydraulic flow control zone of injected ethanol and an outer loop for flow-field protection. Uranium concentrations in groundwater were reduced to levels below 0.126 uM.

4. Associated Knowledge Areas

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

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
2010	978	658

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With state water quality monitoring budgets declining and the Michigan Governor's Executive Order creating the Michigan Clean Water Corps, the role of volunteer water quality monitoring has been a hot topic.

What has been done
Interest in citizen science increased due to this change and the Kellogg Biological Station Land & Water Program was created the
?Introduction to Volunteer Stream Monitoring? to respond to this educational need. The two-day program provided intensive hands-on training that equipped participants with basic monitoring skills and an understanding of their responsibility as citizen scientists.
Lectures were given on stream ecology, water quality standards, riparian rights, and the importance of good study design and interspersed with field instruction in the physical, chemical and biological aspects of stream monitoring.

Results
Evaluation of the program found fifty percent increased their skills in water sampling. Participants? ability to design a stream study increased by sixty-one percent. Other skill sets taught in the class had similar increases. Seventy percent of participants responding to a follow-up mail survey question about activities during their first field season indicated they had conducted water quality monitoring. The majority described the program as very or extremely useful to their efforts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

Outcome #3

1. Outcome Measures

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

Not Reporting on this Outcome Measure

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
2010	850	856

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michigan forests provide 400,000 jobs and contribute more than $13 billion to the state's economy each year. Timber industry professionals need information about environmentally sound management practices that allow them to remain profitable and harvest a high-quality crop while protecting Michigan's forests for future generations.

What has been done
MSUE conducted workshops that had more than 1,000 people representing 800 forestry businesses in sustainable forestry.

Results
Evaluation found that 87% of the timber industry professionals learned about environmentally sound management practices that helped them to remain profitable and harvest a high-quality crop while protecting Michigan's forests for future generations.

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
2010	2	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 sistain biodiversity and conserve wildlife populations, communities and habitat.

What has been done
Research to: quantify ungulate-habitat relationships in forests and agricultural ecosystems at multiple spatial and remporal 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
Aspen is an important tree species for its economic and ecological values. Following an evaluation of the ecological contributions various age classes of aspen have on wildlife species, communities and habitat sustainability, researchers developed a database that describes the ecological conditions where aspen occurs in the Upper Peninsula of Michigan and the resulting wildlife habitat conditions. The database is being used by the Michigan Department of Natural Resources to plan aspen management practices that will result in sustaining aspen.

The holdings of the A.J. Cook Arthropod Research Collection grew by approximately 10,000 specimens as a result of an extensive effort by an AgBioResearch entomologist and his students to collect specimens from the western United States for research. A specimen-level database was also constructed, and 8,000 bark beetle specimens were entered into this data base.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1275	876

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example is in Ottawa County where the changing of the urban - rural population has created a number of issues with regards to
land use, economic, and community development. These changes and changes in social concern/philosophy have affected agriculture, natural resources, green space, residential life, and business and industry. This has been especially true in the need for alternative energy and the effect it may have on land use, especially in wind energy that may require ordinance changes.

What has been done
MSUE, Ottawa County and the Ottawa County Department of Planning and Performance Improvement on behalf of the Ottawa County Planning Commission created a model for land use ordinances/regulations. Once developed, it was disseminated to surrounding cities and townships/

Results
Currently the city of Holland has adopted the model with two townships and one city in the process of adopting the model while eight other communities are reviewing the model for adoption. The Model Ordinance won the 2009 National Achievement Award from the National Association of Counties.

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
2010	681	1221

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increased fertilizer prices have created a teachable moment for improving manure applictions to retain more nitrogen value and increased utilization of manure on crop farms. Educational needs identified were: 1-understanding of nitrogen gains and losses in
the environment; with special emphasis on cover crops to aid in the retention of manure N from fall and winter applications 2-providing nitrogen to crops from manure with attention to phosphorus balance in fields and on farms 3-working with specialists and educators on the renewed outreach of P information due to DEQ priority 4-work with the Manure GAAMPs committee 5-build relationship with DEQ as they venture into the next CAFO permit process. Forsee winter spreading and off site movement of manure as issues of importance in the next

permit.

What has been done
One example, is a field day was held at the MSU Beef Purebred and Beef Cattle Research Center during the first day of Ag Expo. The goal of this was to showcase environmental protection practices and how those same practices can also be cost effective to the producer.

Results
One hundred and fifty people attended with 53 participants evaluating the program. The results were:

The main reason for attending was to
learn practices that were more profitable (60%),
reduce their chances of getting into regulatory issues (44%) and to
protect the environment (34%).

One-third of the producers indicated that the environmentally protective practices they saw and were considering doing were ?just the right thing to do?. When asked if they learned anything they planned to apply back on their farms, 94% indicated yes,
listing the following as the top 6 items they would implement:
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, and
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
12% would try slurry or frost seedings.
When asked what the most significant tour stops were, they listed the above plus the stop on electronic identification
systems for livestock.
69% of the livestock producers who attended indicated that they increased their awareness of environmental impact of
livestock production.

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.

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	400	289

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In one example, fertilizer prices have increased significantly that has reduced farm profitability. Fertilizer recommendations from private agronomists and salespersons are often not consistent with those provided by Michigan State University Extension and usually less profitable. Field crop producers and commodity group representatives serving on an advisory committee identified these issues and ranked nutrient management as one of their highest priorities.

What has been done

MSUE developed a program to help field crop producers reduce the adverse impact of increasing fertilizer prices on their businesses and help protect the environment.

Results
The program reached producers and agribusiness agronomists. An evaluation of the program found 90 percent of the participants learned new information by participating in the programs. 89% indicated that they planned to use the information they learned to make nutrient management decisions in 2011. 71% said that they expected these decisions to make their businesses more profitable in 2011. The total
amount of money that the participants expected to earn/save by utilizing the information they learned was over $398,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

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
2010	5	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Urban, industrial and agricultural development have caused remarkable changes in the lakes' flora and fauna and 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
AgBioResearch scientists are fine-tuning computer models that can predict what will happen to key fish species and invasive species populations related to survival rates, feeding patterns and reproduction rates, when certain management decisions are made. This is providing fisheries managers with more effective ways to manage fish populations and to control destructive invasive species to help protect the Lakes' $7 billion dollar fishery.

A food-web model was created for Lake Huron and is being used to examone harvest policy options for commercial whitefish fisheries.

A national database summarizing distributions of relative abundances of fluvial fishes throughout the conterminous United States was developed.

A nationwide web-based data sharing program operated by USGS was developed using a Google Earth platform that allows users to download a variety of biological and environmental data in various spatial units. It is the first of its kind to provide nationwide to users in such a manner.

4. Associated Knowledge Areas

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

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
2010	5	7

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: 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; and help develop dynamic, interactive computer interfaces in resource-based recreatin management.

Results
Researchers have developed a way to rear Bythotrephes (the spiny water flea) in the laboratory through multiple generations, allowing them to test the interaction of predator presence and absence on the morphology of Bythotrepehs reared in clonal lines and examine whether "rapid evolution" is affecting the success and impact of the flea.

Researchers have developed a novel approach to multi-ecosystem classification using lakes as a case study after completing an analysis of 2300 lakes to demonstrate the approach. Tools developed to date include an inland lake classification system and statistical models for lake monitoring and assessments, and a landscape-based model to set standards for nutrient levels in lakes and streams.

4. Associated Knowledge Areas

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

Outcome #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
2010	6	3

3c. Qualitative Outcome or Impact Statement

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

What has been done

Research to: study the characteristice of high content soil blends used in athletic fields and golf putting greens; explore diversification with cover crops to enhance nutrient cycling efficiency and rhizosphere traits for resilient, productive row crop systems; and better understand the degree to which soil biological communities influence molecular carbon structure and the association of carbon with mineral surfaces and whether these processes are influenced by agricultural management.

Results
Research findings showed that, for athletic fields, drain tiles, spaced up to 4 m apart and 23 kg m-2 of topdressing will keep surface fiels conditions relatively dry.

Research findings support the use of conservation tillage and organic sources of nitrogen (such as compost and cover crops) for more efficient nitrogen management.

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michigan's 37 million acres of land support the plants and animals that provide our shelter, food and fiber. The land provides us with minerals and 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: evaluate the occurance and human health risks of historic pesticide contamination of agricultural soils; determine the mechanistic functions and contributions of soil humus and clays to the immobilization of pesticides and POPs found in soils; create and validate new computationsl techniques for environmental chemistry research; evaluate the environmental occurrence of antibiotics in animal farms and their mobility; control and convert rural waste to resources; and to understand the mechanisms by which chronic estrogen exposure brings about reproductive failure.

Results
Research evaluating geochemical control of antibiotics in the soil demonstrated that manganese oxides in soils and sediments could plausibly decompose antibiotics released into the environment.

