2005 Plan of Work

Annual Report of Accomplishments

MICHIGAN
AGRICULTURAL
EXPERIMENT STATION

MICHIGAN STATE
UNIVERSITY

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Guide to Acronyms in this Report

AAI	Animal Agriculture Initiative
AoE	Area of Expertise
ARS	Agricultural Research Service
BL-3	Biosafety level III
CDC	Centers for Disease Control
DCPAH	Diagnostic Center for Population and Animal Health
DEQ	Michigan Department of Environmental Quality
DNP	Diversified Natural Products
EAB	Emerald ash borer
FACT	Families and Communities Together coalition
GPM	Gallons per minute
GREEEN	Generating Research and Extension to meet Economic and Environmental Needs
HHS	U.S. Department of Health and Human Services
KBS	Kelloggg Biological Station
LTER	Long-Term Ecological Research
MAES	Michigan Agricultural Experiment Station
MEAP	Michigan Educational Assessment Program
MRU	Microbiology Research Unit
MSU	Michigan State University
MSUE	Michigan State University Extension
NIAID	National Institute of Allergy and Infectious Diseases
NIH	National Institutes of Health
NSF	National Science Foundation
POW	Plan of Work
SARE	Sustainable Agriculture Research and Education
SOSS	State of the State Survey
TB	Tuberculosis
USDA	U.S. Department of Agriculture
USGS	U.S. Geologic Survey

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Goal 1

An Agricultural Production System that is Highly Competitive in the Global Economy

Executive Summary

Agriculture is one of Michigan's top three industries. The state's agricultural/food system -- including agriculture, leather, food, floriculture/ornamentals/turfgrass and biomass energy industries -- accounts for $60.1 billion in total economic activity (direct and indirect) and more than 1 million jobs. Agriculture generates more than $35 billion in direct economic activity and more than 727,000 direct jobs. In total, the agricultural/food system employs nearly a quarter of all people working in Michigan. The system is likely second only to the auto industry in importance to the state's economy.

Michigan also has one of the most diverse agricultural industries in the United States. The state is second only to California in variety of crops grown. From field crops such as corn, wheat and soybeans to fruits such as cherries, apples, grapes and blueberries; to horticultural crops such as ornamental trees and flowering plants; and livestock, honey and fish, Michigan grows just about anything one can think of except citrus.

Michigan leads the nation in production of 12 commodities, including tart cherries, several varieties of dry beans, blueberries, pickling cucumbers, geraniums, impatiens and petunias.

Michigan Agricultural Experiment Station (MAES) researchers from a range of disciplines are working to foster a globally competitive agricultural production system. From developing new processing techniques to allow growers to take advantage of existing markets in other countries to breeding more productive varieties to conducting research on the viability of new products, MAES researchers provide the research underpinnings to many of the state's agricultural success stories.

Allocated Resources

	FY 2005
Hatch Funds	
Hatch Regular	2,790,652
Multi-State Funds	531,571
Other CSREES Funds*	7,485,680
Other Federal Funds*	13,250,995
Total Federal Funds (est.)	24,058,899
State Match for Hatch Funds	3,322,223
Remaining State Appropriations	14,961,106
Self Generated Funds*	1,918,078
Industry Generated Funds*	3,438,397
Other Non-Federal Funds*	2,277,685
Total State Funds (est.)	25,917,489
Total Estimated Funds	49,976,389
Scientist Years	77.6

* Values extracted from Fiscal Year 2005 Funds and Manpower Report

1) Improving Forage Management Systems in Michigan

Key Themes: agriculture profitability, plant production efficiency

A. Brief Description: Alfalfa and alfalfa mixtures account for about 80 percent of all hay produced in Michigan and add more than $260 million to the state's economy. However, from 2000 to 2004, average yields dropped from 3.7 tons per acre to 3.2.

MAES scientists have provided research on alfalfa cultural techniques, varieties, pest resistance and management. Each year, growers receive this information through the alfalfa variety trial reports, which are published in the *Michigan Farm News*, the Plant Management Network online journal (www.plantmanamentnetwork.org), an MSU Extension (MSUE) bulletin and on the MSU Forage Information Web site: (www.msue.msu.edu/fis/).

B. Accomplishment Statement: MAES researchers set a new world record for non-irrigated alfalfa yield: more than 10 tons per acre. The previous world record was set by MAES researcher Milo Tesar in 1980. Three released varieties in the trials all had record-setting yields above 10 tons: Garst 6415, WL 357 HQ and DKA33-16. Other varieties in the trials yielded from 5.3 to 9.5 tons per acre. The accomplishment is

notable because the researchers did not use any special treatments on the crop.

The trials are conducted at four locations across the state, using cutting, fertility and IPM management strategies that are optimal for each location.

C. Source of Funding: MAES, MSUE

D. Scope of Impact: MI

2) New Processing Techniques Give Michigan Bean Growers a New Market
Key Themes: adding value to agricultural products, new uses for agricultural products

A. Brief Description: Michigan ranks No. 1 in the United States in the production of five dry bean varieties -- black, cranberry, light red kidney, navy and small red beans. One of these varieties -- the cranberry bean -- is popular in Japan. There, people eat sugar-coated cranberry beans alone as a snack or dessert, add them to salads and mix them with other ingredients to create healthy desserts. Beans are purchased frozen in a sugar solution in a small container and thawed to eat.

Michigan bean producers and processors asked MAES researchers to help them take advantage of Michigan's ranking as one of the country's leading dry bean producers and develop a method for making the sugar-coated beans in the state for export to Japan.

MAES food science and agricultural and biosystems engineering researcher Kirk Dolan was contacted by Agri Analysts, L.L.C., and asked to help develop an easy way to create the Japanese bean snack. Japan's process for producing the sugar-coated bean is labor-intensive. The beans are first soaked for 12 hours and then transferred to a kettle of water and brought to a boil, where they are held for 2 minutes. Next, the beans are transferred to another kettle, where they are held at boiling for another 8 minutes. The beans are then transferred to a final kettle, where they are cooked in sugar water at about 160 degrees for 45 minutes. The total process, which takes about an hour and 15 minutes, produces 50 pounds of sugar-coated beans. Dolan's aim was to create a bean that looked and tasted and had the same crunchy texture as the Japanese snack using only one temperature and one cooking period.

B. Accomplishment Statement: Dolan succeeded in developing a method for producing sugar-coated beans that fits well with U.S. high volume, continuous production methods. Dolan's production method also reduces the total processing time by 20 percent.

   In taste tests, 200 people on a scientific sensory panel could not tell the difference between beans produced using Dolan's processing method and those produced using the traditional Japanese method.

   The sugar-coated beans contain high amounts of proteins and starch and are quite filling. The beans also appear to contain cancer-preventing components, which may be found in the fiber, starch or microconstituents. Any variety of dry beans could be used to produce the snack, which is more nutritious than most cookies, candy and chip snacks.

C. Source of Funding: MAES, GREEEN, Agri Analysts, LLC

D. Scope of Impact: MI

3) Nurturing Ideas for Businesses, Products or Services and Turning Them into Profitable Operations

Key Themes: adding value to new and old agricultural products, diversified/alternative agriculture, new uses for agricultural products

A. Brief Description: Agriculture is the second largest industry in the state, but many rural areas continue to be economically depressed. Productive farmland is being converted to non-agricultural uses because this is perceived as more beneficial economically. Converting agribusiness from a commodity orientation (selling dry beans to a processor, for example) to a differentiated product orientation [producing a value-added bean dip from the beans and keeping the processing money in the state, for example] will help revitalize Michigan agriculture.

   The MSU Product Center for Agriculture and Natural Resources was established in part with funds from the Michigan Agricultural Experiment Station. Its mission is to improve economic opportunities in the Michigan agriculture, food and natural resource sectors, and its experts are available to assist fledgling entrepreneurs and established companies. Acting as a single doorway to Michigan State University's vast collection of knowledge and expertise, the center helps guide clients through the phases of conceptualizing, planning and actually

starting a business.

B. Accomplishment Statement: Nearly 700 individuals sought assistance from the MSU Product Center for Agriculture and Natural Resources in 2005. About 40 new businesses or products were launched in 2005, and 26 of those projected annual sales totaling more than $6 million, with capital investments of more than $3.3 million and 176 new jobs for the state.

   A division of the product center, the Strategic Marketing Institute, does market research and writes reports and working papers that product center clients can use when evaluating the uniqueness or marketability of their products. Some reports are written because clients request the information; others are written because the researchers are being proactive and seeking new markets for Michigan products. Recent reports include "The Market for Organic and Fortified Eggs," "The Black Trumpet Mushroom Market," "The Edamame Market," "The Pet Food Market" and "Spending on Food: Implications for Michigan Agriculture."

   Another component of the product center, the Innovation Academy, provides executive leadership education for entrepreneurs and those wishing to be entrepreneurs through classes and in-service and mentoring programs.

