Annual Plan of Work
Accomplishment Report for 2002

Michigan Agricultural Experiment Station

Michigan State University

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MICHIGAN AGRICULTURAL EXPERIMENT STATION
ANNUAL REPORT
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Guide to Acronyms in This Report

AII	Animal Industry Initiative
CANR	College of Agriculture and Natural Resources
CAT	Crop Advisory Team
CEVL	Computational Ecology and Visualization Laboratory
CHM	College of Human Medicine
CNS	College of Natural Science
CPPT	Center for Plant Products and Technologies
CVM	College of Veterinary Medicine
FACT	Families and Children Together
FDA	Food and Drug Administration
FNDRC	Food and Nutrition Database Research Center
FQPA	Food Quality Protection Act
GCSAA	Golf Course Superintendents Association of America
GIS	Geographic Information Systems
GREEEN	Generating Research and Extension to meet Economic and Environmental Needs
GWP	Global Warming Potential
HACCP	Hazard Analysis Critical Control Point
IFAS	Institute of Food and Agricultural Standards
LTER	Long-Term Ecological Research
MAEAP	Michigan Agricultural Environmental Assurance Program
MAES	Michigan Agricultural Experiment Station
MDA	Michigan Department of Agriculture
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
MFB	Michigan Farm Bureau
MMP	Manure Management Planner
MNN	Michigan Nutrition Network
MSAC	Michigan Sugarbeet Advancement Committee
MSU	Michigan State University
MSUE	Michigan State University Extension
MTESP	Michigan Turfgrass Environmental Stewardship Program
NFSTC	National Food Safety and Toxicology Center
NEAT	Nutrition Education Aimed at Toddlers
NSF	National Science Foundation
PAR	Pesticides at Risk
PPV	Plum Pox Virus

POW	Plan of Work
TB	tuberculosis
TOPC	Thumb Oilseed Producers Cooperative
USDA	United States Department of Agriculture
VPRGS	Vice President for Research and Graduate Studies

Goal 1: An Agricultural Production System that is Highly Competitive in the Global Economy

Summary

When all aspects of production, processing and retail operations are considered, Michigan's agriculture industry remains alive and strong, adding nearly $40 billon to the economy. Ranking second in the state, the food and agriculture industry remain one of the most stable in economic terms for Michigan, employing more than 500,000 people every year. Also reported in economic studies, Michigan's forestry ranks as the state's third major industry.

Michigan's agriculture is impressively diverse, and nationally ranks third behind California and Florida in number of crops grown. Soybeans and corn are the No. 1 and 2 cash crops grown in the state. Flourishing in western Michigan are floriculture, nursery, and fruit crops due to the ideal climate and soil conditions supported by the surrounding Great Lakes. In addition, southeastern Michigan boasts large numbers of turf and nursery operations. The Thumb region provides model conditions for dry beans and sugar beets. According to the MDA in economic terms, Michigan ranks in the top five producing states for 35 crops. The state is the No. 1 producer of several types of dry beans, blueberries, cucumbers for pickles, tart cherries, Easter lilies, and summer potatoes. These specialty crops require specific growing techniques and research, and in the end contribute to the state's agricultural strength.

Animal agriculture accounts for half of Michigan's agricultural income and provides more than 56,000 jobs. It includes dairy, hogs, cattle, sheep, eggs, horse racing, pleasure and sport riding, turkey operations, dairy and meat processing plants, and grain and forage crops.

The Michigan Department of Natural Resources reports that forests cover 53 percent of the land area in the state, or about 19.3 million acres. These forests are a critical component of Michigan's environment and economy for the recreational opportunities and the products they provide. Forestry related industries and manufacturing employ 150,000 people statewide and annually contribute $9 billion to the state's economy. Also supporting Michigan, the forest-based tourism and recreation provide 50,000 jobs and add $3 billion to the economy. Michigan's forests contribute to clean air and water, and reduce soil erosion.

Allocated resources

Hatch funds	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
Hatch regular	2,307,170	2,261,026	2,215,806	2,171,490	2,128,060	2,085,499
Multi-state funds	540,900	540,900	540,900	540,900	540,900	540,900
Other CSREES Funds*	5,715,837	5,715,837	5,715,837	5,715,837	5,715,837	5,715,837
Other Federal Funds*	11,552,480	11,552,480	11,552,480	11,552,480	11,552,480	11,552,480
Total Federal Funds (est.)	20,116,387	20,070,244	20,025,023	19,980,707	19,937,277	19,894,716
State match for Hatch funds	2,848,070	2,801,926	2,756,706	2,712,390	2,668,960	2,626,399
Remaining state appropriations	19,122,892	18,290,196	14,749,756	14,794,072	14,837,502	14,880,063
Self generated funds*	2,691,241	2,691,241	2,691,241	2,691,241	2,691,241	2,691,241
Industry generated funds*	5,049,229	5,049,229	5,049,229	5,049,229	5,049,229	5,049,229
Other non-federal funds*	2,342,430	2,342,430	2,342,430	2,342,430	2,342,430	2,342,430
Total State Funds (est.)	32,053,863	31,175,024	27,589,363	27,589363	27,589,363	27,589,363
Total Estimated Funds	52,170,250	51,245,268	47,614,386	47,570,070	47,526,641	47,484,079
Scientist years	86.4	86.4	86.4	86.4	86.4	86.4

*values extracted from Fiscal Year 2002 funds and Manpower report

1. Improving the financial decision-making, financial instruments, and financial market information in agriculture.

Key theme: Risk management

A. Brief Description: Michigan's agricultural sector accounts for $40 billion to our economy and more than 500,000 jobs. Researchers identified a method to disseminate financial information via the Internet to producers for the development of marketing plans including revenue enhancement and risk management.

B. Accomplishment Statement: The Internet site developed by the researchers continues to be one of the MSU's College of Agriculture and Natural Resources most frequently "hit" sites.

This research provided producers, lenders, crop insurance vendors, grain marketing companies, and federal insurance facilitators information on the financial risk along with pre-harvest pricing strategies. It also indicated the products that best fit different environments.

The most recent research focused on changes in the Federal Crop Insurance Legislation and assisted producers to reformulate their risk management strategies accordingly. The premium volume for this component of the insurance sector is about $4 billion and the liability insured is over $50 billion.

The research also contributed to the development of new crop revenue insurance product designs for specialty crops such as those grown in Michigan. This program was extended to other markets with the potential liability of over $10 billion.

The Risk Management Agency/USDA included this research in policy discussions ranging from input to strategic planning for the Risk Management Agency board of directors.

C. Source of Funding: see table for Goal 1.

D. Scope of Impact: MI, Risk Management Agency/USDA, Federal Crop Insurance Agency

2. Improving Michigan's potato industry through late blight forecasting and weather monitoring.

Key theme: Agricultural profitability

A. Brief Description: Michigan's 50,000 acres of potatoes are worth more than $100 million annually, and are quite often infected with late blight, the No. 1 disease worldwide. Results of this study showed late blight risk significantly increased in the Great Lakes Region over the years.

This growing problem is compounded by the demand to reduce chemical input in agricultural systems. MSU researchers developed a computer system providing daily statewide late blight risk potential data by calculating disease severity values and identifying appropriate fungicide application rates.

B. Accomplishment Statement: In 2001 and 2002, Michigan growers using the model reduced the amount fungicide input by $60 per acre.

Applications of predictive models allow growers to consider comprehensive risk, both current and future, when making management decisions.

Predictive services and results were also implemented in Ontario, Rwanda, Mexico, Northern Ireland and Brazil.