A robust analytical method was developed and validated to quantitatively determine pharmaceuticals in the collected to-be-land- applied biosolids. For the 15 target pharmaceuticals tested, recoveries ranged from 49 to 95 percent, indicating that pharmceuticals could survive wastewater treatment processes and accumulate in sewage sludge and biosolids. Subsequent land application of the contaminated biosolids could lead to the dissemination of pharmaceuticals in soil and water environments, which poses potential threats to at-risk populations in the receiving ecosystems.

4. Associated Knowledge Areas

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

Outcome #19

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	5

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

What has been done
Research to: understand the consequernces of global environmental changes on biodiversity in time and space; increase management among agencies to better integrate biological and human dimensions of management in wicked problems, such as wildlife health management; and develop sustainable agro-ecosystems that protect public health and the quality of the environment and promote efficient and profitable resource use.

Results
Research has shown that slurry seeding and the integration of manure and cover crops in no-till and reduced tillage cropping systems can reduce manure contaminant loss to the environment, capture manure nutrients for crop use,stabilize soil and enhance soil quality. This information has been shared through numerous workshops, field days, presentations and via a webinar to a national audience and two educational videos that were posted on the Web page of the Mid-West Cover Crops Council.

Researchers have written a series of books to help wildlife professionals work with a large and growing array of stakeholders with diverse and ofeten competing interests related to wildlife management. The books cover the challenges faced by contemporary wildlife managers, how to apply new wildlife management approaches and leadership in wildlife management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
131	Alternative Uses of Land
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, funding reallocations, appropriations changes and competing public priorities. Attrition and faculty departures have also had an impact on outcomes. For example, in the last reporting year, we have gone from 135 Hatch-funded faculty (representing 89.5 FTEs) to 108 Hatch-funded faculty (representing 77.1 FTEs). Further, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised and, as a result, are skewed, significantly so in some cases. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were migrated into the new planned programs.

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

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Plant Sciences

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		15%	
202	Plant Genetic Resources	6%		8%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	7%		10%	
204	Plant Product Quality and Utility (Preharvest)	5%		5%	
205	Plant Management Systems	30%		18%	
206	Basic Plant Biology	3%		11%	
211	Insects, Mites, and Other Arthropods Affecting Plants	3%		9%	
212	Pathogens and Nematodes Affecting Plants	15%		10%	
215	Biological Control of Pests Affecting Plants	3%		5%	
216	Integrated Pest Management Systems	20%		9%	
806	Youth Development	3%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	37.0	0.0	27.0	0.0
Actual	24.2	0.0	17.0	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**
1134585	0	1317206	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1134585	0	1315927	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	10683437	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs to:

- Develop insect and disease control strategies and/or cultural and management strategies for crops that meet USDA certified organic standards.
- Develop biological controls for pest insects and diseases to minimize effects on the environment.
- Develop integrated management strategies for producers of fruit, field, 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.
- 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.
- 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.
- Develop improved varieties of economically important crops for Michigan and the region.
- Develop weed control methodology, protocols and practices.
- Develop controls for pathogens and nematodes.
- Develop production protocols and environmental and cultural strategies for the floriculture/nursery industry.

Extension activities included:

- Conducting educational programs to help farm producers control weeds and more effectively manage high-cost fertilizer inputs while optimizing crop production.
- Developing plant disease prediction models.
- Conducting educational programs to help plant producers control disease caused by pathogens and nematodes and teach integrated pest management methods.
- Providing 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.
- Training Native American adults in sustainable agriculture.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8677	17354	5251	0

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

Patent Applications Submitted

Year: 2010
Actual: 2

Patents listed

MICL01907-Elimination of airborne ascospore inoculum as a control for fungal diseases of plants; TEC2009-0050-01; 12/630,244, 12/3/09. MICL01910-Molecular biology of plant-bacterial interactions; TEC2008-0075-01; 12/695,605; 1/28/09. One patent was awarded - MICL02145-Development of novel plant transformation system suitable for large seeded legumes; TEC2003-0012-01US; 10/561,720; patent7,696,406, 4/13/2010.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	75	75

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research projects on plant sciences.

Year	Actual
2010	58

Output #2

Output Measure

- Number of adult participants trained in plant management systems.

Year	Actual

2010	6726

Output #3

Output Measure

- Number of youth participants trained in plant management systems.

Year	Actual
2010	5251

Output #4

Output Measure

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

Year	Actual
2010	756

Output #5

Output Measure

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

Year	Actual
2010	1169

Output #6

Output Measure

- Number of native american adults trained in small scale sustainable agriculture.

Year	Actual
2010	26

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.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

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

Not Reporting on this Outcome Measure

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
2010	1275	1052

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers have expressed the desire to attend core manual reviews prior to taking the certification test for IPM.

What has been done
In one example, MSUE conducted a series of workshops on IMP.

Results

One hundred ninety three farmers participated in this series of workshops with 181 responding to an evaluation survey. The results found:
#1 - 74% were more knowledgable 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
2010	2	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
American organic farmers represent only 1 percent 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 more than $3 billion in 2009. Michigan has 230 organic farmers and just under 50,000 certified organic acres. As this only represents about .45 percent of total farmed acreage in Michigan, additional ways to increase production and marketing efficiences is important if organic growers are to remain economically viable. Further, to ensure that organic growers continue to be a contributor to this important market, they need pest control methods that conform to organic standards and allow them to produce plentiful, pest-free crops.

What has been done
Research to: investigate the production and use of thermophilic compost and vermicompost as important tools for organic and sustainable production and management of vegetable transplants and high tunnels for year-round vegetable production and marketing on rural and urban farms; develop a novel methodology for quantifying ecosystem services and their response to varying agricultural practices; develop pest management approaches that maximize ecosystem services; and develop a methodology for quantifying multi-trophic crop/pest/ beneficial interactions.

Results
Research data from the nematode project suggests that Steinernema feltiae can persist in Michigan organic orchards for 30 days post application.

Data from the greenhouse biological control project indicates that intraguild predation among thrips predators reduces biological control success, and that the predaceous mite and exposure of breeding piles to soil is likely the root cause.

Research to test the hypothesis that vermicomposting of food resuduals can continue through winter in zone 5 climates using the same methosd of interior covers that allow hoophouse winter vegetable harvesting demonstrated that a mobile structure (one that rolls on pipe track) can provide useful porduction for 16 months versus 12 months by starting crops inside and then moving the structure to start other crops.

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

2010	7	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Biological control is the use of living organisms to suppress pestpopulations, 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 on mechanisms of mating disruption of tortricid moths has enabled the load of pheromeone in dispensers to be reduced so that the number of dispensers per hectare can be elevated, as results showed was necessary.

Scientists discovered that the survirorship and fecundity of malaria mosquitoes feeding on the blood of cattle treated with avermectin-type dewormers is reduced, opening a new avenue for suppression of malaria mosquitoes.

Research related to honey bee learning and insecticide effects has demonstrated that pesticide interaction can affect honey bee learning or memory-these results might shed some light on what is happening with colony collapse disorder, where bees mysteriously disappear from their hives.

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
2010	5	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers' livelihoods depend on production systems that are healthy and sustainable -- environmentally, ecologically and economically. Farmers in Michigan grow a diversity of crops second only to California, a state almost three times the size of Michigan. This world-class diversity necessitates a unique mixture of research and Extension programs to meet the needs of more than 200 commercially grown commodities.

What has been done
Research to: 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; collaborate on innovative orchard management strategies and technologies; and improve row crop nitrogen management to optimize economic return and reduce environmental impacts.

Results
Sweet cherry genotype performance data was expanded in 2010 with the second significant fruiting of more than 35 genotypes and the first significant fruiting of an additional 10 genotypes in tunnels at the Southwest Michigan Research and Extension Center. The majority of these had average fruit sizes of 10g or larger, with the largest fruit sizes ranging up to 36 mm in diameter and 17 to 18 g. Several selections continued to exhibit good resistance to powdery mildew infection.

Research results related to corn grain yield response to nitrogen rate and timing are being used in Michigan's corn N recommendation database.

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
2010	21	10

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

What has been done
Research to: develop and select high yielding oat, barley and canola varieties for Michigan; provide guidance on disease control and crop health to the Christmas tree and chestnut production industries;determine the biochemical mechanisms involved in turfgrass disease control; develop production methods to increase net returns to Michigan berry producers; elucidate molecular and biochemical mechanisms of plant resistance to athropod herbivores;determine how to enhance resistance to plant invaders; and develop improved analytical mass spectometry approaches and the applications of these methods to investigate the chemical basis on plant-insect and plant-pathogen interactions.

Results
In a winter canola trial, the Kansas State National Canola variety had a winter survival rate of over 90 percent. The two highest yielding cultivars were Dynastie and Hybridsurf at over 54 bushels per acre.

Dollar spot-resistant creeping bentgrass clones were found and collected from an old, segregated

creeping bentgrass green. These clones proved to be far more resistant to dollar spot than any resistant commercially available creeping bentgrass cultivar. The most promising resistant lines have been entered into the National Turfgrass Evaluation Program creeping bentgrass trials.