C. Source of Funding: MAES, MSUE, CANR

D. Scope of Impact: MI

4) Growing Michigan's Bioeconomy

Key Themes: diversified/alternative agriculture, agricultural profitability, plant production efficiency

A. Brief Description: Michigan has been a national leader in adapting its natural resources, industrial resources and human resources to seize opportunities presented by socioeconomic change. With a central location, a rich natural resources base, including an abundance of water, and a diverse work force, Michigan first advanced agricultural science and engineering to become one of the nation's most successful and diverse agriculture product-producing states. In the industrial age, Michigan mastered new sciences and engineering to develop one of the nation's strongest manufacturing economies, becoming a leading producer of automobiles, pharmaceuticals, chemicals, food products

and furniture. This broad and diverse economy has served Michigan well, although the manufacturing sector has been hard hit in recent years by technological and global changes.

For MAES researchers, the possibilities to expand ties between industry and agriculture go far beyond alternative energy. The state is uniquely positioned to build a new biobased economic sector upon the existing foundation of agriculture, forestry and natural resources, and industrial and manufacturing sectors. The result will be the advancement of a new, sustainable biobased sector that will provide a competitive advantage in meeting the growing global demand for renewable sources of materials, chemicals and energy in products, processes and packaging.

During her State of the State address, Michigan Gov. Jennifer Granholm announced plans to invest in alternative energy research through the 21st Century Jobs Fund and singled out MSU President Lou Anna K. Simon as a university president who would lead the way in such efforts.

B. Accomplishment Statement: MAES researchers helped start Diversified Natural Products (DNP), a company in northwestern Michigan that is using MSU biotechnology research to make new biobased products. The company has two divisions – biobased fuels and chemicals, and gourmet and nutritionally enhanced foods. The unifying theme is agriculture-based biotechnology that harnesses readily available natural resources. One of the company's first products is exotic specialty mushrooms, including the elusive morel. This is the first time morels have been mass-produced indoors. The company is selling 2 tons of mushrooms per week and expects to sell 800,000 pounds of fresh mushrooms per year. DNP so far has brought 56 jobs to an area hard hit by business closings and layoffs.

DNP's biobased fuels and chemicals division produces succinic acid from "green" sources. Global demand for succinic acid is enormous — it is used in everything from industrial solvents and biodegradable polymers to airport runway deicers. DNP makes succinic acid from natural sugars derived from sources such as Michigan corn. Fifteen of DNP's patents have sprung from MAES researcher Kris Berglund's research.

In another project, MAES chemical engineering researcher Bruce Dale has developed a patented pretreatment process that makes the

breakdown of cellulose 75 percent more efficient. Breaking down cellulose into fermentable sugars is the first step in creating bioproducts such as ethanol, biodegradable plastics and other industrial chemicals.

C. Source of Funding: MSU, MAES, MSUE

D. Scope of Impact: MI

5) **Boosting Productivity and Profits for Michigan Small Red Bean Growers**
Key Themes: agricultural profitability, plant production efficiency, small farm viability

A. Brief Description: Michigan is the No. 1 producer of small red beans in the United States. The state's 26.1 million pounds produced each year are about 43 percent of the country's total.

MAES researchers are continuously studying new cultural techniques and pest control strategies, as well as maintaining an extremely strong and prolific dry bean breeding program. Growers look to MAES scientists for research to keep their farms productive and viable.

B. Accomplishment Statement: In 2004, MAES and USDA Agricultural Research Service researchers released Merlot, a new high-yielding small red bean variety.

In 2005, Merlot's first year of release, the bean was planted on 15,000 of the 31,000 acres planted with small red beans in Michigan. This 48 percent adoption rate is the highest recorded for dry beans in Michigan and rivals the adoption rate of Roundup Ready® soybeans when they were introduced. Merlot yields were 75 percent higher per acre than those of other small red beans. In 2005, the increase in revenue for growers who planted Merlot vs. other varieties of small red beans was $2.16 million.

C. Source of Funding: MAES, USDA ARS

D. Scope of Impact: MI

Goal 2

A Safe and Secure Food and Fiber System

Executive Summary

Keeping both people and animals healthy is a large and important part of the MAES mission. Many times animal health research and human health research are intertwined, and much of this research directly affects the safety and security of the state's food and fiber system. For example, the new MSU Diagnostic Center for Population and Animal Health (DCPAH) protects Michigan's people and animals from disease and potential biological attacks or outbreaks. Research done at the DCPAH by MAES scientists has played a pivotal role in reducing bovine TB rates in Michigan (disease prevalence has been reduced 65 percent since 1995). In October 2005, Michigan's Upper Peninsula was declared free of bovine TB by the USDA. This is the first part of the state to regain TB-free status since 2000.

MAES scientists also are part of a multistate and multiagency consortium intensely studying the emerald ash borer (EAB), an exotic beetle that has killed about 15 million ash trees in southeastern Michigan and cost municipalities, property owners, nursery operators and forest product industries millions of dollars. The researchers are working quickly to piece together the biology of the insect and are also testing chemical and biological controls for the pest. MAES researchers are also working to help city arborists and homeowners find suitable species to replace dead ash trees.

Through the Center for Animal Functional Genomics, MAES researchers study how animals respond to stresses from disease, giving birth, shipping and other environmental factors at the cellular and molecular levels. By understanding immune system response, the scientists have created new diagnostic tools for beef producers that also may be applied to human health.

Allocated Resources

	FY 2005
Hatch Funds	
Hatch Regular	159,306
Multi-State Funds	89,695
	0
Other CSREES Funds*	414,222
Other Federal Funds*	5,533,005
Total Federal Funds (est.)	6,196,229
State Match for Hatch Funds	249,002
Remaining State Appropriations	1,404,456
	0
Self Generated Funds*	148,960
Industry Generated Funds*	374,128
Other Non-Federal Funds*	450,698
Total State Funds (est.)	2,627,244
Total Estimated Funds	8,823,473
Scientist Years	13.9

* Values extracted from Fiscal Year 2005 Funds and Manpower Report

1) **New Facilities for the Diagnostic Center for Population and Animal Health (DCPAH)**
Key Themes: food safety, food security, food-borne pathogen protection

A. Brief Description: The original collection of MSU labs known as the Animal Health Diagnostic Laboratory was created in the 1970s in response to the accidental introduction of PBB, a chemical fire retardant, into the food supply. The lab grew rapidly and became one of the busiest in the country in numbers of tests and complexity of problems with which it dealt. When bovine tuberculosis was found in Michigan, the need for new facilities -- located in one spot -- was underscored. Both MAES scientists and state government officials wanted to be able to make more rapid diagnoses safely and securely, and this couldn't be done with the original configuration of labs.

During this time, the Sept. 11 attacks happened. Many people became concerned about homeland security and felt that if some type of biological attack or outbreak occurred, it would probably be seen in animals first. Because Michigan has the second most diverse agricultural commodity base behind California, everyone wanted to be certain that Michigan's food and fiber system was well protected.

B. Accomplishment Statement: Dedicated at the end of 2004, the new DCPAH facilities allow MAES scientists to run more than 1.3 million tests per year, making it one of the top three diagnostic labs in the country. The tests range from rabies to West Nile virus to bovine TB to chronic wasting disease, and the center's clients are in all 50 states and several foreign countries. The center, one of the most advanced in the nation, provides personnel safety, high levels of biocontainment and the ability to offer expanded services. It is a member of the USDA National Animal Health Laboratory Network and the Centers for Disease Control Laboratory Response Network.

   The DCPAH is equipped to address animal health in all species, from fish and wild animals to agriculture and companion animals. It has several biosafety level III (BL-3) labs as well as a BL-3 necropsy floor, something no other diagnostic lab has, and containment facilities. The center is certified to work with nine agents of concern that are on the federal government's overlap list, which means they affect both animals and humans.

   The DCPAH better prepares Michigan to handle emerging issues and has made the state a national model in coordinating and integrating systems for animal and human health. Besides having cutting-edge facilities, the DCPAH allows MAES scientists to make diagnoses rapidly and efficiently and to handle a large volumes of work.

C. Source of Funding: State of Michigan, MAES, MSU

D. Scope of Impact: MI, national, international

2) **Reducing Michigan's Bovine Tuberculosis Rates**
Key Themes: food security, food safety, animal biosecurity

A. Brief Description: In 1994, a beef cow in Alpena County, Mich., tested positive for bovine tuberculosis (TB). The situation spiraled downward, and in 2000, the USDA revoked Michigan's TB-free status. The decision restricted movement of cattle and reduced out-of-state demand for Michigan beef and dairy products. The disease has cost the state tens of millions of dollars during the past decade.

B. Accomplishment Statement: MAES scientists generated research on all aspects of the problem: supplemental feeding of white-tailed deer, how bovine TB is transmitted in the deer population, the environmental and farm management conditions associated with

bovine TB, and how to improve testing to eliminate false positives. The research helped state agencies craft TB eradication strategies and assisted MSU Extension in educating communities about the issues surrounding the disease.