C. Source of Funding: see table for Goal 1.

D. Scope of Impact: MI, ND, MN, WI, BASF, Syngenta, Dow, Bayer, Dupont, Agraquest, ISK, Sipcam, Frito-Lay, Nufarm, Michigan Potato Industry Commission, National Potato Council, USDA, MDA, and Michigan Vegetable Council, and MSUE.

3. Genetic engineering of oilseed crops.
Key theme: Agricultural profitability

A. Brief Description: Plant oils are the dominate source of renewable reduced-carbon chains available from nature. In western diets, vegetable oils constitute approximately 25 percent of all calories consumed, with worldwide consumption reaching over 90 billion pounds at a value of $50 billion.

   The demand for vegetable oils is expected to grow substantially, due to increased consumption by humans in developing nations and their industrial use as petrochemical replacements. Even at a minimal 1 percent increase, oilseed production would add several hundred million dollars to agricultural income.

B. Accomplishment Statement: the MAES scientists successfully mapped the genes involved in controlling oil content within the seeds. This discovery allows for increased oil production meeting the growing worldwide demand.

   The discovered genes were patented and the technology licensed to Monsanto.

C. Source of Funding: see table for Goal 1.

D. Scope of Impact: MI, Washington State, Brookhaven, Danforth Center, and Oilseed Engineering Alliance, Dow Chemical and Dow AgroSciences.

4. Developing starch-based microcellular foamed bioplastics.
Key theme: Biobased products

A. Brief Description: Plastic is the principal construction material in most consumer products. The strong dependency on petroleum-based plastic comes with an increasing risk to our economy, environment, and individual health.

   Plastic is synthesized from non-renewable petrochemicals, are sensitive to the price of oil, and a burden on waste management because of the inherent non-biodegradability. In addition, the intermediates and catalysis utilized in making plastic have been shown to have adverse effects on health, particularly children.

MSU researchers developed a material to substitute for foamed polystyrene, polyethylene, and polyurethane in the packaging industry. Currently the total sale of foamed packing material in the U.S. reaches $15 billion, requires landfill management, and is costly to recycle.

B. Accomplishment Statement: The biodegradable, starch-based material designed requires no need for costly recycling and has a smaller impact on our global climate since it is disposed of by water exposure, and then degraded by microbial and fungal action in the environment.

   KTM Industries in Lansing signed an agreement to commercialize the developed material.

C. Source of Funding: see table for Goal 1.

D. Scope of Impact: MI

5. Evolving pathogens, targeted sequences, and strategies for control of bovine respiratory disease.

Key theme: Animal health

A. Brief Description: Bovine respiratory disease (BRD) is one of the most important disease problems facing the cattle industry. BRD results in annual losses of more than $3 billion to the US cattle industry.

   Developing approaches to control BRD requires a coordinated research effort investigating multiple aspects of this disease complex. Areas of study included identifying and characterizing emerging and reemerging pathogens, improvement of surveillance and detection methods, and development of intervention strategies for critical control points to reduce impact of BRD.

   To reduce BRD, MAES scientists studied immunohistochemistry (IHC), an early detection method in neonatal calves that are persistently infected (PI) with bovine viral diarrhea virus (BVDV). Detection and elimination of PI cattle with BVDV is an important strategy for controlling the transmission of this virus.

B. Accomplishment Statement: The usefulness of IHC for identifying neonatal calves persistently infected with BVDV was evaluated and determined to be very accurate. The use of IHC to identify PI calves was economical and strategically beneficial for the early elimination. IHC costs 50 percent less than traditional methods used for identifying PI cattle with BVDV. Since making this technology available at MSU's diagnostic

laboratory, submissions of skin samples to identify PI calves increased substantially.

PI cattle with BVDV shed large amounts of virus and are the major source of virus transmission and impact the performance of cohort feedlot cattle by increasing morbidity and decreasing average daily gain. Results showed treatment costs per calf averaged $4 per head for calves not exposed to BVDV while treatment costs for BVDV exposed calves averaged $8 per head for vaccinated calves and $14 per head for non-vaccinated calves. Antibiotic use was also reduced. Based on this research, support was generated in the industry for the implementation of stronger BVDV control programs that leading to the eradication of the virus.

C. Source of Funding: see table for Goal 1.

D. Scope of Impact: MI, AL, IA, IL, KS, MN, OK, SD, TX, CA, CO, GA, IL, MS, LA, MO, NE, OH, WI, NADC, and American Association of Veterinary Laboratory Diagnosticians

Goal 2: A Safe and Secure Food and Fiber System

Summary

Food safety continues to top the list of important issues in the United States. Over the past decade the United States is not only concerned with our own food safety, but also that of our global community since many food products come from all over the world. This has created a need to monitor and check foodstuffs before and after they are shipped, not only within the United States, but also internationally.

Diseases and pests affect the human food supply as well as jeopardize the plants and animals supplying the food. Being proactive and vigilant with relevant research, MAES scientists work to develop tools to detect pathogens before they infect the population, educate, and implement their research to control the problems.

The concept of risk plays an important role in understanding food safety. MSU is home to the National Food Safety and Toxicology Center (NFSTC), and several MAES researchers affiliated with NFSTC are using risk assessment tools as a framework to assess risks associated with food.

Allocated resources

Hatch funds	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
Hatch regular	320,778	329,812	338,748	347,506	356,088	364,499
Multi-state funds	117,160	117,160	117,160	117,160	117,160	117,160
Other CSREES Funds*	904,777	904,777	904,777	904,777	904,777	904,777
Other Federal Funds*	11,552,480	11,552,480	11,552,480	11,552,480	11,552,480	11,552,480
Total Federal Funds (est.)	5,590,105	5,599,138	5,608,075	5,616,832	5,625,415	5,633,825
State match for Hatch funds	437,939	446,972	455,908	464,666	473,248	481,659
Remaining state appropriations	2,464,130	2,339,014	1,856,460	1,847,703	1,839,120	1,830,709
Self generated funds*	140,799	140,799	140,799	140,799	140,799	140,799
Industry generated funds*	574,546	574,546	574,546	574,546	574,546	574,546
Other non-federal funds*	505,408	505,408	505,408	505,408	505,408	505,408
Total State Funds (est.)	4,122,822	4,006,739	3,533,122	3,533,122	3,533,122	3,533,122
Total Estimated Funds	9,712,927	9,605,878	9,141,196	9,149,954	9,158,536	9,166,947
Scientist years	11.6	11.6	11.6	11.6	11.6	11.6

*values extracted from Fiscal Year 2002 funds and Manpower report

1. Safeguarding the supply of specialty crops for the consumer.
Key theme: Food quality

A. Brief Description: The complexity of pest problems in Michigan and other fruit production states led to a pest management system highly dependent on broad-spectrum insecticides. In order to prevent losses in yield or rejection of the entire crop due to insect feeding, Michigan fruit growers annually spend at least $20 million to protect more than 100,000 acres of tree fruit.

   Tree fruit are grown widely and are economically important to United States agriculture. Michigan is the leading fruit production state in the Midwest with apples, tart cherries, sweet cherries, peaches, pears, and plums having a combined farm-gate value of close to $200 million. Michigan produces over 75 percent of the United States' processed cherries and 70 percent of the world's. In addition, Michigan ranks in the top three states in apple production.

   At least a dozen insect pests that directly feed on the crops must be controlled to maintain adequate yields of fruit acceptable to our consumers. If left unchecked, the pests could reduce marketable fruit yield by in the United States by 80 to100 percent.

   New regulations governing pesticides and increasing resistance of key pests to insecticides created uncertainty as to the availability of many broad-spectrum insecticides. MAES researchers developed a novel, innovative control tactic to produce high quality fruit through environmentally sound, safe, and effective methods.