Research on short-term control methods for apple fire blight showed the efficacy of the experimental antibiotic kasugamycin for blossum blight control under Michigan conditions. Levels of control were similar to those observed with strptomycin, the industry standard.

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
2010	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 mechanism by

which plants tolerate environmental stresses; and better understand disease resistance signaling in plants.

Results
An AgBioResearch plant pathologist was the first to show that the actin cytoskeleton plays a role in resistance to bacterial pathogens in plants. Knocking out one of the actin-binding proteins stopped Arabidopsis from defending itself against Pseudomonas syringae, a bacterium that causes surface damage in plants at low temperatures. This disease resistance work in Arabidopsis will be a template for other plant systems.

Scientists have characterized the growth and development of 10 transgenic petunia lines that are constitutively freezing tolerant. Genetic linkage maps for two interspecific F2 families, Petunia exerta x Petunia axillaris and Petunia axillaris x Petunai integrifolia are now being developed in addition to recombinant inbred lines for these populations.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	14	11

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 one 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: identify the genes critical for the replication and repair of chloroplast DNA; understand the patterns of evolution of flora form that contributes to the reproduction and persistence of Michigan plants; increase the environmental and economic sustainability of small fruit production in Michigan; understand central metabolism and transport in plant systems well enough to rationally manage and engineer them for human benefit; and develop a data driven protocol for culture of juice grape cultivars in Michigan.

Results
Research on the patterns of evolution of flora form that contributes to the reproduction and persistence of plants has resulted in the release of a herbarium database of specimen data for specimens from the state of Michigan - the Michigan State University Herbarium. Almost 5,500 specimens were added to the database in 2010.

To complement the standard flat-based statistical analysis method used to determine functions for the 4,400 nuclear genes predicted to encode plastid-targeted proteins in Arabidopsis, researchers developed an empirical distribution-based method to analyze the full phenotypic dataset. The method - Mutant Identification by Probabllistic High throughput-Enabled Normalization - normalizes quantititative data without the need for explicit in-group controls. Analysis of the high throughput phenotypic data from the Chloroplast 2010 Project showed a four-fold increase in the ability to detect prviously described or expected phenotypes over the standard group-based z score.

Research on sustainable viticulture in Michigan demonstrated that Concord berries accumulate 50 percent of their final weight at harvest by 1200 GDD at base 50 degrees, providing a tool for anticipating final crop.

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
2010	4275	5201

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example is the Midwest Cover Crops Coucil with Michigan, Ohio, Indiana, Illinois, Iowa, Minnesota, North Dakota, Wisconsin and Ontario collaborating on regional issues to develop a network which allows for more rapid exchange of new research pracice for farmers.
The group focuses on changes expected within 2 and 4 years that addresses the environmental, social and economic barriers of adoption of perennials and cover crops.

What has been done
Since 2006 the group has utilized the expertise of researchers for these tasks, producers, environmental stakeholders, marketing specialists, policy and economics experts in addressing issues related to cover crops. In 2009, the forth conference was conducted in Windsor, Canada with over 80 participants including 40 farmers and agribusinesses from the US and Canada.

Results
Evaluation results found: 96% increased their knowledge about cover crops, 89% felt better prepared to work on cover crop issues, and 96% of the participants believed they would utilize information gained from the conference in the future.

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
2010	4	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Weed control is an essential part of all crop production systems. Weeds reduce yields by competing with crops for water, nutrients and sunlight. Weeds may also reduce profits by hindering harvest operations, lowering crop quality and producing chemicals harmful to crop plants. Weeds left uncontrolled may harbor insects and diseases and produce seed or rootstocks that infest fields and affect future crops. Weeds are a major source of yield loss for growers in Michigan and in the North Central Region. Is 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
Flaming has been used in field crops for many years, but has had less success in vegetable production because of the potential for crop injury. To address this issue, a digital cmaera and

computer guidance system wth a shielded applicator was developed to flame between rows of vegetable crops -- snap beans, carrots and lettuce. Results showed that beans treatment at two and four miles per hour did not cause serious crop injury; carrots were more sensitive to thermal injury, but leaves regrew and there was no reduction in yield from any of the flame treatments; leaf lettuce suffered yield reduction from the flame treatments. The most effective propane does for both crop safety and weed control was 15 to 20 gallons per acres, and crop safety was greatest at two and four miles per hour.

In studies conducted to evaluate weed management in organic production systems, experiments using a propane flamer and rotary hoe alone and in combination in black bean fields showed that flaming followed by two rotary hoeings, or rotary hoeing three times, resulted in the fewest weeds and highest yields. Another study demonstrated that rotary hoeing, regardless of timing, reduced weed density compared to treatments that were not rotary hoed.

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
2010	5	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 to improve the baculovirus expression vector system to reliably express internal membrane proteins to high levels sufficient for crystalization and structural studies has resulted in the development of a T. ni cell line for use in baculovirus expression systems. The cell line has been distributed to several pharmaceutical companies for testing.

Research to incorporate functional ecology into food management systems has resulted in the development of a functional ecology measurement system designed to provide growers with a more economical and IPM-friendly method to measure an ecosystem's health and the economic benefits accrued.

Research on several biological pesticides demonstrated that biopesticides require precise timing, good coverage and modification of the microclimate in order to achieve mandated quality standards. The experiments yielded data critical to grower survival under Food Quality Protection Act promulgations, including optimum application timings, various barrier strategies and the impact of pre- and post-irrigation on biologicals' performance in on-farm experiments.

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
2010	6	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The wholesale value of floriculture crops produced in Michigan is more than $397 million annually. There are 651 commercial floriculture companies in Michigan, with over half of them reporting wholesale sales of more than $100,000. Total greenhouse cover is about 50 million square feet with an additional 3,600+ acres of open ground used for floriculture production.

What has been done
Research to: enhance control over quality loss in horticultural produce; evaluate turfgrass species and mixes for their adaptation to athletic field turf and to assess the effects of cultural practices; investigate nitrogen fate in turfgrass; promote the use of less utlilized 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
A trial garden Web site (http://trialgardens.hrt.msu.edu) was developed, along with a monthly e-Newsletter to inform amateurs and professionals about new plants and opportunities in horticulture.

Research has shown that agressive topdressing with high sand content materials on native soil athletic fields combined with the drainage can improve event capacities of sports fields at significant cost savings to school and municipalities. This method can be implemented over multiple years without removing the field from play.

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.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, funding reallocations, appropriations changes and competing public priorities. Attrition and faculty departures have also had an impact on outcomes. For example, in the last reporting year, we have gone from 135 Hatch-funded faculty (representing 89.5 FTEs) to 108 Hatch-funded faculty (representing 77.1 FTEs). Further, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised and, as a result, are skewed, significantly so in some cases. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were migrated into the new planned programs.

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

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

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

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	36.0	0.0	11.0	0.0
Actual	25.6	0.0	5.0	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**
1197618	0	419111	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1197618	0	418704	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3399275	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research program activities 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.

Extension program activities to:

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

2. Brief description of the target audience

Agriculture and natural resources producers and industry representatives, tourism industry representatives, risk assessors, regulatory agency reprentatives, local, state and federal elected officials and policymakers, other researchers and academics, and the interested public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3982	7964	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

No patent applications submitted for this reporting period.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	30	30

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	18

Output #2

Output Measure

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

Year	Actual
2010	507

Output #3

Output Measure

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

Year	Actual
2010	856

Output #4

Output Measure

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

Year	Actual
2010	1031

Output #5

Output Measure

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

Year	Actual
2010	1588

Output #6

Output Measure

- Number of youth trained about starting businesses and entrepeneurship.

Year	Actual
2010	35

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 and human resources management practices of Michigan farm markets, greenhouses and other green industry retailers.
8	Number of research programs to develop a framework to understand and analyze domestic and international trade policies and assess their impact on Michigan.
9	Number of research programs to develop models to estimate the demand for and value of recreational fisheries and wildlife resources.
10	Number of research programs to identify and evaluate the policy, technology and marketing issues faced by Michigan organic growers and develop responses.
11	Number of youth that increase knowledge about business and entrepreneurship.

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
2010	700	456

3c. Qualitative Outcome or Impact Statement

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

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

Results
Summarized the more than 100 returned surveys. The results are listed below:

94% found the information contained in their reference notebooks to be beneficial to their businesses.
93% of the respondents utilized information or implemented new management practices they learned from
the presentations given at the programs
55% indicated that the information or practices they implemented actually saved or earned them additional
money.
The average amount of money they actually earned or saved was $14.71 per acre on 19,561 acres.
The actual financial impact of the 2008 and 2009 educational programs was $287,722.00.