This MAES research has played a pivotal role in reducing bovine TB rates in Michigan. Disease prevalence has been reduced 65 percent since 1995. Minnesota reopened cattle trade with parts of Michigan deemed lower risk by the USDA in April 2005. In October 2005, Michigan's Upper Peninsula was declared free of bovine TB by the USDA. This is the first part of the state to regain TB-free status since 2000.

MAES researchers also have found that the bacterium that causes bovine TB, *Mycobacterium bovis*, can survive in soil, feed and water in northeastern lower Michigan weather conditions. *M. bovis* can survive long enough (about 4 weeks) in grain, hay, soil and water in Michigan to directly infect cattle and deer. This new information will enhance the state's eradication efforts.

C. Source of Funding: MAES, MSU, MSUE, State of Michigan

D. Scope of Impact: MI

3) **Controlling the Emerald Ash Borer**
Key Themes: fiber security, invasive species

A. Brief Description: Since its discovery in Michigan 4 years ago, the emerald ash borer (EAB) has killed at least 10 million to 15 million ash trees in southeastern Michigan. Additional populations have been found in other areas of Michigan and in northern Ohio and Indiana. EAB has cost municipalities, property owners, nursery operators and forest products industries tens of millions of dollars.

EAB, *Agrilus planipennis* Fairmaire, is an exotic beetle that was identified in southeastern Michigan near Detroit in the summer of 2002. The adult beetles are a dark metallic green. During the summer, adults nibble on ash foliage but cause little damage. The larvae feed on the inner bark of ash trees, leaving winding, serpentine-shaped trails called galleries that disrupt the tree's ability to transport water and nutrients. Over time, EAB populations build up and larval feeding causes an increasing amount of damage to the water- and nutrient-conducting tissues in the branches and the trunk. Eventually, the leafy

canopy thins out and branches begin dying. Even large ash trees will die after 2 to 4 years of heavy EAB infestation. The emerald ash borer probably arrived in the United States on wood packing material carried in cargo ships or airplanes from its native Asia. The emerald ash borer is also established in Windsor, Ontario, and localized populations have been found in Ohio and northern Indiana.

B. Accomplishment Statement: MAES scientists are part of a multistate and multiagency consortium intensely studying the emerald ash borer. The researchers are working quickly to piece together the biology of the insect. They have found the beetles are more attracted to stressed ash trees and believe that the stressed trees release certain chemicals that are attractive to the EAB. Using gas chromatography and flame ionization technology, the scientists are isolating tree volatiles and testing EAB reaction to them. Isolating these volatiles will allow researchers to create better EAB traps to keep the pests away from susceptible trees.

   MAES researchers also are testing chemical and biological controls for the pest. Imidacloprid works well but is not 100 percent effective; it may be helpful in saving or protecting a healthy tree but will not save a heavily infested tree. It also needs to be applied preventively every year, which can be expensive for homeowners and municipalities with thousands of trees. MAES researchers have found that injecting trees with imidacloprid in late May helps to control adult beetles and seems to be more effective than injecting trees in July. This effectiveness was more apparent in small trees than larger trees. Spraying the tree canopy with cyfluthrin once in mid-June seems to effectively control the beetles through the summer. Spraying the leaves is just about as effective as spraying the whole tree -- spraying the trunk was not as effective. A single spray application in June seems to be as effective as spraying twice (once in June and once in July) and saves money. The scientists are continuing to study various insecticides -- how to use them and do it efficiently. They are also looking at ways to apply insecticides without wounding trees.

   The researchers are also searching for natural predators, but because EAB is an exotic species, it has few natural enemies in North America. They've found that woodpeckers eat anywhere from 2 percent to 90 percent of EAB larvae at various sites. New research is underway to understand why these levels vary so widely.

   Researchers are also working to help city arborists and homeowners

find suitable species to replace dead ash trees. MAES horticultural researchers set up an arboretum at the MSU Tollgate Education Center in Novi so people could see trees that are good alternatives to ash trees. They also created a publication highlighting the trees that do well in Michigan urban environments. Many of these ash alternatives do not transplant well, so MAES scientists have started another new project to study pot-in-pot production systems as an alternative to bare-root or balled-in-burlap trees.

C. Source of Funding: MAES, MSU, Michigan Department of Agriculture, USDA Forest Service, Michigan Department of Natural Resources, USDA Animal and Plant Health Inspection Service

D. Scope of Impact: MI, OH, IN, Ontario

4) **Bettering Animal Health with Animal Functional Genomics**
Key Themes: food security, food safety

A. Brief Description: Functional genomics -- research that determines the functions of genes and the proteins they encode in determining traits, physiology or development of an organism -- is growing rapidly. In the MSU Center for Animal Functional Genomics, MAES researchers use technology that allows them to track animals' responses at the cellular and molecular levels to stress from diseases, giving birth, shipping and other environmental factors. This allows them to understand why stress may make animals sick or more susceptible to disease. They look at the genes that are expressed or suppressed when the immune systems of animals respond to an infection or other stresses. Because human and animal immune systems are similar, this research offers exciting possibilities for a new understanding of the human immune system as well as new types of treatments and diagnostic tools for both people and animals.

For example, dairy cows that have difficult, still or premature births often become sick with opportunistic infectious diseases such as mastitis. Mastitis is one of the most costly infectious diseases affecting the U.S. dairy industry, resulting in losses of more than $2 billion annually. The highest rates of mastitis occur in the first few weeks following the birth of the calf.

Similarly, Johne's disease, caused by the bacterium *Mycobacterium avium* subspecies paratuberculosis, is a significant, global problem in the dairy industry. U.S. producers lose more than $1 million per year

because of it. There is also an increasing concern for human health because of the growing connection between paratuberculosis and Crohn's disease. Paratuberculosis has been detected in the intestinal tissue of about 70 to 90 percent of Crohn's disease patients.

B. Accomplishment Statement: MAES scientists have found a relationship between a key birthing hormone in cows, glucocorticoid, and neutrophils, a type of white blood cell. Neutrophils normally protect cows from opportunistic infections such as mastitis. During the birthing process, glucocorticoids from the calf reprogram the mother's neutrophils so they have a different function. Instead of fighting infection, the reprogrammed neutrophils remodel structural proteins of tissue. The researchers speculate that this altered functionality is why cows are more prone to mastitis the first few weeks after the birth of a calf -- fewer white blood cells are available to help fight the infection.

   The scientists have also found that it takes 2 to 3 weeks after a normal birth for the neutrophil system in the bone marrow to revert to creating bacteria-fighting neutrophils. This is usually when mastitis hits the hardest. In a stressful or premature birth situation, glucocorticoid levels may remain high, and this may delay the neutrophil system's reversion to infection fighting. This might explain why cows that have difficult births or abort the calves have more infections. Because of the parallels in neutrophil responses to stress between cows and humans, MAES scientists have begun collaborating with human medicine scientists studying premature birth in women.

   MAES researchers also have found that cows infected with paratuberculosis, whether they are or are not showing clinical symptoms of Johne's disease, have immune systems that have been changed so they express higher levels of various genes than uninfected cows. By determining this genetic fingerprint or signature of infected cows, the scientists are working to create a new diagnostic tool for Johne's disease/paratuberculosis and possibly other diseases. In conjunction with researchers from University College Dublin and the USDA National Animal Disease Center, MAES scientists are determining genetic signatures for diseases such as bovine TB, brucellosis, trypanosomes and several viral infections. The researchers believe they can develop general genetic signatures for each type of disease -- so a bacterial disease has one type of genetic signature, a viral disease has another and a parasitic disease has another. If an animal develops an unknown disease, the type of general immune

response can be determined.

C. Source of Funding: MAES, MSU, Animal Agriculture Initiative

D. Scope of Impact: MI, national, international

Goal 3

A Healthy, Well-nourished Population

Executive Summary

MAES work promoting a healthy and well-nourished population ranges from research in the basic sciences to surveys about day-to-day behavior in high school. The scientists' work targets issues that are important to all Michigan residents such as the rise in childhood obesity and bullying. The benefits of other research, particularly on bacterial pathogens, reach far beyond the state's borders.

According to the National Center for Education Statistics, about 43 percent of middle school students in the United States report being bullied once a week. About 26 percent of elementary students and about 24 percent of high school students report being bullied with the same frequency. This means that about one in four students is bullied in some way every week. Another study, by the American Association of University Women, found that, by high school graduation, more than 80 percent of all students had experienced harassment by classmates. While other school problems have declined, bullying continues to increase. In mid-Michigan, two rural high schools that are aggressively working to reduce and eliminate bullying are working with MSU researchers on a project funded by the MAES to document their students' experiences with gendered bullying and determine how it affects them.

MAES horticulture researcher John Biernbaum, who oversees the Student Organic Farm at MSU, partnered with Lansing's Gunnisonville School to expand its children's garden to include a greenhouse. With the original garden, the school was able to harvest salad greens only before summer break because the plants died after the first frost. With the greenhouse, the school has multiple harvests in both the spring and fall, and the cafeteria has access to fresh, locally produced food that it serves to students.