B. Accomplishment Statement: MAES scientists developed, tested, and delivered to growers improved monitoring systems for several key fruit pests including plum curculio, apple maggot, and cherry fruit fly.

   Various mating disruption products proved to be effective for the control of several key lepidopteran pests of cherries, apples and peaches either alone or in combination with a reduced insecticide program. Four new mating disruption products were introduced into the marketplace in 2002 with more than 3,000 acres being treated in Michigan.

   Attractant-baited circle traps were developed for monitoring plum curculio and used by consultants to monitor the pest in apples, cherries, and peaches.

   In addition, by incorporating reduced-risk control options into their growing programs, Michigan apple producers reduced insecticide and miticide use by an average of 28 percent. This included a 28 percent and

37 percent reduction in the use of organophosphate and carbamate compounds, respectively.

C. Source of Funding: see table for Goal 2.

D. Scope of Impact: MI, MA, NY, PA, NJ, WV, NC.

2. Reduce hazard incidences with apple juice products and improve viability of apple juice processing plants.

Key theme: Food safety

A. Brief Description: New federal regulations require hazard analysis and critical control point (HACCP) procedures be adopted by juice processors in order to control the biological, chemical and physical hazards associated with these products.

MAES scientists in cooperation with the Michigan Department of Agriculture and their inspectors randomly sampled juice products from processing plants and retail food stores. In addition, surveys were conducted with apple juice processors to determine production and processing practices during manufacturing, and then a second survey was also completed to assess the processor's perceptions and attitudes toward HACCP regulations and food regulations in general. A web-based survey of consumer perceptions regarding juice safety was also conducted.

B. Accomplishment Statement: The information identified the prevalence of microbiological hazards in juice products, identified barriers to HACCP implementation, and provided training materials and hazard information for the industry.

The research resulted in the development and implementation of three juice industry HACCP training courses, which had a total of 100 juice processors in attendance during 2002 working to ensure a safe product. Upon completing these training courses, the industry leaders are integrating the materials into their businesses. The training materials for future juice HACCP training courses are being modified to align with the FDA-recognized standardized curriculum.

C. Source of Funding: see table for Goal 2.

D. Scope of Impact: MI, FDA

3. Measuring the occurrence and effects of microbial food-borne diseases.

Key theme: Foodborne illness

A. Brief Description: United States crop losses from mycotoxins are annually estimated at $932 million. There is potential for mycotoxin-related illnesses to contribute to some of the outbreaks of unknown etiology. These unknown agents account for 62 million illnesses, 265,000 hospitalizations, and 3,200 deaths.

   Research began with the development of a novel ELISA for the rapid detection of the zearalenone, a mycotoxin with estrogenic and carcinogenic properties, and was successfully applied to corn. Zearalenone can now be detected at the grain elevator level, potentially protecting consumers throughout the world from a harmful naturally occurring food-borne toxin.

B. Accomplishment Statement: Results are being used for hazard assessment of mycotoxins by the Joint Expert Committee on Food Chemicals and Additives of the World Health Organization and Food Agricultural Organization in the establishment of CODEX standards for mycotoxins.

   Long-term this research contributes to the enhanced knowledge of specific hazards associated with mycotoxin exposure used in the risk assessment for humans and animals.

C. Source of Funding: see table for Goal 2.

D. Scope of Impact: MI, Food Agricultural Organization, and Joint Expert Committee on Food Chemicals and Additives of the World Health Organization

4. Enhanced control over quality loss in horticultural commodities after harvest.

Key theme: Food quality

A. Brief Description: MAES scientists have evaluated numerous strategies to improve quality after harvest for horticultural commodities like apples, blueberries, onions, raspberries, tomatoes, and cherries. Strategies developed include harvest management tools, the use of controlled-atmosphere (CA) storage, modified-atmosphere packaging (MAP), anti-microbial atmospheres, and the use of the ethylene action inhibitor 1-methylcyclopropene (1-MCP).

B. Accomplishment Statement: Research on apple maturation resulted in the creation of weekly fruit maturation data being communicated to apple growers during harvest season. Information was utilized by growers to better time apple harvest and storage operators to make informed decisions for storing apple fruit.

MSU was the first to recognize the sensitivity of Empire apples to low levels of CO_2 and then developed the storage standards followed by Michigan and other apple industries.

In addition, MSU was the first to determine the low temperature sensitivity of the Honeycrisp™ apples and recommend appropriate storage temperatures. Currently, Honeycrisp™ apples have a greater return per bushel than any other apple variety grown in Michigan. Honeycrisp's™ anticipated loss reduction of 10 to 80 percent is possible because of their utilization of MSU's recommended storage temperatures.

Storage temperatures were developed for blueberry and onion. MAES scientists were instrumental in developing an approach to store Vidalia onions in CA storage, creating a new industry for the Georgia-grown vegetable.

The researchers evaluated the inclusion of antimicrobial natural volatiles in storage atmospheres. These volatiles are metabolized by the product into harmless or even beneficial compounds. Hexanal gas was used at low concentrations to prevent apple decay and is converted by the apple to aroma compounds. A patent has been granted for this concept.

The 1-MCP was measured on maintaining the quality of broccoli, tomato, and apple. Significant improvement in quality maintenance was determined and approved by the EPA in 2002. The use of 1-MCP may displace the use of CA storage, given the fact that 1-MCP can control the development of superficial scald and allows for the elimination of antioxidants and fungicides. Antioxidants and fungicides are the most common residues found on apples. 1-MCP has no detectible residue. Assuming 25 percent of the Michigan apples utilized 1-MCP application, which substitutes for CA storage and avoids the use of antioxidant and fungicide, Michigan apple growers would experience approximately $1.2 million in returns annually.

C. Source of Funding: see table for Goal 2.

D. Scope of Impact: MI, GA, NY, PA

5. Optimizing the safety, yield, and quality of value-added protein foods.
Key theme: Food quality

A. Brief Description: Commercial cooking systems in the meat and poultry industry need to meet two competing objectives: (1) ensure the microbial safety of the products and (2) maximize the processing yield and economic return for ready-to-eat (RTE) products. Unfortunately, the

current state-of-knowledge is insufficient for reliable lethality predictions for products in commercial processes. Additionally, the design and operation of these systems are generally based on prior experience, rather than science-based methodologies. Therefore, processors are generally compelled to include a large margin of safety in their processes, rather than take significant risks associated with the uncertainty in process outcomes. Over-processing results in a loss of product yield, and therefore economic return.

The MAES scientists developed improved methods for the design and operation of thermal processing systems for protein foods, based on the criteria of microbial safety, processing yield, and product quality.

B. Accomplishment Statement: The most significant accomplishment related to the processing model was the development and commercial-scale validation of a fundamental model enabling food processors and equipment manufacturers to predict dynamic oven performance characteristics prior to running any actual tests. The model is currently being used by the largest supplier of commercial impingement ovens to the poultry industry.

Related to pathogen inactivation, uniquely designed laboratory-based tests revealed that process humidity does not directly affect pathogen inactivation in convection cooking systems, which contradicts speculations in previously published work. Rather, it appears that the product water activity (a function of moisture content) is the controlling factor; the rate of thermal inactivation decreases as the meat water activity decreases. Secondly, although it is commonly assumed that the interior of an intact, whole-muscle meat product is free of pathogens; conclusive results showed significant potential for pathogens to migrate into the interior region of vacuum marinated products. Preliminary results show significantly greater heat resistance for Salmonella in these products, as compared to Salmonella in ground products. Both of these findings enable more accurate predictions of process lethality for commercially processed, ready-to-eat meat and poultry products.