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
2010	1275	1322

3c. Qualitative Outcome or Impact Statement

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

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

Results
Evaluation of the Telfarm tax management training found producers saved on an average over $10,000 per farm. As a result, the participants in 2010 gained approximately $2,360,000 in delayed income tax. Producers learned the necessary management skills and strategies that can help them achieve their tax management goals. Many tax changes in the depreciation system allow for fast depreciation, enabling a significant reduction in the taxable income.

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.

Not Reporting on this Outcome Measure

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
2010	1368	1227

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example, The local need included assisting Hematite Township officials requesting assistance with coordinating business assistance that included bonding opportunities, grant requests, funding assistance, industrial development establishment, employee skill training and the coordination required to administer the project. Stakeholder input included establishing an Industrial Development within the Township of Hematite.

What has been done
MSU Extension assisted throughout the decision process of this business development.

Results
The impact of the project was the retention of 11-15 jobs in the community and creation of 30 additional jobs. Funding for this project included Private investment of $8.2 Million for a new building and state of the art equipment. Michigan Economic Development Corporation assistance of $600,000 toward a water line extension required for fire safety and business needs in the sawmill. Michigan Department of Transportation road improvement of approximately $160,000

submitted by the Iron County Road Commission with a local community match of $40,000 to be provided by the Iron County Economic Development Corporation. USDA Rural Development assistance with water line extension funding in the form of low interest loans up to $200,000 to Hematite Township. Escanaba Lake Superior, MDOT and Pine River Hardwoods, LLC rail improvements at approximately $235,000.

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
2010	6	4

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: 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; develop and extend knowledge concerning the role of legal and economic analysis on environmental and natural resources management; develop, extend and apply economic and ecological theory to analyze economic and ecological tradeoffs associated with ecological problems; and help understand what forces spark Michigan food system conflict

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

Results
Research exploring how the media - as an agent of social influence - frames conflict around biofuels, found that the media constructed three distinct frames in their efforts to shape public discourse: economic development, environment and national security. Findings showed that, in their efforts to construct meaning around biofuels, the media draw on frames that are coded with symbolic meanings to leverage their positions/interpretations of biofuels' relative usefulness to society.

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
2010	7	6

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

What has been done
Research to: analyze the ways in which social structures and processes influence the sustainability of animal agriculture and fisheries in Michigan; discern the relationship between entrepreneurship and innovation; examine the causes and consequences of Michigan state and local government fiscal challenges; analyze farm business and financial risk profile and performance in a rapidly changing environment; and identify strategies and policies to accelerate the adoption of entrepreneurial practices among Michigan agrifood stakeholders.

Results
A local government fiscal data web portal for the state of Michigan has just been completed. The site is designed so that researchers, policymakers and the interested public can use the site to obtain important local government information that will be used in assessment and decision making.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Management of personnel and human resources has changed over the past three decades, partially due to increasing employment legislation, education issues, employee awareness, and

changes in demographics. As competitors strive to win the war for talent, effective human resource management is necessary to gain true competitive advantage in the marketplace.

What has been done
Research to: analyze human resource management practices in agriculture, including recruitment, selection, training, evaluation, motivation, compensation and benefit systems, etc.; and profile and characterize consumers and markets for eco-friendly products.

Results
The Stewardship Index for Specialty Crops was created to help develop valid sustainability measures for agricultural labor management. It compares labor-related measures introduced by sustainability initiatives and measures used by different certification agencies and other organizations.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

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

Results
Hedonic land valuation research comparing two methods for analyzing agricultural land sales data showed that recreational and water quality ecosystem services are the ones most highly valued through land prices, although certain other ecosystem services cannot properly be valued by this method.

Researchers developed a prototype math programming model of food and bioenergy crop choices in southern Michigan that predicts the quantities of biomass that profit-maximizing farmers would produce.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The natural beauty and outstanding recreation opportunities provided by Michigan draw more than one million visitors a year. Improving ecological conditions and fisheries has the potential to enhance economic and recreational benefits. For this reason, it is important for natural resources and wildlife managers to understand the recreational demands and economic benefits stemming from these important resources in order to 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; apply economic models to resource management issues; and study issues related to the management of human resources in a commercial recreation and tourism context.

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.

4. Associated Knowledge Areas

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

Outcome #10

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 #11

1. Outcome Measures

Number of youth that increase knowledge about business and entrepreneurship.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	35

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With Michigan's economy in the challenging place where it is, there is a need across the state to prepare young people to be good money managers and prepared to be their own source of money (as an entrepreneur).

What has been done
MSUE developed program to increase the awareness & importance of financial and entrepreneurship education and empower youth to utilize the skills they learned to develop their own businesses in their local communities. Youth received financial education and entrepreneurship training through a small-group setting.

Results
Evaluation found that 75% of the youth learned about pricing products, 50% gained knowledge in how to use financial statements to make decisions, and 50% gained knowledge in how competitors impact a business, 62% gained knowledge about prototype development and break even points.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, funding reallocations, appropriations changes and competing public priorities. Attrition and faculty departures have also had an impact on outcomes. For example, in the last reporting year, we have gone from 135 Hatch-funded faculty (representing 89.5 FTEs) to 108 Hatch-funded faculty (representing 77.1 FTEs). Further, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised and, as a result, are skewed, significantly so in some cases. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were migrated into the new planned programs.

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

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

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%		15%	
302	Nutrient Utilization in Animals	5%		15%	
303	Genetic Improvement of Animals	2%		10%	
304	Animal Genome	4%		11%	
305	Animal Physiological Processes	5%		9%	
307	Animal Management Systems	41%		13%	
308	Improved Animal Products (Before Harvest)	1%		1%	
311	Animal Diseases	28%		16%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	4%		0%	
315	Animal Welfare/Well-Being and Protection	3%		10%	
605	Natural Resource and Environmental Economics	1%		0%	
806	Youth Development	3%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	15.0	0.0	17.0	0.0
Actual	17.5	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**
819423	0	598730	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
819423	0	598149	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	48561080	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research program activities to:

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

Extension program activities to:

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

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2096	4192	16793	0

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

Patent Applications Submitted

Year: 2010

Actual: 3

Patents listed

MICL01573-Impact of the high variation in number of oocytes in ovaries on ovarian function, health and fertility in cattle; TEC2003-0053-02; 12/258,800,10/27/09. MICL02020-pathogenicity factors of gram-negative bacteria: secretion apparatus structure and function; TEC2007-0002-01Prov; 61/334,090, 5/14/10. MICL02127-Increasing the efficiency of somatic cell nuclear transfer cloning in bovine; TEC2010; 0050-01Prov; 61/259,783, 11/10/09.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	1	50	51

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs on animal production and protection.

Year	Actual
2010	27

Output #2

Output Measure

- Number of adult participants trained in animal management systems.

Year	Actual
2010	2096

Output #3

Output Measure

- Number of youth participants trained in animal management systems.

Year	Actual
2010	16793

Output #4

Output Measure

- Number of adult participants trained in animal diseases.

Year	Actual
2010	1048

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of adult participants with increased knowledge about animal management systems.
2	Number of youth participants with increased knowledge about animal management systems.
3	Number of adult participants with increased knowledge of animal diseases.
4	Number of research programs to understand the processes that control/influence reproduction at the molecular and genetic level.
5	Number of research programs to develop and test new cropping, grazing and feeding strategies for cattle, sheep and other ruminants.
6	Number of research programs to develop and evaluate new nutritional management strategies for non-ruminant animals.
7	Number of research programs to understand the molecular processes that influence growth and meat quality in food animals.
8	Number of research programs to add to the understanding of various food animal genomes by improving and integrating genetic maps.
9	Number of research programs to develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.
10	Number of research programs to understand the environmental fate and biological effects of vaccines, steroids and other substances fed to animals.
11	Number of research programs to develop and evaluate management/training strategies for horses to reduce injuries.
12	Number of research programs to test new cropping, grazing and feeding strategies for food animals.
13	Number of research programs to understand the genetic and molecular processes that control/influence the immune system in food animals.
14	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
2010	1260	1781

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To increase beef market share and to position Michigan producers to remain competitive in the market place we must develop breeding programs around the consumer needs. Less than 10% of the beef herds use artificial insemination, yet AI is one of the best management tools to consistantly produce a profitable beef product for consumers. Producers need educational opportunities on practical ways to add AI to their management tools to enhance genetic progress and profitability.

What has been done
MSU Extension developed an outreach program to enhance the long term social and economic viability of the Michigan livestock industry by providing information to improve all aspects of livestock management.

Results
One example of major impact on a farm, after evaluating a feedlot enterprise system based on the information learned in a training and developing a comprehensive nutrition plan to meet the cattle nutritional requirements in a more cost effective and efficient means as well as utilizing growth promotant implants to increase performance efficiencies while minimizing risks of decreased quality grades in the harvested animals, the producer saved $225.00 in the cost of taking a Holstein feeder calf to slaughter while decreasing the days each steer in the system by 110 days. The producer saved approximately $33,750 per year who feeds 150 Holsteins per year. It is estimated, the program statewide saved over $2.5 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

311 Animal Diseases

Outcome #2

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of adult participants with increased knowledge of animal diseases.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	850	891

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One example, a high level of concern developed about the spread of hi-path avian influenza and the possibility of a pandemic in the past several years. There is particular concern about an outbreak of AI in small flocks as a result of exposure to wild birds and poor biosecurity procedures compared to the comercial poultry industry.

