

V(A). Planned Program (Summary)**Program # 2****1. Name of the Planned Program**

Soil, Water and Natural Resources

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

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	1%		2%	
102	Soil, Plant, Water, Nutrient Relationships	19%		15%	
111	Conservation and Efficient Use of Water	12%		15%	
112	Watershed Protection and Management	15%		10%	
123	Management and Sustainability of Forest Resources	8%		7%	
131	Alternative Uses of Land	18%		10%	
132	Weather and Climate	1%		15%	
133	Pollution Prevention and Mitigation	12%		14%	
134	Outdoor Recreation	1%		1%	
135	Aquatic and Terrestrial Wildlife	5%		8%	
806	Youth Development	8%		3%	
	Total	100%		100%	

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	24.0	0.0	14.0	0.0
Actual	11.8	0.0	15.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
792688	0	1043054	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
792688	0	1041170	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	10270440	0

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

Research to: develop new land use models for Michigan communities; offer education to planners, elected officials and citizens on how these new models will reduce sprawl and ensure that the desirable outcomes will become reality; create new remediation strategies to clean up polluted soil and water; discover new knowledge about the composition, organization and

fluctuations of microbial populations in the soils; develop a user-friendly computer program for nutrient management for Michigan crop and livestock producers to improve the management of fertilizer and manure nutrients on cropland to protect water resources and boost crop productivity; develop greenhouse gas mitigation strategies; develop management techniques for potato and vegetable growers that includes cover crops; develop new nitrogen application recommendations for turf managers; develop a management system for Michigan inland lakes that does not involve sampling the lakes; develop Total Maximum Daily Load (TMDL) assessment tools for evaluation of Michigan watersheds; determine how wildlife responds to ecosystem management decisions in forest and agricultural systems; quantify the benefits and costs of a sample green roof system installed on campus; develop fish population/community computer models for species important to Michigan; develop web-based tools and models for natural resources managers so knowledge can be shared quickly and easily; develop computer models to assess how habitat management affects species important to Michigan, including white-tailed deer, salmon, trout and perch; promote and support value-added processing of forest products, including wood products, biofuels, maple syrup and other nontimber products; identify, prevent and control exotic invasive pests and diseases of forests.

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

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

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

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

Patent Applications Submitted

Year: 2009

Plan: 7

Actual: 4

Patents listed

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

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	30	
Actual	3	30	54

V(F). State Defined Outputs

Output Target

Output #1**Output Measure**

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

Year	Target	Actual
2009	40	44

Output #2**Output Measure**

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

Year	Target	Actual
2009	800	764

Output #3**Output Measure**

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

Year	Target	Actual
2009	234	534

Output #4**Output Measure**

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

Year	Target	Actual
2009	767	1007

Output #5**Output Measure**

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

Year	Target	Actual
2009	711	3381

Output #6**Output Measure**

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

Year	Target	Actual
2009	1151	1007

Output #7**Output Measure**

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

Year	Target	Actual
2009	1422	3381

Output #8**Output Measure**

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

Year	Target	Actual
2009	1352	1210

Output #9**Output Measure**

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

Year	Target	Actual
2009	445	431

Output #10**Output Measure**

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

Year	Target	Actual
2009	732	1120

Output #11**Output Measure**

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

Year	Target	Actual
2009	763	655

Output #12**Output Measure**

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

Year	Target	Actual
2009	322	1185

Output #13**Output Measure**

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

Year	Target	Actual
2009	97	208

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.
2	Number of adult participants with increased knowledge of watershed protection and management.
3	Number of youth participants with increased knowledge of watershed protection and management.
4	Number of adult participants with increased knowledge in management and sustainability of forest resources.
5	Number of research programs to determine how wildlife responds to ecosystem management decisions in natural resource and agricultural systems.
6	Number of youth participants with increased knowledge in management and sustainability of forest resources.
7	Number of adult participants with increased knowledge of alternative uses of land.
8	Number of adult participants with increased knowledge of soil, plant, water and nutrient relationships.
9	Number of youth participants with increased knowledge of alternative uses of land.
10	Number of youth participants with increased knowledge of soil, plant, water and nutrient relationships.
11	Number of adult participants with increased knowledge of pollution prevention and mitigation.
12	Number of adult participants with increased knowledge of conservation and efficient use of water.
13	Number of youth participants with increased knowledge of conservation and efficient use of water.
14	Number of youth participants with increased knowledge of pollution prevention and mitigation.
15	Number of research programs that deal with fish population dynamics and the management of Great Lakes fisheries.
16	Number of research programs that deal with the security, stewardship and management of Michigan's water resources.
17	Number of research programs that analyze key soil characteristics to better assess their agricultural and environmental contribution.
18	Number of research programs to develop new recommendations, strategies or assessment tools to better manage soil, water or natural resource system outputs, such as greenhouse gas, carbon, nitrogen and phosphorus.
19	Number of programs to develop new land use models for Michigan communities.
20	Number of research programs that explore the occurrence, transport, fate/effect of organic contaminants, chemicals, pesticides, pharmaceuticals and particulates in soils.

Outcome #1**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	3	8

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

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

What has been done

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

Results

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

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources

Outcome #2**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	978	948

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

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

What has been done

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

Results

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

Outcome #3**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1208	2976

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

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

Outcome #4**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1149	1064

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	1	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

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

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

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	379	388

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	622	986

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

Outcome #8**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	681	672

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

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

Outcome #9**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	649	576

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

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

What has been done

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

Results

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
806	Youth Development

Outcome #10**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	199	469

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

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

Outcome #11**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #12**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #13**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #14**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #15**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	5	6

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

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

What has been done

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

Results

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

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

4. Associated Knowledge Areas

KA Code Knowledge Area

112	Watershed Protection and Management
134	Outdoor Recreation
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
2009	5	9

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

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

What has been done

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

Results

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

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

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water

112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #17**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	6	6

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

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

What has been done

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

Results

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

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

4. Associated Knowledge Areas

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

Outcome #18**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #19**1. Outcome Measures**

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	6

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

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

What has been done

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

Results

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

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

turnip yielded 2.8 ton/acre; the drilled turnip yielded 1.2 ton/acre.

4. Associated Knowledge Areas

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

Outcome #20

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Michigan's 37 million acres of land support the plants and animals that provide our shelter, food and fiber. The land provides us with minerals and fuels for our industry and our businesses. At the same time, human activities are generating and releasing large amounts of pollutants -- including pesticides, antibiotics and dioxins and other industrial emissions -- that may end up in the soil.

What has been done

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

Results

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

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

Research related to animal waste management strategies using anaerobic digestion continues. Anaerobic digesters

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

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

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

1. Evaluation Studies Planned

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}