MAES scientist Linda Mansfield is working to find new ways to treat and prevent *Campylobacter*, a food-borne bacterium that sickens more than 2.5 million people each year -- more than *E. coli* or *Salmonella*.

No public health issue has received more attention lately than obesity, especially childhood obesity. The Centers for Disease Control and Prevention has said that obesity may overtake smoking as the leading cause of death in the United States very soon. MAES food science and human nutrition researcher Sharon Hoerr has found that children who eat their meals at a table have better diet quality than

those who don't eat at the table. Hoerr's research is an important first step in mapping the relationship between family mealtimes and adolescent weight and diet quality.

Allocated Resources

	FY 2005
Hatch Funds	
Hatch Regular	148,290
Multi-State Funds	98,840
	0
Other CSREES Funds*	342,382
Other Federal Funds*	3,373,020
Total Federal Funds (est.)	3,962,532
State Match for Hatch Funds	247,130
Remaining State Appropriations	1,416,127
	0
Self Generated Funds*	143,499
Industry Generated Funds*	168,203
Other Non-Federal Funds*	103,403
Total State Funds (est.)	2,078,361
Total Estimated Funds	6,040,893
Scientist Years	9.7

* Values extracted from Fiscal Year 2005 Funds and Manpower Report

1) **Stopping the Cycle of Bullying**
Key Themes: youth development, human development

A. Brief Description: According to the National Center for Education Statistics, about 43 percent of middle school students in the United States report being bullied once a week. About 26 percent of elementary students and about 24 percent of high school students report being bullied with the same frequency. This means that about one in four students is bullied in some way every week. Another study, by the American Association of University Women, found that, by high school graduation, more than 80 percent of all students had experienced harassment by classmates. While other school problems have declined, bullying continues to increase.

For many years, bullying was considered part of growing up. Parents went through it and expected their kids to do the same. But after the

1999 shootings at Columbine High School, in which two frequently bullied students killed 13 people and wounded 23 others before killing themselves, discussions about bullying became deadly serious. Increasing numbers of schools have taken steps toward preventing bullying, from having in-class discussions about how to relate to others to involving parents in determining the kind of behavior expected in school.

In mid-Michigan, two rural high schools that are aggressively working to reduce and eliminate bullying are working with MSU researchers to document their students' experiences with gendered bullying and determine how it affects them. The project is funded by the Families and Communities Together (FACT) coalition, a collaborative effort of the Office of the Provost, the Michigan Agricultural Experiment Station and MSU Extension in partnership with University Outreach and Engagement.

B. Accomplishment Statement: In the project, NiCole Buchanan, MSU assistant professor of psychology and project leader, and her colleagues interviewed students and teachers at the two rural Michigan high schools and surveyed another 100 students about their experiences. Because the schools are considered very progressive in implementing and enforcing anti-harassment policies, Buchanan was surprised at the levels of gendered bullying revealed by the interviews.

   More than half the students said someone had said sexual things to them or made sexual or obscene gestures that upset them. Almost 40 percent said they had been touched in a way that made them feel uncomfortable. About 40 percent of the students had been hit at least once. About 35 percent had been put down because of their gender. About 22 percent had been kissed or hugged when they did not want it or had sexual rumors spread about them. When she analyzed the types of bullying that were occurring, Buchanan found that much of the bullying focused on gender socialization and questioning sexual orientation. Buchanan also found that this type of gendered bullying affects all students, even those who are not targeted, because it makes them act in certain ways so they won't be bullied.

   The research showed that gendered bullying hurts students in multiple ways. Harassed students show higher rates of depression, anxiety, trauma and feelings of anger. Students also begin to believe that their school is not safe. Dealing with the continuous threat of being bullied and fears that the environment is unsafe may interfere with a student’s

healthy development and ability to concentrate on learning. Additionally, the experiences the students have now also may lay the groundwork for their adult behaviors.

Buchanan has presented the schools with a report, including suggestions on how they can deal with gendered bullying. One suggestion involves giving teachers words to say when they see an incident happening. Teachers are told to intervene but are not told what to say. Many teachers have said they would like help with this. Schools' zero-tolerance policies on bullying and harassment also may need revising. Incidents happen very quickly, and teachers have to make split-second decisions about what they see or overhear. Teachers may make a choice so a good student is not expelled for something that seems minor. Levels of discipline would offer teachers more choices. Other disciplinary methods might include establishing a student peer review committee to mete out punishment for certain behaviors or using community service activities at school as an alternative to expelling students.

C. Source of Funding: FACT, MAES

D. Scope of Impact: MI, national

2) **Offering Fresh Food and Education for Students**
Key Themes: human nutrition, youth development, human health

A. Brief Description: According to statistics from the Centers for Disease Control and Prevention, the number of overweight children between the ages of 6 and 11 doubled in the past 20 years, going from 7 percent in 1980 to 16 percent in 2002. The rate among adolescents ages 12 to 19 more than tripled. An estimated 61 percent of overweight young people have at least one additional risk factor for heart disease, such as high cholesterol or high blood pressure. In addition, children who are overweight are at greater risk for bone and joint problems, sleep apnea, and social and psychological problems such as stigmatization and poor self-esteem. Overweight young people are more likely than children of normal weight to become overweight or obese adults and are more at risk for associated adult health problems, including heart disease, type II diabetes, stroke, several types of cancer and osteoarthritis. Healthy lifestyle habits, including healthy eating and physical activity, can lower the risk of becoming overweight. In Michigan, 82 percent of Michigan students eat fewer than five servings of fruits and vegetables per week.

In 2001, MAES horticulture scientist John Biernbaum received funding for a winter baby leaf salad greens production research. His experiments led to successful production techniques to grow salad greens year round in unheated greenhouses. This research led to an opportunity to partner with Lansing's Gunnisonville School to expand its children's garden to include a greenhouse.

B. Accomplishment Statement: A greenhouse was built at Gunnisonville School, and the school now has multiple harvests of salad greens in both the spring and fall. The school cafeteria has access to fresh, locally produced food that it can serve to students; the greenhouse resulted in fresh salad ingredients for the entire 200-plus student body. The greenhouse has allowed children to have greater access to fresh, nutritious food that they otherwise might not have at home or through the federal lunch program.

   In addition to offering more variety in the cafeteria, teachers at Gunnisonville also received assistance developing creative lessons on horticulture and science that satisfy the state-mandated curriculum. The garden and unheated greenhouse provide a living classroom that makes learning more meaningful to students, according to teachers at the school. The students have taken ownership of the greenhouse, and it has made their learning more tangible.

C. Source of Funding: MAES, GREEEN, North Central SARE

D. Scope of Impact: MI

3) **Fighting the No. 1 Food-borne Bacterial Pathogen**
Key Themes: human health, food safety

A. Brief Description: *Campylobacter,* not *E. coli* or *Salmonella*, is the No. 1 food-borne bacterial pathogen in the United States. Much like the other two pathogens, *Campylobacter* causes bloody diarrhea, vomiting, cramps and fever. But because its associated disease, campylobacteriosis, occurs as isolated, sporadic events, not as large outbreaks, most people haven't heard of it. The bacteria live in the gastrointestinal tract of animals and people. Chickens, pigs and dairy cows can all be infected with *Campylobacter* but have no symptoms. A few people who are infected with *Campylobacter* don't have symptoms, either. Most people, however, develop short-term bloody diarrhea. In immunocompromised people, *Campylobacter* can spread to the

bloodstream and cause a life-threatening infection.

The bacterium is estimated to affect more than 2.5 million people each year -- more than *E. coli* or *Salmonella.* People pick it up mostly by handling raw poultry or eating raw or undercooked poultry meat. Even one drop of juice from raw chicken meat can infect someone. *Campylobacter* can survive cold temperatures and can live in water, and it can colonize and spread in chicken processing chilling tanks. Some researchers speculate that freezing might kill it, but it has been found on frozen chicken. Thorough cooking will kill the bacterium. *Campylobacter* has no vaccine for either animals or humans. The only available animal models to study *Campylobacter* are swine and ferrets.

B. Accomplishment Statement: MAES scientist Linda Mansfield is working to develop an animal model for *Campylobacter* so it can be studied to determine how it causes disease and to develop new treatments and preventive measures for campylobacteriosis. Mansfield is working with several strains of mice with dysfunctional immune systems because they allow her to see any response the mice have immediately and also because campylobacteriosis is a more serious disease in the immunocompromised. She has fed the bacterium to the rodents orally to see if the *Campylobacter* would colonize and produce invasive disease. So far, most normal mice appear to be resistant, and many of the mice with defective immune systems are highly susceptible to this bacterium. These results show hope that these mouse models will ultimately help Mansfield's research. Normal mice may not have the right receptors for *Campylobacter* on their cells or they may be introduced to another bacterium at a young age that makes them immune. Another likely explanation is that a normal immune system is needed to fight off *Campylobacter*.