What has been done
A team of people at MSU developed an outreach program to educate small flock owners about the issue. The team included; the MSU Diagnostic Center poultry vet, two faculty specialists from the MSU Animal Science department, MSUE Emergency Mgt specialist, and a MSUE educator. Eight regional seminars were held in the evening or on Saturday.

Results
Evaluation results found 85% had a better understanding of good small flock poultry production practices, 88% had a better understand how bird flu is transmitted to poultry, 88% felt that they understand how to reduce the chances of you or your poultry getting bird flu, and 62% believed as a result of the training that they would change the way they managed their poultry flock to

reduce their chance of getting bird flu.

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
2010	5	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Unless you are a strict vegetarian or lactose intolerant, chances are that dairy and beef products make up half of your diet. According to the U.S. Department of Agriculture, almost 40 percent of the average American diet is dairy, and beef makes up about 10 percent. 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
Experiments were completed in cattle or with granulosal cells isolated from cattle to show that: concentrations of anti-Mullerian hormone (AMH) are highly variable among 12-month old dairy heifers, but static during estrous cycles and positively associated with ovary size and number of follicles 3mm or greater in diameter; a 20 percent decrease in energy requirements during the first trimester of pregnancy decreased follicle numbers and increased blood pressure in the female offspring; and dairy cows with a high somatic cells count had daughters with relatively low AMH

concentrations compared with cows with a low somatic cell count.

Scientists conducting research on the reproductive performance of swine discovered that the site of sperm deposition impacts fertility to insemination of aged sperm.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	4

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: 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 using the cow as a dual-purpose biomedical model to address infertility in beef/dairy cows and humans has identified gene differences that have implications in diagnostics and markers in the surrounding cells that are predictive of a bad quality egg. Based on this knowledge, treatments were developed that can be added while these eggs are maturing so that more embryos develop and can be transferred to the cow. This new discovery will allow for enhanced reproductive efficiency, especially for in vitro production of embryos.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
305	Animal Physiological Processes

Outcome #9

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	7	4

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: collect and screen for bacterial strains with antagonistic properties for foodborne pathogens and test their efficacy; better understand parasitic and mutualistic interactions in a bacteria-nematode insect association; and improve immune recognition in order to protect against or eliminate viruses and diseases such as Johne's disease.

Results
Additional sequencing of the Heterorhabditis bacteriophora nematode genome this past year completes most of the sequencing data generation for this genome project, which was initiated in June 2005. This sequence has been submitted to Entrez public database along with other sequence data from the genome project. This will revolutionize research in H. bacteriophora and be important for gaining insights into the nemotode biology related to symbiosis, parasitism and the biological control of insects.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Michiganders are an exceptionally vulnerable population due to their chronic exposure to complex mixtures of endocrine disruptors 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 these operations must be assessed.

What has been done
Research to: 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
Bromiated flame retardants (BFRs) have been incorporated into a variety of consumer products for several years. Demonstration of BFRs in the environment, wildlife and humans has prompted concern for these emerging contaminants. Two of the commercial polybrominated diphenyl ether BFRs (octa-BDE and penta BDE) are no longer being produced because of environmental concerns. As a result, the production and use of non-PBDE BFR alternatives, such as BTBPE, have increased. Previous studies had indicated that mink - a sentinel wildlife species was sensitive to a commercial penta-BDE mixture (no longer on the market) as indicated by reproductive impairment and alteration of thyroid hormone concentrations. Therefore it was of interest to determine sensitivity of the mink to BTBPE. The results of this study indicate that exposure to BTBPE at dietary concentrations up to 2.0 ppm feed had no effect on the

reproductive performance of mink and the survivability and growth of their offspring.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	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; define the role that EHV-5 plays in the development of spontaneous equine multinodular pulmonary fibrosis.

Results
Research to determine the cause and pathology of exercise-induced pulmonary hemorrhage (EIPH) in horses resulted in a breakthrough discovery - it was discovered that horses with the disease have chronic scarring around their pulmonary veins, making the veins less flexible and

unable to cope with the significant increase in blood pressure that occurs during intense exercise. Research is now under way to determine what causes this chronic scarring in the first place. These findings will ultimately allow us to intervene in creative ways to prevent EIPH from occurring in these horses.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	4

3c. Qualitative Outcome or Impact Statement

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

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

Results
Weanling pigs (n=160) were used to evaluate dietary microminerals (Cu, Fe, Mn, Se and Zn) on performance, tissue minerals, and liver and plasma enzymatic activities during a 35-day post

weaning period. Results indicated that innate microminerals Cu and Mn from a complex nursery diet may meet the pig's micromineral needs, but the weaned pig's need for Fe, Se or Zn were not met in the basal diet.

4. Associated Knowledge Areas

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

Outcome #13

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: gain a clear understanding of the molecular and cellular mechanisms that mediate changes in neutrophil function in periparturient cows; how to improve immune recognition in order to protect against, or eliminate, viruses and cancers; and better understand the regulation of gene expression during early embryogenesis.

Results
Research findings showed that in a certain cell type in a mouse embryo, a regulatory protein known as Brahma Related Gene 1 fails to turn off a gene critical to early embryo vitality. This

work has important implications for humans and cattle because the stages being looked at in mouse development where the highest number of pregnancies are lost -- those occurring between days 0.5 and 6.5 -- correspond to the early stages of development for humans and cattle.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
304	Animal Genome
305	Animal Physiological Processes
311	Animal Diseases

Outcome #14

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{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 non-human primates. Animal welfare without knowledge is impossible. Animal behavior researchers look at the behavior and well-being of animals in lab and field. Good animal welfare requires solid science that informs and directs policies and practices related to disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter.

What has been done
Research to: identify management practices and environmental conditions, particularly for young animals, that allow expression of positive natural behaviors while improving animal welfare in the context of environmentally-sustainable production systems.

Results
Research using wireless sensors to remotely monitor the health and well-being of egg-laying chickens in non-cage housing systems has shown that the sensors are accurate at detecting the physical location of the hens and that the information can be used to determine where hens spend their time, how the group of hens is distributed through the available space, if there is a circadian rhythm to their behavior and whether access to resources may be limited due to crowding or the presence of dominant hens. The data will serve as a scientific basis for determining the resources and space allocations that chickens need and can be used by consumers and producers to design non-cage systems for laying hens that provide the best possible welfare for the animals.

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

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, funding reallocations, appropriations changes and competing public priorities. Attrition and faculty departures have also had an impact on outcomes. For example, in the last reporting year, we have gone from 135 Hatch-funded faculty (representing 89.5 FTEs) to 108 Hatch-funded faculty (representing 77.1 FTEs). Further, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised and, as a result, are skewed, significantly so in some cases. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were migrated into the new planned programs.

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

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Global Food Security and Hunger

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	0%		4%	
102	Soil, Plant, Water, Nutrient Relationships	10%		16%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		23%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		5%	
205	Plant Management Systems	30%		12%	
307	Animal Management Systems	20%		6%	
308	Improved Animal Products (Before Harvest)	0%		11%	
603	Market Economics	40%		3%	
604	Marketing and Distribution Practices	0%		5%	
606	International Trade and Development	0%		12%	
610	Domestic Policy Analysis	0%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	13.5	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**
630325	0	658603	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
630325	0	657964	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5341718	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

To meet the challenges faced in this program, activities included research to: genetically improve dry beans, rice, soybean, wheat, vegetable crops (e.g., potatoes, tomatoes) and fruits (e.g., strawberries, blueberries, tart and sweet cherries) for yield, pest resistance and food quality; better understand the processes and factors that influence the growth, meat quality and other economically important traits in food animals; increase the efficiency of milk production in dairy cattle; ensure food access and security to all; develop strategies and approaches that enhance the sustainability of vegetable production systems; and identify beneficial plant-microbe interactions and soil properties and their influence on crop yield.

Extension activities included: assist producers and processors in national and international policy issues that impacts the industry competitiveness.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	356	712	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 2

Patents listed
MICL01907-Elimination of airborne ascospore inoculum as a control for fungal disease of plants; TEC2009-0160-01; 12/630,244.MICL01910-Molecular biology of plant-bacterial interactions; TEC2008-0075-01; 12/695,605. In addition, one patent was awarded: MICL02145-Development of a novel planttransformation system suitable for large seeded legumes; TEC2003-0012-01US; 10/561,720; patent 7,696,406, issued 4/13/10.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	32	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	12

Output #2

Output Measure

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

Year	Actual
2010	5

Output #3

Output Measure

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

Year	Actual
2010	6

Output #4

Output Measure

- Number of research programs that enhance sustainability/reduce risk for agricultural systems.