A computer simulation, heat transfer model was created based on fundamental principles of heat and mass transfer, was validated in commercial-scale cooking trials conducted with beef patties at a corporate partner. The model is currently being refined to improve the accuracy of the yield predictions, and an optimization protocol is being developed in order to use the final cooking/lethality model to optimize multi-stage convection cooking systems.

Short courses have been taught at various institutions and at FMC FoodTech where results of this research project were incorporated into industry training materials.

The United States meat and poultry industry contributes more than $90 billion in annual sales, and RTE products account for more than $28 billion in annual sales. The high value of products in this category makes even small increases in cooking yield highly profitable. It is conservatively expected that more reliable process design and operation, made possible by the models developed in the project, will enable a 0.5 percent improvement in processing yield, while simultaneously ensuring product safety. Although this seems like a modest improvement in yield, it would translate into an additional $140 million increase in annual revenue for RTE products in the U.S.

C. Source of Funding: see table for Goal 2.

D. Scope of Impact: FMC FoodTech (Stein-DSI), USDA-ORACBA, USDA-ARS, OH, AR

Goal 3: A Healthy, Well-Nourished Population.

Summary

Beyond the diversity of our nation, lies a universal truth: everyone needs to eat. What people don't eat is just as important as what they do. The importance of eating a well balanced diet throughout life is emphasized in projects conducted by MAES researchers. Implementing the results collected from their research could make a significant impact on the health of Michiganians, with national and global implications.

Though the link between poor diet and health problems such as hypertension, obesity, some cancers, and heart disease is well documented, the majority of people in the United States still eat too much fat and sugar and not enough fruit and vegetables.

Finding the answers to the immediate questions of "Why?" and "How can this be changed?" is the driving force behind many MAES scientist's research. The MAES has one main thrust in this area – food and nutrition.

Allocated resources

Hatch funds	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
Hatch regular	112,485	115,652	118,786	121,857	124,866	127,816
Multi-state funds	39,281	39,281	39,281	39,281	39,281	39,281
Other CSREES Funds*	94,628	94,628	94,628	94,628	94,628	94,628
Other Federal Funds*	878,384	878,384	878,384	878,384	878,384	878,384
Total Federal Funds (est.)	1,124,777	1,127,945	1,131,079	1,134,149	1,137,159	1,140,108
State match for Hatch funds	151,765	154,933	158,067	161,138	164,147	167,096
Remaining state appropriations	1,214,621	1,156,798	930,670	927,599	924,589	921,640
Self generated funds*	18,918	18,918	18,918	18,918	18,918	18,918
Industry generated funds*	330,389	330,389	330,389	330,389	330,389	330,389
Other non-federal funds*	246,186	246,186	246,186	246,186	246,186	246,186
Total State Funds (est.)	1,961,879	1,907,224	1,684,229	1,684,229	1,684,229	1,684,229
Total Estimated Funds	9,712,927	9,605,878	9,141,196	9,149,954	9,158,536	9,166,947
Scientist years	4.8	4.8	4.8	4.8	4.8	4.8

*values extracted from Fiscal Year 2002 funds and Manpower report

1. Nutritional assessment comparing carbohydrate intake to diabetes risk.
Key theme: Human health

A. Brief Description: As public interest heightens and new research findings look at the correlation of diet and chronic diseases, many more new questions are posed. One of the new questions is whether carbohydrate intake is associated with the increasing incidence of diabetes.

   Michiganians have a high prevalence of risk factors and predictors for diabetes. The MAES scientists assessed the dietary intake patterns and validity of food group score systems in assessing nutritional and health risks.

B. Accomplishment Statement: Utilizing national, statewide, and local nutrition surveillance program databases, as well as previously published reports, the MAES scientists assessed the carbohydrate intake to diabetes risk. Their efforts found no clear association between carbohydrate intakes and diabetes.

C. Source of Funding: see table for Goal 3.

D. Scope of Impact: MI

2. Influence of tart cherry phytochemicals (anthocyanins) on colon cancer risk.
Key theme: Health care

A. Brief Description: Colon cancer continues to be a predominant chronic disease in the United States and worldwide. It is believed that diet plays a major role in the etiology of colon cancer and its prevention. MAES scientists conducted experiments to determine the potential of tart cherry anthocyanins to reduce colon cancer risk.

B. Accomplishment Statement: MAES research indicated that inclusion of the foods such as tart cherries rich in phytochemicals (anthocyanins) may have the potential to reduce or prevent colon cancer. Results showed that mice receiving the anthocyanin-containing diet had significantly fewer cecal and colonic adenomas volumes. These results have implications for adults who have colon cancer. This information is consistent with trends linking food intake with human health, and complements the anti-inflammatory action seen in cherry products such as concentrates and pills. This and other food and health research has helped establish a food and health program at Michigan State University.

C. Source of Funding: see table for Goal 3.

D. Scope of Impact: MI

3. Metabolism and function of vitamin A on avian embryonic heart development.

Key theme: Human nutrition

A. Brief Description: Congenital heart abnormalities in the western industrialized world are as high as 12 out of every 1000 live births, and pediatric cardiovascular abnormalities account for 8 percent of all deaths during the first year of life, yet the etiology of these abnormalities remains unknown. Clinical data confirms that nutritional and dietary deficiencies such as a vitamin A deficiency contribute to birth defects. MAES research led to improving the understanding of how vitamin A functions at the early stages of avian embryonic development in order to have a normal, healthy infant population. Early embryonic heart development in the avian is comparable to that of a human.

B. Accomplishment Statement: MAES findings showed that critical vitamin A-dependent developmental events are initiated in the first two to three weeks of embryonic development. The avian embryonic development was seriously compromised when maternal vitamin A intake was marginal or if there was an interference with vitamin A function during pregnancy.

   Information gathered by MAES scientists clarified vitamin A requirements and provided a framework for informing and advising health and nutrition professional on the importance of vitamin A during pregnancy.

C. Source of Funding: see table for Goal 3.

D. Scope of Impact: MI, worldwide

4. Relationship of dry bean diet and colon cancer.
Key theme: Human health

A. Brief Description: Beans are an important food staple in the diet of many populations worldwide. While providing a good source of dietary fiber, nutrients, and proteins, beans may have the capability of inhibiting colon cancer. The MAES study was to determine if bean consumption would reduce colon cancer.

B. Accomplishment Statement: MAES scientists concluded that rats fed beans had a 50 percent reduction in the incidence of colon cancer when compared to the control rats. In addition, the bean fed rats were much thinner than those rats not fed beans because of the bean's slower digestion process creating the feeling of fullness longer.

   Based on overwhelming national and international support of this research a commitment was made to establish a Global Developmental Alliance to promote globally the health and nutritional benefits of beans utilizing the

research collected by MAES scientists. Consumers will be educated as to the benefits of beans, especially their important roles in child survival and slowing the progression of HIV/AIDS, through coordinated international educational and promotional efforts.

C. Source of Funding: see table for Goal 3.

D. Scope of Impact: MI, Africa, Bean/Cowpea CRSP, Michigan Dry Bean Commission, USAID, American Dry Bean Board, National Dry Bean Council.

5. Enhancing the value of dairy and dairy-based products.
Key theme: Human health

A. Brief Description: While milk is recognized for the important role it plays in a balanced diet and serves a good source of nutrients, scientific studies are still needed to substantiate the benefits of fermented dairy products such as yogurt and cheese. MAES research investigated the benefits resulting from the consumption of fermented dairy products and the probiotics contained in them, which are typically lactic acid bacteria and bifidobacteria.

B. Accomplishment Statement: Results indicate that the human immune system may be reprogrammed by the consumption of the fermented dairy products. The data reported the products health benefits and has contributed to the rapid increase in their sales and consumption in the U.S. and around the world resulting in an increase of 6.6 percent per year for yogurt sales in the U.S. The cultured milk products were shown to improve nutrition by improving lactose utilization, controlling serum cholesterol levels and competing with pathogens.