   Some strains of *Campylobacter* have developed resistance to antibiotics, so the researchers also want to develop an animal vaccine. If this vaccine works well, there would be no need to worry about antibiotic resistance from *Campylobacter* developing in people. Because chickens have a higher rate of *Campylobacter* infection than pigs or dairy cows, the USDA is focusing on eliminating the bacterium in poultry. This is expected to dramatically reduce infections in humans.

C. Source of Funding: MAES, MRU, NIH, NIAID

D. Scope of Impact: MI, national, international

4) **Eating at the Table Improves Kids' Nutrition**
Key Themes: human health, human nutrition

A. Brief Description: Obesity costs Michigan an estimated $3 billion a year. Seven percent of all medical expenses in the state are related to obesity, and half of that is paid for by taxpayers through Medicaid and Medicare. Obesity is Michigan's most expensive preventable public health killer and is on track to overtake smoking as the deadliest, according to research by RTI International and the CDC. Both obesity and smoking kill about 400,000 people per year. Health problems linked to obesity – heart disease, diabetes, stroke, arthritis, gout, high blood pressure, certain cancers and depression – cost about $300 for every man, woman and child in the state. This drags down the state's already lackluster economy. Compared to other, less obese states, Michigan is a less attractive place to do business because of higher health insurance costs, absenteeism at work and lower productivity.

Experts agree that Michigan's collective girth is due to a number of complex, interrelated factors:

Unhealthy food choices. Nearly three-quarters of Michigan residents do not eat the recommended number of servings of fruits and vegetables per day.
Long winters, unsafe neighborhoods, a lack of sidewalks or bike lanes for those who do want to use something other than a car to move around, and lack of access to health clubs. A quarter of residents get no regular exercise. As schools put more resources into raising test scores, **physical education classes have been cut or drastically reduced**. Children grow up with no history of exercise or other physical activity.
An increase in poverty in the state means more families are eating cheaper, starchier, fatter and more sugary foods.

According to Sharon Hoerr, MAES food science and human nutrition scientist, obesity is complex. Biology and genetics interact with environmental factors and psychosocial development. Research is needed on behavior, sociology, the human environment, biology and policy to solve the problem.

B. Accomplishment Statement: Hoerr, an expert on the psychosocial and contextual factors that drive health behaviors, is the first scientist to study families' eating environments. Working with the MSU College of Nursing and the Early Head Start Program in Jackson County, she

surveyed approximately 200 Head Start parents with young children to see who made the food choices for a meal and how often parents and children ate together.

According to Hoerr, children should be seated while eating to reduce the risk of choking. Her research found that only 50 of 118 kids ate all three meals seated at the family table. About 10 percent of the children were not seated at all while eating. They were in the bedroom, in the basement, in the laundry room – eating everywhere but at the table.

For breakfast most of the children were seated, but after that many began to roam. More than half ate their snacks and dinner while watching television. Many parents allowed their children to leave the table after only 5 minutes and randomly snack on sugary foods, such as ice cream, throughout the rest of the evening. The researchers found that children who ate their meals at the table had better diet quality than those who didn't eat at the table. Children who were talking to their parents and siblings rather than watching TV or running around the house also had better diets.

Hoerr's study is an important first step in mapping the relationship between family mealtimes and personal factors of adolescent weight status and diet quality.

Hoerr's research shows that eating meals as a family influences diet quality. This affects children's weight as they move into adolescence. If children have good eating habits then, they're less likely to become overweight adults.

C. Source of Funding: MAES, MSU, MSUE, Early Head Start Program of Jackson County

D. Scope of Impact: MI, national

Goal 4

Greater Harmony between Agriculture and the Environment

Executive Summary

Michigan is a state defined, literally, by water. Without the Great Lakes, Michigan's peninsulas would not exist. Nor would much of the state's agriculture, shipping and tourism offerings. Water is necessary for life -- every human needs water to live, as do the plants and animals that provide food and shelter for the state's residents. According to the Michigan Department of Environmental Quality (DEQ), Michigan has more households -- 1.12 million -- served by private wells than any other state. Accordingly, the MAES funds several projects focused on keeping Michigan's water safe and plentiful for both private citizens and industry.

One of these projects developed a statewide groundwater inventory and map that is available online. The map was mandated by the state legislature, and the state-of-the-art system has been praised by DEQ Director Steve Chester for meeting all the state's requirements and providing a single Web-based location for all types of groundwater information.

Other MAES research has found that using less water can increase crop yields. MAES scientists, working in conjunction with tomato growers in the state, found it was possible to reduce drip irrigation water by 40 percent and increase tomato yields by up to 15 percent at the same time.

Globalization is making the world smaller and increasing the likelihood that what happens in one country will influence the environment of another on the other side of the world. Now an MAES researcher has found just how high the cost of this new neighborliness is. MAES fisheries and wildlife scientist Jack Liu has found that China's challenges -- from polluted air and water to making and consuming goods to family life -- are making a big impact on the environment and human well-being in other parts of the world, including North America and Europe.

Many of Michigan’s fruit and vegetable crops, valued at more than $400 million, depend on pollination from a healthy honeybee population. Honey and beeswax add another $5 million to the state's economy each year. But honeybees around the world are under attack from a deadly parasite smaller than a grain of rice. Varroa mites, which invaded the United States from the eastern hemisphere in 1987, can kill an entire bee colony within 1 to 2 years if left untreated. In 1995, Michigan had about 92,000 bee colonies, with roughly 30,000 bees in each colony.

By 2003, the number of colonies had dropped to 65,000. MAES entomologist Zachary Huang has invented a honey of an idea -- a chemical-free, inexpensive way to control deadly mites: the Spartan Mitezapper.

Allocated Resources

	FY 2005
Hatch Funds	
Hatch Regular	683,755
Multi-State Funds	168,079
	0
Other CSREES Funds*	4,009,789
Other Federal Funds*	8,510,844
Total Federal Funds (est.)	13,372,468
State Match for Hatch Funds	851,834
Remaining State Appropriations	6,335,801
	0
Self Generated Funds*	986,580
Industry Generated Funds*	3,226,540
Other Non-Federal Funds*	4,039,998
Total State Funds (est.)	15,440,753
Total Estimated Funds	28,813,221
Scientist Years	46.0

* Values extracted from Fiscal Year 2005 Funds and Manpower Report

1) **Developing Statewide Groundwater Inventory and Map**
Key Themes: water quality, natural resources management

A. Brief Description: Groundwater and protection of water resources are a major concern to Michigan citizens. Michigan Gov. Jennifer Granholm recently reaffirmed the state's bipartisan opposition to Great Lakes diversions by signing the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement, which prohibits diversions of Great Lakes water and provides for state and provincial management and conservation of Great Lakes Basin water. In 2003, a legislative mandate required the Michigan DEQ to develop a statewide groundwater inventory and map.

B. Accomplishment Statement: The Institute of Water Research, which receives funding from the MAES, and Remote Sensing and Geographic

Information Science Research and Outreach Services, in cooperation with the U.S. Geological Survey, helped the state develop the mandated inventory and map and make it available online at http://gwmap.rsgis.msu.edu. The state-of-the-art system was praised by Michigan DEQ Director Steve Chester for meeting all the state's requirements and providing a single Web-based location for all types of groundwater information.

The groundwater inventory and mapping project addressed the eight major areas required by legislation:

(1) Location and water-yielding capabilities of aquifers.
(2) Aquifer recharge rates.
(3) Static groundwater levels.
(4) Base flow of rivers and streams.
(5) Conflict areas.
(6) Surface waters, including designated trout lakes and streams and groundwater-dependent natural resources identified in the natural features inventory.
(7) Locations and pumping capacities of industrial or processing facilities, irrigation facilities and public water supply systems.
(8) Aggregate agricultural water use and consumptive use.

The new groundwater map shows several regions with minimal yields (less than 10 gallons per minute) from glacial deposits throughout the state, especially in the areas northwest, south and southeast of Saginaw Bay, and in extreme southeastern lower Michigan. Many areas in Delta and Menominee counties (in the Upper Peninsula) also exhibit poor yields from glacial deposits. The minimum well yield for small residential homes is 10 to 15 gallons per minute (gpm), according to industry standards.

High-capacity wells -- capable of producing 70 gpm or more -- are routinely possible throughout much of lower Michigan. Zones of very high yield potential are located in southwestern and south-central lower Michigan, the core of the Thumb (Oakland, Lapeer and southeastern Tuscola counties), the Houghton-Higgins lakes district of northern lower Michigan, and across the northern Lower Peninsula.

C. Source of Funding: MAES, USGS, MSUE, Michigan DEQ

D. Scope of Impact: MI

2) **Saving Water, Improving Crop Yield**
Key Themes: water quality, natural resources management

A. Brief Description: Michigan growers plant almost 6,000 acres of fresh market and processing tomatoes each year, with an annual value of about $35 million. Many of these tomatoes are grown using drip irrigation. Though drip irrigation is more efficient than most other irrigation methods, it is often overused. This wastes water, washes away soil nutrients and potentially adds nitrates to groundwater.