Year	Actual
2010	7

Output #5

Output Measure

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

Year	Actual
2010	356

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	12

3c. Qualitative Outcome or Impact Statement

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

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

Results
Results of 19 yield trials in eight market classes for dry beans identified sources of drought resistance in black, navy, pinto, red and great northern market classes, and modest levels of white mold tolerance in cranberry and kidney bean trials. A total of 2994 plots were harvested for yield in 2010, and over 2600 single plant selections were made in the early generation nurseries.

Phytopthora blight is one of the most serious diseases affecting pickling cucumbers. Research

showed that very young fruit are the most susceptible, with a transition to resistance occurring at the end of the period of rapid exponential growth. Peel studies indicated that resistance is associated with the upper 1-2 mm of the fruit surface, and preliminary results indicate that peel extracts from 12 and 16 dpp inhibit phythopthora growth and spore development relative to 4 or 8 dpp fruit or water controls.

Genetically engineered potatoes incorporating the Cry3a Bacillus thuringiensis gene were shown to be highly resistant to Colorado potato beetle in detached leaf bioassays.

Two new aphid-resistant soybean germplasm were released to the soybean industry in 2010.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The molecular basis underpinning beef and port quality is highly complex, and continued advances in understanding the biological processes that contribute to the delivery on consistent quality meat is critical to the sustainability and security of the industry. Knowledge gained from research efforts in this area can be beneficial in defining and optimizing management systems for quality, providing assurance of meat quality and in tailoring quality to suit market needs.

What has been done

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

Results
Supplementation of milk replacer with a blend of butyrate, coconut and flax oils improves some immune responses in calves (n=88), which may partly explain the reduction in scours and concurrent improvements in growth.

In a second study with 48 bull calves fed milk replacers based on lard and supplemented with 2 percent lard, 2 percent fish oil or 2 percent flax oil, flax oil, but not fish oil, improved body weight gain and hip width gain. Further, flax oil, but not fish oil, reduced the inflammatory response to Pasturella vaccine at 5 weeks old.

Studies evaluating the influence of development factors on longevity in sows revealed that sows that were younger than one year of age at farrowing and had larger and heavier litters at their initial farrowing had a lower culling risk. In addition, gilts that were near average for growth and backfat thickness at a constant weight had a lower subsequent culling risk than faster growing or leaner gilts.

Results of an expression eQTL study found 62 unique eQTL and three gene networks enriched with genes involved in lipid metabolism, DNA replication and cell cycle regulation. These results provide novel candidate genes for important complex pig phenotypes.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	6

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: investigate the causes and effects of price, yield and revenue risk in agriculture and the food system; evaluate the economics of alternative strategies for managing these risks; develop and test a theoretical model of behavioral relationships between retail buyers and suppliers to understand the distribution systems related to the entry of U.S. agribusiness products into Chinese and Indian consumer retail markets; better understand the implications of global food supply chain structure and performance; and to better understand how science and technology are used in the creation, maintenance and modification of agricultural grades and standards.

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

Research exploring ways to organize food supply chains that create more effective market and communication channels found that, for fresh eggs, the individual attributes of organic, welfare-managed and nutritionally enhanced eggs carry price premiums equal to 16.5 cents, 3.57 and 2.30 cents per egg, respectively, over a base egg price of 7 cents. This type of information will help producers maximize their profits and receive the price premiums they deserve, while providing customers with the specialty products they desire.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	7

3c. Qualitative Outcome or Impact Statement

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

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

Results
A study testing the impact of cover crops and organic amendments on soil microbial activity and tomato yield under organic production systems showed that soil microbial biomass was enhanced with the combination of rye cover crop and compost application. The highest marketable tomato yield was recorded when rye and hairy vetch mixtures were followed with compost application.

Low tunnels were evaluated for frost protection and earliness in tomato and cucumber production. Both the single and the double layer low tunnels were able to protect cucumber and tomato when

the outside temperature was as low as 29 degrees F. This allowed harvesting cucumbers two to three weeks earlier than the rest of the industry.

Research showed that the clover root-nodule occupant, Rhizobium leguminosarum bv. trifolii participates in a natural, beneficial association with rice roots that can significantly improve rice growth, grain productivity and the agronomic fertilizer use efficiency with less chemical fertilizer inputs and independent of nodule formation and biological nitrogen fixation.

A methodology has been developed for best use of topographical information for predicting spatial variability in cover crop and main crop biomass and yield.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, appropriations changes and competing public priorities. In addition, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were cross-walked into the new planned programs.

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Climate Change

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	10%		15%	
131	Alternative Uses of Land	10%		12%	
132	Weather and Climate	50%		27%	
133	Pollution Prevention and Mitigation	30%		33%	
135	Aquatic and Terrestrial Wildlife	0%		7%	
136	Conservation of Biological Diversity	0%		6%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	4.0	0.0	4.5	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
189098	0	359238	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
189098	0	358889	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2913664	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

As the red rises in thermometers worldwide, MSU is positioning itself to play a leadership role in addressing emerging climate change issues and opportunities.

Research was undertaken to: ensure sustainable crop and livestock productivity in the face of addressing emerging climate change; determine the impact of global warming on the Great Lakes water budget and fisheries; develop effective tools and agricultural management practices for air emission mitigation related to greenhouse gas reduction on agricultural lands and operations; and to take advantage of emerging economic opportunities offered by climate change mitigation technologies.

Extension activities included: assist farmers in projecting crops using up-to-date information from local weather stations and research data, train farmers in how to reduce pollution that impacts climate, and help costal communities adapt as water levels change due to climate shifts.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	527	1054	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

none submitted for this reporting year.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	17	17

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	7

Output #2

Output Measure

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

Year	Actual
2010	5

Output #3

Output Measure

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

Year	Actual
2010	3

Output #4

Output Measure

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

Year	Actual
2010	527

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	7

3c. Qualitative Outcome or Impact Statement

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

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

Results
An econometric model was developed to evaluate the impacts of climate changes and biofuel policies on farmers' land use decisions. This model will be used to develop a new, dynamic paradigm of lifecycle analysis that accurately accounts for the carbon footprint of biofuels.

Research to optimize lactating and dry cow decision making as it relates to animal health, nutrient utilization, milk production, reproduction and profitability showed that dietary coconut oil reduced dry matter intake compared with energy balance, leading to a greater fatty acid mobilization in early lactation. In addition to economic implications, this and other findings contribute to the development of best management practices related to emission reductions of livestock operations.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nearly one-tenth of all human-induced greenhouse gas emissions in the United States are caused by agriculture, according to the U.S. Global Change Research Program. Meanwhile, the world population doubled between 1960 and 2000 and is still increasing by 75 million people (1.1 percent) per year, according to the U.N. Food and Agriculture Organization. Reducing agriculture's carbon footprint will be essential as the system adapts to meet the needs of growing numbers.

What has been done

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

Results
Research findings on the global warming potential (GWP) of 11 different cropping and natural ecosystems showed that nitrous oxide continues to be the largest single source of GWP in all annual crop ecosystems. The analysis of nitrous oxide fluxes across nine different fertilization levels continues to show a non-linear response of nitrous oxide to fertilizer inputs regardless of crop. Research also showed that methane oxidation is affected by fertilization but not by tillage in non-cropped sites; in cropped sites, methane oxidation is already low and is not further affected by tillage or nitrogen fertilizer. These results offer significant promise for reducing the GWP of agricultural systems, both grain and biofuel-based.

Green roof research done on MSU buildings has become one of the first long-term research programs in green roof technology. Data from the research has helped to identify plants that are best suited for green roofs and to analyze how much carbon the roof system's plants and soil are storing. As a result, the amount of green roof space, primarily on government and commercial buildings in North America, has been doubling each year since the research began.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

A National Center for Environmental Prediction data set was produced with an improved precipitation and land surface description, and an improved treatment of the Great Lakes ice cover compared to many previous climate data sets. These features enable a more detailed and more accurate climate depictions of the moisture budget and the hydrological cycle for the Great Lakes region. A manuscript on the performance of regional climate models as down-scaling tools for climate projections over the Great Lakes region was also produced.

A publication on the landscape ecology of lake ecosystems was published and has led to new fundamental and applied understanding of freshwater ecosystems and their relationships to the surrounding landscape. The publication provides a general strategy for the management of thousands of ecosystems for which state and federal agencies are responsible.

Sampling of larval rainbow smelt populations in 2008-2009 in St. Martin Bay, Lake Huron, showed that growth rates of larval rainbow smelt and relative survival of stream cohorts was higher during 2009 than 2008, a consequence of warmer water temperatures during June, and cooler, more optimal temperature during July. Early hatching stream cohorts of this population experienced high mortality during 2008, and fish surviving experienced lower growth relative to cohorts produced in 2009.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, appropriations changes and competing public priorities. In addition, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were cross-walked into the new planned programs.