C. Source of Funding: see table for Goal 3.

D. Scope of Impact: MI, UDIM, U.S., New Zealand, Rhodia, Sanofi, Rhone Poulenc, Chris, Hansens, National Honey Board, USDA, National Dairy Council

Goal 4: Greater Harmony Between Agriculture and the Environment.

Summary

The term "sustainable agriculture" became commonplace during the 1980's. Although it can mean many different things to many people, most can agree that sustainable agriculture provides producers with a just income, provides consumers with a dependable, safe, nutritious food supply while having a minimal negative impact on the environment. Sustainable agriculture means managing the various systems through understanding and integration.

At MSU, there is not an isolated sustainable agriculture program. Biological integration is a theme that runs through many MAES programs and is important to everyone.

MAES believes in the support and creation of harmony between agriculture and the environment. The main areas of focus are plants' response to biotic and abiotic stress, and environmental stewardship managing apple pesticides. MAES scientists and producers are looking for methods that will not only improve agriculture, but their environment.

Allocated resources

Hatch funds	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
Hatch regular	995,586	1,023,623	1,0551,358	1,078,538	1,105,175	1,131,280
Multi-state funds	184,556	184,556	184,556	184,556	184,556	184,556
Other CSREES Funds*	2,909,688	2,909,688	2,909,688	2,909,688	2,909,688	2,909,688
Other Federal Funds*	5,794,906	5,794,906	5,794,906	5,794,906	5,794,906	5,794,906
Total Federal Funds (est.)	9,884,736	9,912,773	9,940,508	9,967,688	9,994,325	10,020,429
State match for Hatch funds	2,848,070	2,801,926	2,756,706	2,712,390	2,668,960	2,626,399
Remaining state appropriations	19,122,892	18,290,196	14,749,756	14,794,072	14,837,502	14,880,063
Self generated funds*	519,201	519,201	519,201	519,201	519,201	519,201
Industry generated funds*	1,713,042	1,713,042	1,713,042	1,713,042	1,713,042	1,713,042
Other non-federal funds*	3,721,662	3,721,662	3,721,662	3,721,662	3,721,662	3,721,662
Total State Funds (est.)	13,662,935	13,354,574	12,096,460	12,096,460	12,096,460	12,096,460
Total Estimated Funds	23,547,671	23,267,346	22,036,968	22,064,148	22,090,785	22,116,890
Scientist years	38.1	38.1	38.1	38.1	38.1	38.1

*values extracted from Fiscal Year 2002 funds and Manpower report

1. Minimizing the impact of plant diseases on field crops.

Key theme: Nutrient management

A. Brief Description: Since the mid 1990s the wheat industry has experienced significant economic losses due to the disease Fusarium head blight (FHB), which results in the contamination of grain by a mycotoxin called vomitoxin. In 1996, the Michigan wheat industry lost $56 million. Overall, the U.S. wheat crop has experienced losses exceeding $1 billion, not including the cost of fungicides or the cost of vomitoxin testing by wheat buyers to insure vomitoxin does not get into the feed or food chain. MAES researchers compared the pre and post harvest vomitoxin levels in fields, evaluated the FHB prediction model, and evaluated fungicides for reducing vomitoxin and FHB.

B. Accomplishment Statement: MAES scientists collaborated their research efforts with other affected states. The result identified the most efficacious fungicides, and the best timing for application and growers have adopted based on these recommendations. In addition, a disease prediction model developed by the Ohio State University was evaluated in Michigan and helped producers in deciding when to spray or not spray fungicides. The research also identified wheat varieties with higher levels of resistance. Based on the recommendations made by MAES, an ELISA was developed to assay wheat for vomitoxin, and is being marketed by Neogen Corporation. Both the sampling procedure and the ELISA were accepted by the industry as standards for insuring a safe supply of wheat.

C. Source of Funding: see table for Goal 4.

D. Scope of Impact: MI, ND, SD, MN, IN, OH, NY, VA, KY

2. Identifying weather and climate impacts on Michigan agriculture.
Key theme: Weather and climate

A. Brief Description: Weather and its long-term variant climate remain among the most important uncontrollable variables affecting plant-based agriculture in the Upper Great Lakes Region (MI, WI, MN). Since 2000, the farm gate value of annual and perennial crops across the region averages more than $10.4 billion per year, and all three states rank among the top 20 producing states nationally in most crop categories.

   The amount of rainfall and the availability of soil moisture were identified as primary climatological constraints for the production of most crops. However, other climate-related factors such as abnormally cold springs, cold, wet weather during harvest, and growing season length were also important. MAES researchers investigated the historical and projected future impacts of climate on three key crops in the region: corn, soybean, and alfalfa.

B. Accomplishment Statement: Several trends were identified in the historical simulations. Across the mid-season study period, increases were found in growing season precipitation and soil moisture available to plants as key variables in determining ultimate yield potential. In contrast, simulated potential evapotranspiration was found to have decreased. As a result of the trends toward wetter, less stressful conditions, yields in both corn and soybean across the majority of stations in the region increased.

Simulated yield increases were due to both the effects of CO_2 enrichment and more favorable growing season weather especially in northern sections of the region. The simulations also suggest that the amount of water from soil storage necessary to meet crop demands will decrease, making in-season water shortages (and moisture stress) less likely than in the past.

Results from the historical and future crop model simulations, while not forecasts of future conditions in the region, help the agriculture industry identify potential agronomic impacts associated with projected climate change and guide future research efforts dealing with adaptation and mitigation strategies. Growers and crop insurance agents can utilize the information to help identify weather-related risk.

C. Source of Funding: see table for Goal 4.

D. Scope of Impact: MI, WI, MN

3. Evaluation of atrazine as an endocrine disruptor in the environment.
Key theme: Riparian management

E. Brief Description: Atrazine is a widely used broadleaf herbicide used to protect corn from weed competition and result in significant increases in production. In 1995, 33,000 metric tons of atrazine were used in the United States with 85 percent used on corn.

Atrazine is generally applied to crops in the spring when amphibians are congregating and preparing for the breeding season. The aquatic environment is exceptionally susceptible because water is the universal solvent and contaminants can enter from runoff from urban and agricultural landscapes as well as in effluents from industries and municipal treatment works.

Exposure of amphibians to atrazine is of particular concern when agricultural fields are adjacent to wetlands. In such cases, agricultural runoff can potentially expose frogs to greater concentrations of atrazine. It

has been suggested that atrazine may function as an endocrine disrupting chemical in amphibians.

Endocrine "disruption" by environmental contaminants has become a cause for concern. In addition, the endocrine disrupter issue has brought agricultural chemicals, especially herbicides and some fungicides under additional scrutiny.

B. Accomplishment Statement: The MAES scientists worked to provide regulators and growers with unbiased information, to make rational decisions about the safety of atrazine as an agricultural chemical.

The national debate has centered on the issues of relative safety, risks, and benefits. The EPA's decision on the future use of atrazine will have a large impact on the economy of the country, but in particular on corn producers in the Midwest. It is estimated that if atrazine were not used it would have a $1 trillion impact on the U.S. economy. Thus, it is important to know the ecological risks and the magnitude of our current atrazine practices.

MAES research focused on developing both instrumental and bioanalytical methods to identify and quantify endocrine disrupting compounds in the environment. This information can then be used to conduct risk assessments to determine if agrochemicals can be used to protect crops and increase production without causing unacceptable harm to the environment.