B. Accomplishment Statement: Working with MSUE agents and tomato growers in southwestern Michigan, MAES researchers found that it is possible to save 40 percent of drip irrigation water inputs and increase tomato yields by up to 15 percent at the same time. Results from 2 years of research indicate that withholding water post-transplant for tomatoes was beneficial for the plants and the environment. The exact duration of the period of limited irrigation depended primarily on weather conditions and ranged from approximately 3 weeks in dry conditions to 5 weeks when rainfall was adequate.

   To make the results work for them, farmers need to consider the soil type, heat, rainfall and crop stage. It is critical that the soil be moist at planting and that farmers monitor soil moisture status, especially during excessively dry seasons.

C. Source of Funding: MAES, MSUE, GREEEN, Michigan Vegetable Council

D. Scope of Impact: MI

3) **Where China Goes, So Goes the Global Neighborhood**
Key Themes: natural resources management, water quality, land use

A. Brief Description: Globalization is making the world smaller and increasing the likelihood that what happens in one country will influence the environment of another on the other side of the world. What is the cost to the rest of the world of air and water pollution, manufacturing, agriculture and family life in developing countries? What role should developed nations play to assist and support developing countries?

B. Accomplishment Statement: Using China as a model, two internationally acclaimed scientists, one of them MAES fisheries and wildlife researcher Jack Liu, have found sweeping evidence that China's challenges – from

polluted air and water to making and consuming goods to family life – already are making a big impact on the environment and human well-being in China and other parts of the world, including North America and Europe. Developed nations must take a more active role – with policy, with aid and through business – to assist and support developing countries and recognize that the only real borders are drawn on paper, according to the scientists.

"The world is increasingly connected," Liu said. "If we want to make the environment in China better – and there are many important reasons for us to do so – the whole world needs to do something about it."

Liu teamed with Pulitzer-prize-winning author Jared Diamond, professor of geography and physiology at UCLA, to write "China's Environment in a Globalizing World – How China and the Rest of the World Affect Each Other," the cover story in the June 30, 2005, issue of the international science journal Nature. Liu and Diamond found a litany of push and pull between China and the rest of the world. The hallmark is environmental damage that creates economic, social and health burdens with which China is ill-equipped to cope. According to the scientists, developed nations carry a strong moral obligation to lead in helping the developing nations protect the environment and achieve economic sustainability. In the developed nations, the big picture is easier to see on a full stomach. Protections – such as laws, zoning rules and regulations – are possible thanks to the luxury of economic power. The developing nations' first priority on the most basic needs makes bigger picture concerns harder to address.

Among the authors' recommendations:

i. Aggressive support of education in China. An educated population better understands global and environmental impacts and is the first step toward effecting change. "Environmental education is important, but it's not enough," Liu said. "You have to enhance education in general. People who have more schooling have the ability to develop new technology and use technology to understand and solve some of these problems."
ii. Rigorous implementation and enforcement of environmental laws and regulations already on the books in China, an effort that will require greater funding.
iii. Use of market tools to address environmental issues, such as eliminating subsidies for industries that severely harm the environment, such as coal.

iv. Addressing lifestyle issues such as household size and even divorce, which have an environmental impact. They suggest examining the benefits of a mandatory waiting period for divorce, saying divorce ultimately has negative environmental impacts.

The scientists assert that it is time to realize that the other side of the world really is the United States' backyard, and that good neighbors don't just borrow but also return favors. "This is not just a recommendation for China but for the whole world," Liu said. "We focus on China, but that doesn't mean only China needs to do this."

C. Source of Funding: MAES, National Science Foundation, National Institutes of Health, National Science Foundation of China

D. Scope of Impact: MI, national, international

4) **Researchers Battle No. 1 Bee Killer**
Key Themes: pest management, environmental quality

A. Brief Description: Many of Michigan's fruit and vegetable crops, valued at more than $400 million, depend on pollination from a healthy honeybee population. Honey and beeswax add another $5 million to the state's economy each year.

Honeybees around the world are under attack from a deadly parasite smaller than a grain of rice. Varroa mites, which invaded the United States from the eastern hemisphere in 1987, can kill an entire bee colony within 1 to 2 years if left untreated. Infestation causes a general weakening in the colony as mite numbers increase. This results in fewer bee offspring and deformed bees. The Varroa mite wiped out nearly 50 percent of the U.S. commercial honeybee population during the winter of 2004. Michigan has an estimated 65,000 commercial honeybee colonies. An average honeybee colony contains 30,000 bees.

B. Accomplishment Statement: MAES entomology scientist Zachary Huang invented the Spartan Mitezapper, a chemical-free method of controlling Varroa mites. Looking like a 1-foot by 2-foot circuit board, the Spartan Mitezapper is built into a frame. Wires from each side of the Zapper are attached to a 12-volt battery for about 4 minutes. The Mitezapper generates enough heat to kill both the mites and the drone larvae (which aren't important to a colony's survival) but not the worker bees. Beekeepers also can regulate the amount of heat the Mitezapper puts out so only the mites die. In laboratory tests and in actual colonies, the

Spartan Mitezapper killed 100 percent of Varroa mites in combs. It doesn't interfere with bee management practices -- the Mitezapper has the same dimensions as a regular frame and can even go into a honey extractor, if needed.

The Mitezapper, for which Huang has applied for a patent, costs about one-eighth the cost of chemicals, potentially saving Michigan beekeepers upwards of $120,000 per year in chemical costs. In addition to being expensive, chemicals also can harm the bees or contaminate the honey or beeswax if not used carefully.

C. Source of Funding: MAES, GREEEN

D. Scope of Impact: MI, national, international

Goal 5

Enhanced Economic Opportunity and Quality of Life for Americans

Executive Summary

Research has shown that young people who have a mentor are six to seven times less likely to reenter the juvenile justice system than young people in the system without mentors. According to the director of Mentor Michigan, one of the most promising things he sees developing is a mentoring program for young adults aging out of the foster care system.

MAES researcher John Seita continues his work on how to smooth the transition from foster care to independent living for kids who age out of the program. He has organized two conferences on the topic and is working to build a mentoring program for foster children that pairs a current foster child with an adult who has been through the system and has achieved success.

According to a report by the Commission on Higher Education and Economic Growth chaired by Michigan Lt. Gov. John Cherry, many students are not prepared for life and work. The report stresses the need for learning environments with high expectations for youth that provide them with opportunities to strengthen skills in creativity, risk taking, responsibility, adaptability, and other skills for school, work and life success.

The K-12 Partnership for Science Literacy is providing hands-on experience with inquiry science for science teachers at 14 rural school districts in Michigan. MAES scientists provide the science content, and MSU College of Education researchers provide a leadership component. After 2 years, the MEAP (Michigan Educational Assessment Program) science scores at some of the schools jumped remarkably. School administrators credit the K-12 partnership program.

In 2005, Michigan Gov. Jennifer Granholm called for stronger criminal background checks for employees of nursing homes and other long-term care facilities to protect one of the state's most vulnerable populations. MAES researcher Jim Oehmke, partnering with several state of Michigan agencies, has designed and developed a new comprehensive background-check system for employees at Michigan's nursing homes and other long-term care facilities, as well as other healthcare workers. On Feb. 2, 2006, the Michigan Legislature passed three bills that expanded requirements for background checks to include all healthcare employees with direct access to vulnerable populations. Michigan is one of the first states in the country to implement strengthened background-check legislation for broad categories of healthcare workers, and the legislation is

being studied by the U.S. Department of Health and Human Services as a possible national model.

MAES research also is focusing on an exotic insect that has dealt a crushing blow to the state's $9 billion forest products industry -- the emerald ash borer (EAB). The Asian invader has killed 10 million to 15 million ash trees in southeastern Michigan since it was discovered in 2002 near Detroit. From a core infestation in six counties, the EAB has spread to 35 counties.

To help communities deal with the infested wood, MAES researchers have developed environmentally safe treatments to sanitize EAB-infested logs. EAB-damaged trees currently are cut down, reduced to wood chips and then burned to generate energy. MAES researchers have found that microwaving and steam conditioning EAB-infested ash logs kills EAB adults and larvae. Once the insects are dead, the logs can be safely transported to sawmills to be made into value-added products such as flooring, molding and architectural products.

Allocated Resources

	FY 2005
Hatch Funds	
Hatch Regular	102,397
Multi-State Funds	35,587
	0
Other CSREES Funds*	1,387,146
Other Federal Funds*	226,737
Total Federal Funds (est.)	1,751,866
	0
State Match for Hatch Funds	137,983
Remaining State Appropriations	1,929,931
	0
Self Generated Funds*	165,166
Industry Generated Funds*	60,805
Other Non-Federal Funds*	260,301
Total State Funds (est.)	2,554,186
Total Estimated Funds	4,306,052
Scientist Years	6.3

* Values extracted from Fiscal Year 2005 Funds and Manpower Report

Helping Former Foster Children Succeed
Key Themes: youth development, jobs/employment

A. Brief Description: More than 25,000 children make the transition from foster care and other dependent care settings every year, classified no longer as children but as young adults, no matter that they may not be ready to make this change. Children in foster care make up less than .003 percent of the nation's population, but 17 percent of state prison inmates are former foster children.