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

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Sustainable Energy

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		20%	
202	Plant Genetic Resources	0%		27%	
205	Plant Management Systems	10%		13%	
402	Engineering Systems and Equipment	0%		15%	
511	New and Improved Non-Food Products and Processes	80%		13%	
605	Natural Resource and Environmental Economics	10%		12%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	4.0	0.0	4.5	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
189098	0	359238	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
189098	0	358889	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2913664	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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

Activities in this planned program include research to: connect Michigan industries with the research, education and entrepreneurial activity needed in the basic sciences, engineering, plant science and production agriculture to provide Michigan with a foundation for the vigorous development of a new biobased economic sector; to develop biomass for use in biofuel production; to develop improved and novel biofuel crops and compounds; to design optimum forestry and crops for bioenergy production; to develop management practices for bioenergy feedstock production systems; produce value-added biobased industrial and chemical products; and develop processes and technologies for biofuel, biomaterial and biomanufacturing production systems.

Extension priorities in this area are: training has been developed and implemented in helping farmers learn about bioenergy crops as well as issues, barriers and opportunities in this area.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	67	1000	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 12

Patents listed
MICL01940-Regulation of metabolism in developing seeds of Arabidopsis; TEC2008-0056-01; 12/639,304; 12/16/09; TEC2008-0057-01;12/559,974,9/15/09; TEC2008-0076-03; 12/506,633, 7/21/09; TEC2009-0042-01Prov; 61/233.467, 8/12/09. MICL02099-REcovery of sugars and pectic ploysaccharides from plants; TEC2007-0002-01Prov; 61317,115, 3/24/10.MICL02166-Chemical catalysis and processing for advanced biofuels and biochemicals; TEC2009-0062-01Prov; 61/265,851, 12/2/09 and two patents: TEC2004-0026-01; 10/894,307; patent 7,652,167, 1/26/10; TEC2004-0026-01CIP1; 11/414,672; patent 7,667,068, 2/23/10. MICL02184-Regional biomass processsing centers for sustainable biofuels and animal feeds; TEC2009-0052-01Prov; 61/236,403, 8/24/09; TEC2009-0068001PCT; PCT/US2010/035826, 5/21/10; TEC2010-0090-01Prov; 61/325,560, 4/19/10; TEC20010-0096-01CIP1; 12/763,102, 4/19/10; and two patents: TEC1999-0047-01CON1-DIV; 12/151,270; 7,569,745, 8/4/2009; TEC1999-0047-01CON2; 11/986,073; 7,696,411, 4/13/10; MICL02185-Nanostructured interfaces for biocalaysis; TEC2009-0160-01; 12/766,169, 4/23/10. MICL02189-Bioderived Fuels and chemicals:facilitatitng development through property characterization; TEC2009-0062-01Prov; 61/265,851, 12/2/09 and two patents: TEC2004-0026-01; 10/894,307; patent 7,652,167; TEC2004-0026001CIP1; 11/414,672; patent 7,667,068, 2/23/10. MICL01533-Genetic engineering of oilseed crops;TEC2005-0039-01EP;6804076.5; patent #1929018, 3/24/10.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	18	18

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	9

Output #2

Output Measure

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

Year	Actual
2010	5

Output #3

Output Measure

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

Year	Actual
2010	1

Output #4

Output Measure

- Number of adults trained in sustainable bioenergy crop production.

Year	Actual
2010	67

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	9

3c. Qualitative Outcome or Impact Statement

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

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

Results
The Biofuel Feedstock Genomics Resource - http://bfgr.plantbiology.msu.edu - has been developed to provide uniform annotation of gene and transcript assembly sequences for a wide variety of model genome and lignocellulosic biofuel crop species. Currently, sequence data from five model and 19 lignocellulosic biofuel feedstock species have been analyzed and annotated.

Using genetic mapping, researchers identified a gene that regulates oil accumulation in plant

seed. When the gene was put into Arabidopsis and a transcription regulator protein known as Wrinkled 1 was overproduced, the seeds made more oil. Additional research building on this breakthrough has created Arabidopsis lines that have produced 5.8-fold more oil in vegetative tissues than plants with Wrinkled 1 or another catalytic isoform, AGPRNAi, alone.

Researchers were able to use cultures of photosynthetic bacteria to develop a palm-sized microbial fuel cell that converts plant biomass into electrical power and produces cellulosic ethanol. Scientists are now working to scale-up the process to determine its commercial viability.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results
Researchers have developed a process, ammonia fiber expansion (AFEX) to pretreat cellulosic biomass with ammonia. MSU has received several patents on this process. Using enzymes alone, about 15 percent of cellulose and hemicellulose is broken down into simple sugars; when AFEX is used before adding the enzymes, more than 60 percent of the cellulose and hemicellulose is broken down into fermentable sugars. The AFEX pretreatment process also increases the value of some cellulosic material for other uses, such as feed for dairy and beef cows.

A manuscript was developed describing the influence of human selection on traits of different prairie grass populations and their consequences for restoration.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

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

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

Results
A spreadsheet model has been developed for analyzing system costs and minimum ethanol selling prices for various supply chain configurations for future biorefineries.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, appropriations changes and competing public priorities. In addition, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our orignail planned programs had to be revised. Five out of six of the original planned programs are included in the report, but a significant number (about 35 percent) were cross-walked into the new planned programs.

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Childhood Obesity

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	8.1	0.0	2.0	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
378195	0	119746	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
378195	0	119630	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	971222	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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

To address these challenges, research was undertaken to: disseminate science-based information to individuals and families so that they can make informed decisions about their helath and well-being, especially related to obesity and overweight; identify and document environmental and cultural influences on health behaviors contributing to obesity and overweight in children that can be shared with individuals, families and communities; and develop effective community-based environmental and policy supports for physical activity and healthy eating.

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

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	321	1000	356	712

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

None for this reporting year.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	6	6

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	3

Output #2

Output Measure

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

Year	Actual
2010	2

Output #3

Output Measure

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

Year	Actual
2010	1

Output #4

Output Measure

- Number of adults trained in controlling food portions.

Year	Actual
2010	321

Output #5

Output Measure

- Number of youth trained in controlling food portions.

Year	Actual
2010	211

Output #6

Output Measure

- Number of youth trained in healthy physical activities.

Year	Actual

2010	211

Output #7

Output Measure

- Number of youth trained in positive coping skills.

Year	Actual
2010	112

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

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

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

Results
Research evaluating 250 advergames targeted to children found that almost all of the foods featured were high in fat 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. Research is now underway to better understand how the games work to see if the same techniques can be used to promote healthy eating habits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

724	Healthy Lifestyle
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement

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

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

Results
A two year initiative -- Project FIT was launched in four Grand Rapids elementary schools to promote student's health through increasing daily structured physical activity and healthy eating habits. School health teams were established at all four schools; Healthy Classrooms, Healthier Kids Nutrition Education staff training was completed with all four schools; newsletters were distributed to educators with ideas for activities and education to do in their classrooms; teachers

serving as "Healthy Eating Coaches" were placed in the cafeteria to eat with students and encouraged them to try healthy foods; and each school was provided with physical activity and nutrition education curricula.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

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

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

Results
The identification of a new link between body fat and cancer could lead to new cancer treatment and prevention strategies. Researchers examined a key hormone,leptin, found in fat tissue and thought to promote cancer. Leptin, a fat cell-derived hormone regulating body energy, is higher in obese individuals. This study is the first to demonstrate that, at higher levels, leptin induces precancerous colon cells to produce more of a growth factor that can increase blood supply to early cancer cells, promoting tumor growth and cancer progression. This information will help

researchers better understand the active signals and mechanisms involved so that opportunities can be created to prevent or interrupt cancer progression early in the process.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, especially related to funding and staffing levels due to state budget cuts, appropriations changes and competing public priorities. In addition, because of the inclusion of the five new national priorities in this year's reporting, many of the projected and actual numbers in our original planed programs had to be revised. Five out of the six original planned programs are still in the report, but a significant number (about 35 percent) were cross-walked into the new planned programs.

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Food Safety

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment	0%		15%	
404	Instrumentation and Control Systems	0%		6%	
501	New and Improved Food Processing Technologies	40%		20%	
502	New and Improved Food Products	10%		25%	
503	Quality Maintenance in Storing and Marketing Food Products	10%		11%	
701	Nutrient Composition of Food	0%		7%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%		8%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	30%		8%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	8.1	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**
378195	0	598730	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
378195	0	598149	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4856108	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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

In an effort to help improve food processing technologies and minimize the risk of food-borne illness, efforts in this area include research to: ensure the microbial safety of foods; develop effective biosensors, RFID tags and other technologies for track, trace and security issues; develop sustainable packaging systems to enhance food quality and shelf life; enhance the economic and nutritional value of food products through post-harvest and food processing technologies; identify and control/eliminate the causes of microbial resistance to contaminants; and improve the diagnosis and prevention of known and emerging infectious diseases of livestock and poultry.