Reports outlining the research will be provided to the EPA for its deliberations regarding the re-registration of atrazine. The results indicate that while atrazine can have adverse effects on plants and animals, the concentrations observed in the environment were seldom sufficient to cause serious adverse effects on humans, wildlife or environments. The results found that exposure to atrazine did not affect the incidence of gross gonadal abnormalities, and the atrazine-exposed frogs were not significantly different from the controls.

C. Source of Funding: see table for Goal 4.

D. Scope of Impact: MI, OH, IN, IL, WI, MN, US EPA

4. Determining the response of drought on the common bean.
Key theme: Nutrient management

A. Brief Description: Nine genotypes of common bean were tested to determine their response to drought. Researchers were in quest of ultimately determining if root growth of tolerant genotypes differed from that of susceptible genotypes.

B. Accomplishment Statement: Results showed water deficit significantly reduced root growth in all root width classes. Results of the studies led to development of a theoretical scheme for considering genotypic performance in yield, total root length, and geometric mean, which then generates a ranking with regard to drought tolerance. Based on the information gathered by MAES researchers reported root length as an important criterion to consider in the drought tolerance selection process.

   This information would then be the building block for future studies to gain a greater understanding of the differing patterns of root growth in dry bean growth habits.

   The research also contributed to the development of the "growth pouch," providing a relatively easy, fast, and reliable method for assessing root growth and could be a great aid for screening root growth in plant breeding programs.

C. Source of Funding: see table for Goal 4.

D. Scope of Impact: MI, Croix, U.S.V.I., Bean/Cowpea Collaborative Research Support Program

5. Assess impact of nitrogen loss in row crop agriculture.
Key theme: Nutrient management

A. Brief Description: MAES scientists were to expand the understanding of row-crop agriculture and how it reacts to changes in global trace gases. Such gases as nitrous oxide, methane and carbon dioxide can be altered through agronomic activity. The research identified the crop-level differences in fluxes, quantified short-term temporal dynamics, and processed specific controls on fluxes.

B. Accomplishment Statement: The results offer excellent means to further reduce the global warming potential of agriculture systems.

C. Source of Funding: see table for Goal 4.

D. Scope of Impact: MI, worldwide

Goal 5: Enhanced economic opportunity and quality of life for Americans.

Summary

The MAES mission has always included rural families and communities, and economic development. Issues such as quality childcare, safe housing, good schools and nutritious food are critical to all Michigan citizens. Information on the best practices for making and evaluating program decisions, as well as training is important to both community organizations and policymakers.

Everyone in Michigan aspires for economic growth and prosperity, which are closely linked to development. At the same time, everyone also wants a clean, healthy environment, with plentiful safe food and water for all. Natural areas for wildlife and vegetation, room to get away, green areas for children to play, and enough room for everyone to live comfortably are important aspects to consider as well.

The MAES is committed to our children, youth, families, and communities; farm management; natural resources initiatives; and leadership programs.

Allocated resources

Hatch funds	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
Hatch regular	193,957	199,419	204,822	210,117	215,307	220,392
Multi-state funds	53,539	53,539	53,539	53,539	53,539	53,539
Other CSREES Funds*	1,062,315	1,062,315	1,062,315	1,062,315	1,062,315	1,062,315
Other Federal Funds*	244,446	244,446	244,446	244,446	244,446	244,446
Total Federal Funds (est.)	1,554,256	1,559,718	1,565,122	1,570,417	1,575,606	1,580,692
State match for Hatch funds	247,496	252,958	258,361	263,656	268,846	273,931
Remaining state appropriations	1,814,450	1,726,511	1,384,598	1,379,303	1,374,113	1,369,027
Self generated funds*	12,771	12,771	12,771	12,771	12,771	12,771
Industry generated funds*	81,424	81,424	81,424	81,424	81,424	81,424
Other non-federal funds*	427,725	427,725	427,725	427,725	427,725	427,725
Total State Funds (est.)	2,583,865	2,501,387	2,164,878	2,164,878	2,164,878	2,164,878
Total Estimated Funds	4,138,121	4,061,106	3,729,999	3,735,294	3,740,484	3,745,569
Scientist years	8.0	8.0	8.0	8.0	8.0	8.0

*values extracted from Fiscal Year 2002 funds and Manpower report

1. Economic impacts of recreational tourism.
Key theme: Tourism

A. Brief Description: In 2001, the National Park Service's (NPS) visitors spent $10.6 billion and supported 212,000 jobs in local tourism-related businesses. The direct effects of this spending also generated $3.1 billion in personal income to employees in the regions surrounding the parks and 4.6 billion in value-added.

It is critical for local regions to know the impacts of tourism for community development strategies and tourism planning, yet most local organizations cannot afford large visitor surveys or economic studies. MAES scientists developed models and a tourism satellite accounting (TSA) method to provide reliable estimates of visitor spending and economic impacts at minimal costs, while also helping to ground tourism impact estimates in official economic accounts.

B. Accomplishment Statement: Utilization of these methods in a dozen counties showed Michigan tourists spent $12 billion in 2000. Outdoor recreation accounted for about 20 percent of all tourist spending or about $1.7 billion in 2000.

The main advantages of the TSA method over the survey method is figures are grounded in official economic accounts and can be generated at minimal expense.

The MAES developed models were applied and adopted in 20 known applications by MI tourism organizations; applied by 34 National Parks, U.S. Army Corps of Engineers, and Travel Michigan; extended to the USDA Forest Service and Alliance of National Heritage areas, and have been applied by four county visitor bureau's (CVB) in Michigan. They are also used by consulting firms, other state travel offices, university-based researchers, state departments of natural resources, recreation and tourism businesses, and regional economic development organizations. Additionally, many others have used the model's on-line version.

This project developed databases of recreation and tourist spending, regional economic multipliers, and spreadsheet models for estimating economic impacts of recreation and tourism activity. The data and tools made economic impact analysis accessible to recreation and tourism organizations within Michigan, nationally, and internationally. Model users can readily simulate the impacts of alternative management, marketing and development decisions in terms of local income and jobs. This research provided a set of tools for both business and government to use in evaluating investments designed to create jobs and increase income in an area through tourism.

Based on the research, Travel Michigan is able to assess the economic benefit of travel markets and products, and then allocate budgets to those

segments with the greatest potential to create jobs and increase income for the state. Local communities are also armed with this same information and can make informed decisions and can promote those markets that have the best return on investment for their community.

Training materials and spreadsheet models reduced errors commonly found in recreation and tourism impact studies and resulted in more accurate and defensible estimates. Training materials, models and reports are available at our web site and are widely downloaded and used.

C. Source of Funding: see table for Goal 5.

D. Scope of Impact: National Parks (NPS), USDA Forest Service NVUM, US Army Corps of Engineers, ANHA, Michigan CVB

2. Plant science education through MSU Horticultural Gardens.
Key theme: Youth development/4-H

A. Brief Description: The MAES scientists strive to establish the MSU Gardens as a leader in technology integration into gardens to enhance and expand plant science learning opportunities. Their work positioned the MSU Gardens as an essential resource for developing school and community gardens, and generating plant science curriculum about new plant science information for children and adults.

B. Accomplishment Statement: Several programs combining hands-on investigation with computer extensions are underway. MSU created custom software enhancing the in-garden materials and activities. The web site contains a new Kid's Tour section for the 4-H Children's Garden receiving 11 web awards for quality, originality, and usefulness to children, parents, and teachers. "Connected Classrooms" links classrooms with the 4-H Children's Garden and scientists. Through web pages, real-time chat and garden visits, students are linked with creator Norm Lownds, known as "Dr. Norm," to explore the garden and plants.