   Research has shown that young people who have a mentor are six to seven times less likely to reenter the juvenile justice system than young people in the system without mentors. According to the director of Mentor Michigan, one of the most promising things he sees developing is a mentoring program for young adults aging out of the foster care system.

B. Accomplishment Statement: MAES social science researcher John Seita continues his work on how to smooth the transition from foster care to living on their own for young people who age out of the program. His research has found that only six out of 105 child welfare agencies in Michigan had board members who were child welfare system alumni. No agencies reported having either a chief executive officer or any executive staff members who were child welfare alumni. This suggests that about 90 percent of child-serving organizations have no policy input from the people who were consumers of their services. This is much different from other agencies in the country. The Bureau of Indian Affairs, for example, has leadership that is about 90 percent Native American.

   To offer foster children role models as well as a way to move into leadership positions, Seita (a former foster child) has organized two conferences on mentoring and leadership skills for foster children. He is building a mentoring program for foster children that pairs a current foster child with an adult who has been through the system and has achieved success. His ultimate goal is to inject more science into the child welfare system, as well as create a pipeline of well-educated former foster children to serve the system.

C. Source of Funding: MAES, W.K. Kellogg Foundation, Michigan Federation for Children and Families

D. Scope of Impact: MI, national

2) **Improving Science Education for Michigan Students**
Key Themes: youth development, jobs/employment

A. Brief Description: According to a report by the Commission on Higher Education and Economic Growth. chaired by Michigan Lt. Gov. John Cherry, many students are not prepared for life and work. The report stresses the need for learning environments with high expectations for youth that provide them with opportunities to strengthen skills in creativity, risk taking, responsibility, adaptability, and other skills for school, work and life success.

The K-12 Partnership for Science Literacy joins MAES Long-Term Ecological Research (LTER) program scientists and researchers in the MSU College of Education with science teachers at 14 rural school districts near the Kellogg Biological Station, where the LTER site is located. By providing hands-on experience with inquiry science for the teachers, the partnership aims to improve science teaching in the area.

B. Accomplishment Statement: Each year science teachers from elementary, middle and high schools participate in five school-year workshops. The science content is provided by KBS scientists, and a science teaching and leadership component is provided by education faculty members. The partnership also sponsors two weeklong science institutes during the summer. The first focuses on science content and methodology; the second focuses on inquiry teaching methods and educational leadership.

The partnership started with 14 teachers from four districts. After 2 years, the MEAP (Michigan Educational Assessment Program) science scores at the schools jumped remarkably. School administrators credited the K-12 partnership program with making the teachers, and subsequently the students, more excited about doing science, as well as making both the teachers and the students think about how science relates to the world around them.

The scientists successfully applied for a $1.2 million NSF grant to increase the size of the program and are now beginning to work with 80 teachers in 14 districts. A new $1.5 million award takes the program through 2008.

C. Source of funding: NSF, MAES

D. Scope of Impact: MI

3) **Improving Nursing Home Employee Background Checks**
Key Themes: jobs/employment, vulnerable populations

A. Brief Description: In 2005, Michigan Gov. Jennifer Granholm called for stronger criminal background checks for employees of nursing homes and other long-term care facilities. Michigan law did not require all employees with direct access to some of the state's most vulnerable populations to undergo background checks. For those employees who were subject to a background check, there was no systematic process across the various agencies to conduct the checks, disseminate findings or follow through on results.

B. Accomplishment Statement: In 2005, a state-MSU partnership received a grant from the U.S. Department of Health and Human Services (HHS) for $5 million, with $4.1 million going to MSU, to develop and study a three-phase comprehensive system to improve background checks in facilities such as nursing homes, hospices and assisted-living centers.

MAES researcher Jim Oehmke, partnering with several state of Michigan agencies and other MSU scientists, has helped to design and develop a new comprehensive background-check system. This state-of-the-art system, involving digital scans and a sophisticated human-computer interface, allows Michigan agencies to conduct more effective background checks on employees who provide direct service to persons in long-term care facilities such as nursing homes, adult foster care and hospice services.

On Feb. 2, 2006, the Michigan Legislature passed three bills that expanded background checks to include all healthcare employees with direct access to vulnerable populations. Michigan is one of the first states in the country to implement strengthened background-check legislation for broad categories of healthcare workers, and the legislation is being studied by HHS as a possible national model.

C. Source of Funding: U.S. Department of Health and Human Services, MAES, Michigan Department of Community Health, MSU, Michigan Department of Human Services, Michigan State Police.

D. Scope of Impact: MI, national

4) **New Uses for EAB-infested Wood**
Key Themes: economic development, jobs/employment, impact of change on

communities

A. Brief Description: An exotic insect -- the emerald ash borer (EAB) -- has dealt a crushing blow to the state's $9 billion forest products industry. The Asian invader has killed 10 million to 15 million ash trees in southeastern Michigan since it was discovered in 2002 near Detroit. From a core infestation in six counties, the EAB quarantine has spread to 35 counties. No ash trees or wood can be transported outside the quarantine areas for fear of spreading the pest. The EAB has also been found in Ohio, Indiana, Maryland and Ontario.

   The state has set up disposal sites where the trees can be chipped; they are then burned to generate electricity. Burning the infested wood is a huge undertaking and dramatically reduces the value of the trees.

B. Accomplishment Statement: To help communities deal with the infested wood, MAES researchers have developed environmentally safe treatments to sanitize EAB-infested logs. The researchers have found that microwaving and steam conditioning EAB-infested ash logs kills EAB adults and larvae. Once the insects are dead, the logs can be safely transported to sawmills to be made into value-added products such as flooring, molding and architectural products.

   The researchers have also developed environmentally friendly preservatives that allow wood from EAB-infested trees to be used in outdoor products. After the ash wood is treated with the preservatives, it can be used in timber bridges, fence posts and signposts, highway guardrails, picnic tables and other products used where exposure to weather and damaging insects causes decay.

   This MAES research offers two benefits: the preservatives do not harm the environment, and they allow the large amounts of EAB-infested wood to be used safely in marketable products. Developing higher value uses for the hundreds of millions of infested ash trees will boost the economies and create jobs in communities where EAB is prevalent.

C. Funding Source: MAES, MSU, USDA

D. Scope of Impact: MI and neighboring states facing EAB infestations

Stakeholder Input Process Section

Actions Taken to Seek Stakeholder Input and Encourage Participation
As the state's land-grant institution, Michigan State University is charged with generating research-based knowledge and educational programs so that people can make informed decisions to improve their lives. To accomplish this important mission, the MAES and MSUE are constantly evaluating and updating the areas they focus on to best meet the ever-changing needs of Michigan's people, industries and communities. As the state's priorities change, research and educational programs, research agendas and external relationships also must change.

The MAES and MSUE are working together in 2005-06 to gather public input on the issues of greatest concern to Michigan citizens. This issues identification process, called Strengthening Michigan's Economy, ensures that relevant, research-based educational programming is available to address local issues. Both organizations are using this input to guide state-level decisions for research priorities and program support.

The Strengthening Michigan's Economy process offered several ways for people in various roles and locations to help identify the issues and opportunities for MAES research and MSUE educational programming during the years ahead. All information is posted on a special issues identification Web site.

Here are the ways the MAES and MSUE sought input from people:

General public: Four focus groups in various locations throughout the state gave a representative sample of residents the opportunity to identify priority concerns and opportunities. In addition, about 1,000 residents participated in a telephone survey conducted by the MSU Institute for Public Policy and Social Research. The survey asked them to identify priority issues. A summary of the results is posted online.

Commodity groups, key partners, other stakeholders: Area of Expertise (AoE) teams asked for input at meetings with their advisory committees and/or through targeted interviews, focus groups or surveys. They were asked to identify specific concerns and trends, and then determine priorities for MAES research and MSUE education.

Program participants, constituents, interested Michigan residents: A link to an online survey was posted on the MAES and MSUE Web sites, as well as on MSUE county office and MAES field station Web sites. The survey asked people

to identify issues of greatest concern and to indicate levels of knowledge and involvement with these two organizations.

County Extension council members and other county residents: These groups were asked to participate in at least two meetings to discuss some of the major issues and trends facing the state, examine the implications for their communities, and then prioritize the concerns for research and education for that county. Counties were asked to consider carefully other sectors beyond the county council that need to be represented in these meetings. Seven MSU faculty members identified some of the major issues and trends facing the state in the areas of economy, land use, agriculture, health, families, youth, communities and the environment. This information was then made available to county Extension directors.