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

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	122	500	598	1000

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

Patent Applications Submitted

Year:	2010
Actual:	2

Patents listed
MICL02007-Development of nanostructured biosensors for rapid detection of disease-causing agents in food and water; TEC2009-0053-02; 12/715,929, 3/2/10; and TEC2010-0034-01Prov; 61/334,090, 5/14/10.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	29	29

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	3

Output #2

Output Measure

- Number of research programs to improve the microbial safety and quality of food.

Year	Actual
2010	6

Output #3

Output Measure

- Number of research programs to develop packaging systems that enhance food safety, quality and shelf life.

Year	Actual
2010	3

Output #4

Output Measure

- Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.

Year	Actual
2010	5

Output #5

Output Measure

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

Year	Actual
2010	7

Output #6

Output Measure

- Number of research programs to examine the functions and effect of dietary nutrients on imune response and other metabolic functions.

Year	Actual
2010	2

Output #7

Output Measure

- Number of producers that are trained on food safety issues.

Year	Actual
2010	43

Output #8

Output Measure

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

Year	Actual
2010	43

Output #9

Output Measure

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

Year	Actual
2010	79

Output #10

Output Measure

- Number of fron-line food handler staff trained in proper cooking temperatures and storing

processes.

Year	Actual
2010	79

Output #11

Output Measure

- Number of youth trained on hand washing practices.

Year	Actual
2010	598

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E.coli, Salmonella, Listeria, Campylobacter, etc.
2	Number of research programs to improve the microbial safety and quality of food.
3	Number of research programs to develop packaging systems that enhance food safety, quality and shelf life.
4	Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.
5	Number of research programs to develop more effective harvest and post harvest protocols and practices to minimize loss and enhance food safety and product quality.
6	Number of research programs to examine the function and effect of dietary nutrients on immune response and other metabolic functions.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The rapid detection of harmful organisms and disease-causing agents in food and water, and the ability to track and trace sources is critical to human health. In the food safety arena, it is estimated that 76 million food-borne illnesses occur each year in the United States, accounting for 325,000 hospitalizations and 5,000 deaths. Biosensors can play a key role in food safety by quickly identifying contaminants in water supplies, food processing and assembly lines, raw food materials and food products before they cause problems further up the food chain.

What has been done
Research to: synthesize, characterize and evaluate nanostructured interfaces that enable molecular level investigations of systems of medical, scientific and technological interests; investigate using radio frequency identification 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
Biosensor research resulted in the successful synthesis of "green" biogenic gold nanoparitcles using microorganisms as bio-nano-factories, which included T. curvata, T. fusca, and T. chromogena. Several detection biosensor modalities were also developed: a biosensor that successfully detected E. coli O157:H7 on screen printed carbon electrode chips with an assay time of 70 minutes from sampling to detection; a nano-BEAM biosensor that could detect anthraccis protective antigen A in DNA concentrations as low as 0.01 ng per microliter, and HA from the Influenza A virus H5N1 at 1.4 M in 10 percent mouse serum. Researchers also demonstrated an electrospun biosensor for the detection of E. coli O157:H7 and bovine diarrhea virus at 60 CFU/mL and 1000 CCID/mL for bacterial and viral samples, respectively.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Number of research programs to improve the microbial safety and quality of food.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	6

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: develop strategies to enhance the safety, quality and shelf-life of ready-to-eat foods, with a focus on the transfer of E. coli O157:H7 during commerical processing of leafy greens; assess the risk of humans to mycotoxins via foodborne and airborne exposure and develop appropriate mitigation strategies to protect human and animal health; increase the understanding of the mechanisms and dynamics of antimicrobial resistance transmission between humans, animals and the environment; identify the mechanisms by which probiotic bacteria exert their beneficial effects when ingested by host animals; help prevent liver cancer by limiting human exposure to aflatoxin in food; and to understand the process of E. coli chromasomal DNA

replication and its regulation at the biochemical level.

Results
Researchers contaminated 20 pounds of radicchio lettuce with E. coli and ran it through a pilot-scale processing line, then ran 2,000 pounds of uncontaminated iceberg lettuce through the line. They then sorted through 40, 50 pounds bags of greens and bits left on the processing equipment and found radicchio in every bag of processed lettuce and more then 200 pieces on the processing line. This information will give the leafy green industry suggestions about improved equipment design, when they need to shut down the line and sanitize the entire line, and how much additional product may be at risk if E. coli O157:H7 is later found in a bag of salad greens.

In research looking at DNA and its replication in E. coli, researchers detected and identified a protein that inhibited chromosomal DNA replications -- a truncated form of ribosomal protein L2. As one of the most evolutionally ancient among ribosomal proteins, it is essential for ribosome biogenesis and a key to understanding chromosomal DNA replication.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In packaging systems, chlorine dioxide gas is used for vapor-phase decontamination in treating produce before packaging and sanitizing products inside their packages. Yet very little is known

about its effects on packaging material properties and performances. In terms of the containers themselves, use of a resuable plastic-based packaging system would greatly reduce the costs associated with packaging and address environmental issues.

What has been done
Research to: develop and use new types of packaging systems for fruits and vegetables; promote functional and sustainable package systems that optimize the utilization of raw materials; and to identify new approaches for decontaminating and improving the quality of fresh and fresh-cut produce.

Results
In research comparing the shelf-life performance of corn-based, compostable containers made using polylactic acid (PLA) with several types of conventional, petroleum-based packages, researchers found that, in some cases, PLA performs better than the conventional plastics tested. Further, packaging material such as PLA has the potential to be returned to the fields as a fertilizer and soil conditioner, benefitting the farmer and reducing solid wastes in landfills.

Researchers exploring the possibility of turning packages into small sanitation chambers to allow for a longer and more thorough exposure to the appropriate bactericide have developed an internal packaging design and ClO2 dosage that demonstrated a significant microbial reduction while maintaining the produce's (lettuce and cherry tomatoes) apprearance and texture. The packages designed for these products will become another asset within the sanitation process and will improve product safety.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	5

3c. Qualitative Outcome or Impact Statement

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

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

Results
Implementation of the Upper Peninsula BVDV Eradication project continues. To date, over 50 percent of the UP cattle farms are enrolled in the program, and the number of verified BVDV-free animals tested through the program has reached more than 20,000.

Studies investigating the role of oxidative stress on mammary gland inflammatory responses to mastitis-causing pathogens identified, for the first time, key enzymatic pathways that could be targeted for therapeutic intervention.

Recently completed trials determined that infection with Bovine Leukosis Virus (BLV) may impair the ability of dairy cattle to serologically respond to a series of multiple immunizations with J5 E. coli bacterin.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	7

3c. Qualitative Outcome or Impact Statement

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

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

Results
Research has confirmed CT x-ray as a means of characterizing and quantifying disorders in fresh in-shell chestnuts.

Rayfresh Foods, Inc., Ann Arbor, MI is using the results of MSU research findings related to the use of x-ray technology in killing pathogens to build the first commercial-sized x-ray machine for food irradiation. The researchers were able to demonstrate that x-ray technology is effective in killing bacterial pathogens (leafy green and almonds) without causing undesirable changes in product quality.

Research examining the molecular structure of soft wheat proteins in relation to end-use quality showed that a stronger protein flour was more desirable for crackers than for cakes and cookies and that the starch fraction of wheat flour plays a dominant role in governing the texture of noodles, followed by the water-soluable fractions, and then the type of protein.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Number of research programs to examine the function and effect of dietary nutrients on immune response and other metabolic functions.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement

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

What has been done
Research to: determine the effects of dietary zinc on the immune response; and to investigate the metabolism and function of Vitamin A.

Results
Studies of the morbidly obese after gastric bypass surgery indicate that most patients are low in zinc in spite of being provided zinc supplements. This is due to reductions in the area of the gut needed for zinc absorption. Researchers are currently investigating the extent and duration of this problem, which could lead to more infections and poorer immune function.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, appropriations changes and competing public priorities. In addition, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised. Five out of the six original programs are included in the report, but a significant number (about 35 percent) were cross-walked into the new planned programs.

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

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

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				
402	Engineering Systems and Equipment				
403	Waste Disposal, Recycling, and Reuse				
404	Instrumentation and Control Systems				
501	New and Improved Food Processing Technologies				
502	New and Improved Food Products				
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				
	Total				

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	9.0	0.0
Actual	0.0	0.0	0.0	0.0

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

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

V(D). Planned Program (Activity)

1. Brief description of the Activity

2. Brief description of the target audience

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Output #2

Output Measure

- Number of adults trained on new and improved non-food and bioeconomy related products and processes.
  Not reporting on this Output for this Annual Report

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

Outcome #1

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Number of research programs to connect Michigan industries with research, education and entrepreneurial activity needed in the basic sciences, engineering and plant science and agriculture to provide the state with a foundation for vigorous development of a new biobased economic sector.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- 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

All of the state defined inputs and outcomes that were in this planned program are now in the new Food Safety and Sustainable Energy planned programs.

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}