The "Head Start on Science" program provided training and experience in teaching science to preschool children. It also involved multiple field trips to the 4-H Children's Garden. Thirty-five Head Start teachers were trained to do hands-on, inquiry– based science education with pre-school children.

One of the newest programs -- Immersion Field Trip -- allowed children to visit the garden for several days in a row and become immersed in garden science exploration. Our unique technology integration efforts serve as the model for gardens and schools throughout the country. Immersion Field

Trips hosted approximately 200 kids in 2nd and 3rd grade and were in the garden for three full days, for five hours per day.

Annually there are nearly 100,000 children through the garden, with 10,000 attending various programs provided.

C. Source of Funding: see table for Goal 5.

D. Scope of Impact: MI, American Horticultural Association

3. Asset evaluation for children, adolescents, families, and communities.
Key theme: Leadership training and development

A. Brief Description: Recently social forces have seriously impacted and eroded the positive development of children, youth, families and communities. More recently, the need for an assets or strength-based approach is apparent. This project will focus on theory development and application related to positive youth, child, family, and community development.

MAES scientists assessed and evaluated the impact of developmental assets for school age children, middle school and high school adolescents and their families as well as university students while taking varying ethnicities into account. Research also focused on understanding the role of community collaborations in bringing about social change on behalf of children, youth, families, and communities.

B. Accomplishment Statement: MSU utilized qualitative methods including focus groups, interviews, and participant observations; quantitative methods including surveys; and pre and post quasi-experimental surveys and evaluations.

MAES researchers evaluated the implementation of the developmental assets model Developmental Assets among Parents of Adolescents. An instrument was developed and pilot tested to measure developmental assets among parents and adolescents. The instrument is now under revision for replication in other communities.

This strength-based model is being used statewide to educate citizens and human service professionals in state and local government, public, and private agencies through workshops, seminars and graduate education. More than 1,000 youth and adults participated in a variety of youth development opportunities through the collaboration projects. Adults who participated in collaborations on behalf of youth have increased their advocacy and leadership skills.

C. Source of Funding: see table for Goal 5.

D. Scope of Impact: MSU Outreach Partnerships, MSUE, MI

4. Influences of natural resource recreation on land management.
Key theme: Community development

A. Brief Description: Michigan provides an ideal laboratory to gauge the impacts of recreation on a wide variety of land uses. With approximately half the state forested, more than one-quarter in production agriculture and internationally renowned industrial and tourism development, a wide range of situations exist for exploration that can be generalized beyond Michigan's boundaries.

   MAES scientists collected information to estimate recreation patterns on public and private lands and integrate that knowledge with efforts to construct landscape level ecosystem models. Information collected also assessed recreation enforcement efforts in terms of efficiency, effectiveness and safety improvements.

B. Accomplishment Statement: The information gathered by MAES scientists was compiled and the findings were generalized to similar situations through regional and national outlets. This project will prove invaluable for organizations interested in recreation uses and activity patterns, and more importantly their influence on natural resource land management.

   Specifically Clinton County utilized MAES research to develop parks, recreation and open space conservation. In December 2002, Clinton County Commission approved the MAES proposed plan. Included in the plan was the transition of mined out pits into recreational lakes; development of rail-trail, agriculture equipment travel way, and wildlife habitat of native prairie grasses; and establishment of farmland preservation ordinance.

C. Source of Funding: See the table for Goal 5.

D. Scope of Impact: MI

5. Perceived justice of public participation and natural resource decision-making.
Key theme: Character/ethics education

A. Brief Description: Researchers identified situational, cultural, political, and historical factors, which impact the perceived justice of public participation. MAES scientists then developed a model of public participation based on justice theory and the factors identified, and a practical, easily administered instrument for agencies within the

Michigan Department of Natural Resources (MDNR) to evaluate the perceived fairness of a public participation process.

B. Accomplishment Statement: Significant influences on perceived fairness were identified from the survey. The survey instrument was revised to reflect these results and was then sent to additional divisions of MDNR.

C. The results from this project are being used to restructure the public participation strategies of MDNR.

D. Source of Funding: see table for Goal 5.

E. Scope of Impact: MI, MDNR, USFS

Stakeholder Input Process Section

(a) **Actions taken to seek stakeholder input that encourages their participation**

Linking research, education and extension to address industry and community needs has been key to forwarding the MAES mission. Stakeholders have increasingly become an important part of the linkage.

Area of Expertise (AoE) Teams: MAES and MSUE have reconstructed their educational delivery system in plant and animal agriculture through the implementation of area of expertise (AoE) teams. These teams were formed as a direct result of demands by stakeholders in the animal and plant industries in Michigan. When asked what they would see as an exemplary 21 century extension service, stakeholders responded with the directive to the MAES and MSUE to produce products and programs that are timely and customer-focused with a multidisciplinary systems approach. Stakeholders do not distinguish between research and extension programs. The AoE team approach addresses the need for joint planning and programming, collaborative professional activities, resource allocation and communication between organizations.

Plant Industry Coalition: Stakeholders, which include plant commodity group and industry leaders, attend biannual meetings to discuss research and extension priorities with MAES faculty members and administrators, MSUE specialists and administrators, CANR department chairs of plant-related departments, the state department of agriculture and agricultural organization representatives. A major focus of discussion is the research/extension programming under Project GREEEN.

Southwest Michigan Research and Extension Center (SWMREC) Growers Advisory Board: Members of this 15-person board are selected on the basis of commodity and geographic distribution. They meet four to six times per year with SWMREC field station administrators, research faculty members and MSUE specialists.

CANR Stakeholder Advisory Board: Members of this 30-member board are appointed by the CANR dean, who serves as chairperson. The members serve staggered three-year terms. Twenty-three stakeholders represent broad interests in the agriculture and natural resources industries.

FACT (Families and Communities Together) Advisory Team: This group was created to provide an ongoing linkage with stakeholders who are engaged in issues affecting families and communities.

Because of the breadth of MAES programs, stakeholders working for the MAES also include faculty members, the MSU Provost's office and the Vice President's Office for Research and Graduate Studies.

(b) **Process used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them**

Our stakeholders were identified as those who benefit from our programs and are seen as an integral part of MAES efforts to provide research aimed at the betterment of Michigan's future. To identify these individuals and groups required the MAES to develop a visionary approach to assessing needs of Michigan, then engage in discussion with MAES faculty members from five MSU colleges, field station administrators, state governmental units, both rural and urban, to pinpoint groups and individuals to work with the MAES in futuristic planning.

Input is gathered through various methods:

AoE Teams: Stakeholder input is required on program/project selection, direction and evaluation. Stakeholders are invited to AoE meetings or project activities to provide feedback on emerging needs and issues facing the industry or interest group. They are also involved in hiring decisions for AoE team members, and participate on a regular basis toward educational programming of AoE teams.

Plant Industry Coalition: In addition to the biannual meetings outlined in (a), commodity groups and agribusiness representatives summarize and document their research and extension priorities and needs. These documents are updated annually and placed on the Project GREEEN Web site.

Southwest Michigan Research and Extension Center (SWMREC) Growers Advisory Board: Members are appointed by local fruit and vegetable grower commodity groups and organizations and the university. As described in (a), they are selected on the basis of commodity and geographic distribution. This board has recently appointed a minority grower.

FACT (Families and Communities Together) Advisory Team: The team holds annual forums. These forums include MSU and MAES faculty members, MSUE and community grant seekers from across Michigan to help them exchange research ideas and find partners for their work.

CANR Stakeholder Advisory Board: As outlined in (a), 23 of the 30-member board represent a broad range of agriculture and natural resources industries. The board meets a minimum of three times a year, and stakeholders are also involved in major stakeholder conference days, held annually.