MSU faculty members (with and without MAES and MSUE appointments) and MSUE specialists and program leaders: All MSU college deans were asked to identify participants for a set of five focus groups to discuss a faculty survey. A more detailed survey was sent to all faculty members to learn about future trends and to further understand the needs and the capacity for research and education.

MAES field station advisory board members: Local advisory board members were invited to participate in county discussions. In addition, these advisory board members were usually involved in AoE team meetings.

MAES and MSUE faculty members: Faculty members were encouraged to seek out and participate in the appropriate AoE team discussions.

Process Used by the Recipient Institution to Identify Individuals and Groups Who are Stakeholders and to Collect Input from Them

With a mission to generate knowledge through strategic research to enhance agriculture, natural resources, and families and communities in Michigan, the MAES has an extremely broad and long list of stakeholders. In reality, every single Michigan citizen is an MAES stakeholder.

The Strengthening Michigan's Economy process offered multiple ways for people in various roles and locations to help identify the issues and opportunities for MAES research and MSUE educational programming during the years ahead.

Statewide telephone surveys for the State of the State Survey and citizen focus groups were used to ask *what are the major issues and opportunities in Michigan?*

A Web-based survey asked *what do you see as the role for MAES and MSUE related to key issues and opportunities?*

Community-based discussions in all Michigan counties, involving the local MAES advisory committees and MSUE councils, were held to learn *what are the issues and opportunities that you think should be addressed by MAES research and MSUE educational programs?*

Area of Expertise (AoE) Teams conducted subject-specific focus groups comprising a variety of stakeholders. Community groups, commodity and producer groups, and other state and local partners were asked *what are the specific issues and opportunities in your field of interest that should be addressed by MAES research and MSUE educational programs?*

The MAES/MSUE State Council responded to the question l*ooking at the results of the SOSS survey, what are the implications for MAES research and MSUE educational programming in the future?*

AoE co-chairs representing 29 teams were asked to identify emerging issues and opportunities. Each team conducted stakeholder/constituent input sessions and reflected the results in plans of work.

Faculty focus groups, with representatives from all MSU colleges and units, were held to learn faculty perceptions on emerging Michigan issues and opportunities and identify ways that MSU science might be used to address those issues and opportunities.

MSU faculty and MSUE/MAES staff surveys were used to develop a better understanding of MSU's ability to respond to the issues and opportunities identified in the faculty focus groups.

County teams, including MAES field station managers, synthesized and submitted local priorities identified by local MSUE councils and MAES advisory committees.

AoE teams synthesized and prioritized content-specific program and research needs generated from input of their advisory bodies.

How Collected Stakeholder Input Was Considered

Stakeholder input provides the foundation for the research and educational programs developed by the MAES and MSUE. Stakeholders help decide the

future direction for the MAES through programs such as Project GREEEN, the Animal Agriculture Initiative (AAI), FACT, commodity advisory boards and the AoE teams. Because of stakeholder input, the MAES has focused more sharply on biobased products that can help boost the Michigan economy, including fuels, chemicals, neutraceuticals and food products, as well as youth and family issues, the environment, land use issues and biotechnology.

The stakeholder input collected in 2005 was used to guide the creation of the Michigan 2007-11 Plan of Work for Agricultural Research and Extension Formula Funds for the MAES and MSUE.

Program Review Process

There have been no changes in the program review process since the MAES submitted the 2005-2006 Plan of Work Update.

Evaluation of the Success of Multi and Joint Activities

Multidisciplinary and Integrated Research/Extension Activity

The Long-Term Ecological Research Site at the Kellogg Biological Station Provides a Vast Array of Data and Collaborative Opportunities for Researchers from a Variety of Disciplines

Did the planned program address the critical issues of strategic importance, including those identified by the stakeholders?

Brief Description: Situated on 200 acres of the Kellogg Biological Station (KBS), in Hickory Corners, the MSU Long-Term Ecological Research (LTER) site was established in 1988 as part of the national LTER Network funded by the NSF. The MSU LTER site at KBS is the only site in the network to focus on agriculture. Research at the MSU LTER site aims to understand the ecological interactions that affect the productivity of field crops such as corn, soybeans, wheat and alfalfa, and forest crops such as fast-growing poplar trees. Scientists compare natural, never-disturbed sites with cultivated crop sites to understand the effects of intensive management on the ecology of the organisms in the ecosystem.

Besides MAES crop and soil scientist Phil Robertson, who serves as LTER director, the site has six other principal investigators: Kay Gross, KBS director; Tom Schmidt, MAES microbiology and molecular genetics researcher; Stu Gage and Doug Landis, MAES entomology scientists; Scott Swinton, MAES agricultural economist; and Steve Hamilton, MSU zoology scientist. The LTER site is extremely inclusive. Currently, more than 25 externally funded projects are underway at the site, involving about 80 to 100 researchers. One of the intents of the LTER is to provide long-term background data for new projects and to attract scientists to build on the data that are already available.

In 2000, the soybean aphid was detected in the United States. The east Asian pest has spread rapidly through the Midwest and costs growers about $30 million to $50 million per year in reduced yield. Sprays are available to control the aphids, but they can be expensive -- about $5 to $10 per acre. Soybean growers have identified control of the soybean aphid as a priority.

MAES entomologist Landis studies natural controls for insect pests in crops, including the soybean aphid. At the LTER site, he found that certain species of ladybird beetles feed voraciously on soybean aphids. If the landscape is diverse (has many types of habitats, animals and insects), the beetles may be able to control the aphids well enough so farmers don't have to spray.

The research findings are based on work that began when the MSU LTER site was established. In 1988, MAES entomologist Stuart Gage began monitoring ladybird beetle populations at the site. He created a unique, long-term data set of the numbers of beetles in the area. Landis' lab took over the project from Gage.

Using a caging system that allowed certain insects access to soybean plants and kept others away, Landis and his research team found that the two species of ladybird beetles could control the aphids. They also found that relatively low numbers of the beetles could control the aphids. In other words, no one had to notice large numbers of beetles on the plants for effective aphid control to happen.

Did the planned programs address the needs of underserved and under-represented populations of the state?
Of the more than 53,000 farms in Michigan, about 300 are classified as organic. Organic growers and growers who are considering incorporating more organic production practices into their operations have been asking for research on pest control methods that meet organic certification standards.

This research on the effectiveness of ladybird beetles as a natural control for soybean aphids fulfills this request and addresses the needs of this underserved population (organic growers).

Did the planned programs describe the expected outcomes and impacts?
Managing the land for agriculture reduces the structural complexity of various biological communities within the crop ecosystem. At the LTER site, MAES and other scientists are studying which features of the row-crop ecosystem regulate biotic complexity; what, if any, are the ecosystem-level consequences of reduced complexity; and to what extent can complexity be managed to lessen what may be an escalating need for subsidies.

At the LTER site, research addresses questions related to the patterns, causes and consequences of changes in community complexity as a function of row crop ecosystem management. One particular area of focus is on communities of aboveground consumers -- pathogens and insects operating at several trophic levels -- that can severely affect primary productivity in outbreak years.

The ladybird beetle/soybean aphid research fits squarely into this research framework.

Did the planned programs result in improved program effectiveness and/or efficiency?
The discovery that ladybird beetles can successfully control soybean aphids is one example of the effectiveness of the MSU LTER site. Apparently the beetles at the LTER site had been keeping the soybean aphids in check and no one knew about it until Landis' research.

"The LTER site and its data sets were critical to this research," Landis said. "We can look at long-term data and pick out patterns that you can't get in a 3- or 4-year grant cycle. Thanks to Dr. Gage and the LTER, we had access to 17 years' worth of data. This long-term perspective is absolutely critical for looking at whole systems. The LTER is a great resource for Michigan."

The LTER site attracts researchers from all over the world and is available to any scientist with a legitimate research interest. Though access to the site itself is somewhat limited to protect the integrity of existing experiments, scientists can establish microplots within experimental plots, and new investigations based on samples taken from the site are regularly started, as are adjacent experiments. The LTER is a basic research project looking at ecosystem diversity and collecting data for decades. However, much of this basic research results in very practical, applied results for farmers and other people involved in agriculture and natural resources around Michigan. The ladybird beetle research is one example of these practical results.

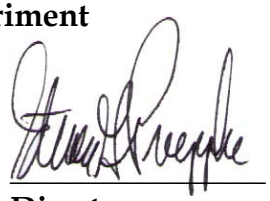
U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Multistate Extension Activities and Integrated Activities
(Attach Brief Summaries)

Institution: Michigan State University
State: Michigan

Check one: ____ Multistate Extension Activities
_XX___ Integrated Activities (Hatch Act Funds)
____ Integrated Activities (Smith-Lever Act Funds)

Actual Expenditures

Title of Planned Program/Activity	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Integrated appointments between the university, Extension service and the Michigan Agricultural Experiment Station	78,628	157,199	155,628	155,736	155,376



Director **5/1/06**
Date

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