(c) **How collected stakeholder input was considered**

As outlined in (a) and (b), stakeholder input gave direction to the types of research and extension activities developed by MAES and MSUE. The success of MAES is predicated on the university-state government-stakeholders model that has been in place for more than two decades. With programs like Project GREEEN, Animal Industry Initiative, FACT, commodity group advisory boards and the AoE teams, stakeholders help shape the future direction for MAES. In recent years, stakeholder input has focused more and more on non-traditional agriculture, i.e., organic and sustainable agriculture. This has led to changes in framing of priorities for MSU's C.S. Mott Chair for Sustainable Agriculture. Stakeholder input has also shifted the focus from traditional

agriculture to include the human element of rural and urban communities, the environment, land use issues, biotechnology, and new and emerging green industries.

Examples:

Plant Industry Coalition: The priorities outlined by the stakeholders in Project GREEEN are the basis on which research project funding is considered.

Southwest Michigan Research and Extension Center (SWMREC) Growers Advisory Board: It deliberates policy regarding work done at SWMREC, including input on research projects to be funded and carried out. The group also has input on capital expenditures, personnel and new program direction. It also is directly involved with the acquisition of private sources of support, oversee fundraising through the SWMREC Agricultural Leaders Club, which supplements other sources of funding.

FACT: Work groups made up of MSU faculty, administrators, and Extension faculty and community partners are facilitating and supporting two self-directed work groups around the topics of children, youth and nutrition, and youth development. Each work group will develop research and outreach initiatives to advance work in their area. These groups will also create and implement a plan for the collective betterment of work in each area, promote professional development activities and measure the impact of their efforts.

CANR Stakeholder Advisory Board: Stakeholder feedback from meetings and conferences is used to make decisions about the effectiveness and impact of CANR, MAES and MSUE programs. At each meeting, questions are framed to the stakeholders for their input, and the feedback is used to make decisions. At one such meeting, stakeholders were asked to consider the five programmatic themes when answering these questions:

1) Are the CANR, MAES and MSUE working on programmatic themes that best serve Michigan?
2) What are the most important programmatic ideas to carry out in each theme?
3) Given the tight budgets, give guidance on creating a “what not to do list.”

Program Review Process

There has been no change in the program review process since we submitted the 1999–2004 POW.

Evaluation of the Success of Multi and Joint Activities

For the MAES, evaluating the success of the multi and joint activities means measuring against its mission. The success of MAES research and programs is also measured by the success its stakeholders achieve using information from the research and educational programs. The following programs represent a few that have been evaluated as successful during FY 2002.

The Tart Cherry Industry

A seamless interface between research, extension and industry

The tart cherry industry in Michigan supplies about 75 percent of the nation's cherries, and is one of Michigan's most important fruit crop industries. The critical issue facing this industry is its economic position and how to make it more viable. Michigan Agricultural Experiment Station researchers and MSU Extension (MSUE) specialists are playing an instrumental role in helping the industry (stakeholders) analyze its situation, plan for the future and implement programs and action steps to improve its economic viability and competitiveness. MAES and MSUE researchers and specialists are involved with the cherry industry in developing futuring, marketing improvement and direction strategies.

One phase has been the development and the effective use of the U.S. Tart Cherry Industry Alliance, a broad-based industry council for the Michigan and United States tart cherry industry. This council has been formed and uses collaboration of industry leaders, MSU researchers and extension specialists. It facilitates overall efforts for strategy development and problem solving for the benefit of the entire industry. It also provides an effective means for the ongoing university-industry partnership linkages on industry priorities as well as implementation of the results of various university research analyses. Other parts of this project included a report on needed strategic directions for the tart cherry industry and holding a national summit conference to present and discuss with industry leaders in various cherry producing states the results of the overall strategic planning work. The report on strategic direction for future success of the tart cherry industry, along with the related summit conference, provided an overall blueprint for strategic directions and for programs to benefit the entire industry.

Opportunities for greater industry strategic emphasis drawn from the analyses included: expanding the market demand for dried cherries, providing information on the healthful properties of cherries, export market expansion, cherry juice promotion and USDA purchases of cherries (especially with newer products for schools). Because of the industry's efforts during recent years, the USDA School Lunch purchases of tart cherries increased to almost 100 million pounds recently, compared with a previous three-year average of 17 million pounds.

Phil Korson, executive director of the national Cherry Marketing Institute, is enthusiastic about the industry's relationship with Michigan State University, MAES, MSUE and the Michigan Department of Agriculture [MDA] and the ongoing useful results of this project.

"We lean on each other to get things done and we all benefit," he says. "This partnership, especially through the effective efforts of the U.S. Tart Cherry Alliance, is unique from other states. We all work on the highest priorities – for the industry,

government agencies, the university and MDA – and this partnership works in all ways to focus on key issues."

An example situation which involved university economic analysis, the results of which were then used by the industry, is illustrated by the large economic losses to the cherry industry from the unusually severe spring frosts in 2002. Michigan, which normally is the largest tart cherry producing state, produced only 14.1 million pounds of tart cherries, less than 5 percent of the 2001 crop. This is the smallest tart cherry crop since the USDA began keeping records in 1938. MAES agricultural economists developed an economic analysis for various impacts of this and the economic losses to the industry. Michigan lost $43 million in tart cherry revenues in 2002. Information from this analysis was used by the industry in a number of ways to help the industry adjust to this difficult situation, including the creation of a request for disaster funds from the federal government.

In July of 2002 the cherry industry pulled together Michigan's political power, including U.S. senators Carl Levin and Debbie Stabenow, and U.S. representatives Dave Camp, Bart Stupek and Pete Hoekstra, as well as industry and Michigan Farm Bureau representatives, and discussed what needed to be done to put together a strategy to fund disaster relief. Korson led the charge.

"We were given 24 hours to put a strategy together, and we asked Don [Ricks, MAES agricultural economist) to do the economic analysis on impact and economic losses to the cherry industry," he says. "The growers and processors met once we had his information in hand, and put together our strategy. The finished document was in Senator Stabenow's hands the next morning.

"What is significant about this industry-university partnership is that it takes our message to the next level – a reputable and credible one," he adds. "We are all on the same team, using the same ball. The analysis is still the basis for dialogue and discussion for all the cherry and agricultural organizations."

The Michigan Apple Industry

Strategic planning including market research on what the customer wants

Obtaining market research information on customer needs is a necessary, yet often difficult, task for a commodity industry which often receives relatively little attention in contrast to major strategies of large food-manufacturing firms. To help the Michigan apple industry with information on consumer and trade customer needs, a series of market-research studies were done on Michigan apples by MAES agricultural economists as part of the apple industry's efforts to analyze, target and develop major strategic directions to improve the industry's performance and success.

Consumer studies included:

- focus groups
- telephone survey
- survey related to in-store demonstrations
- taste tests
- visual tests for color and fruit size

Other surveys included:

- shipper survey on varieties in demand

- Michigan processors of apple varieties in demand for processing markets
- grocery trade customer survey

The information sought in the studies was developed in cooperation with industry leaders and major industry organizations, such as its promotional commission. The information from the market research studies is being used to develop strategies to more effectively and economically serve customer needs. This is an important component for the industry's goal of being highly *market* and *customer* oriented rather than *production* oriented. This market and customer orientation is needed at each of the vertically linked segments of the industry's marketing supply chain.

Like the work with the tart cherry industry, MAES and MSUE have worked extensively with the Michigan apple industry on strategic planning and problem solving. This has included development of an apple industry council, the Michigan Apple Industry Strategic Planning Task Force, which included university research and extension representatives. The goals of the industry's strategic planning have included improved competitiveness, market growth and strengthened economic viability of the industry. Market research is just one component in the Michigan apple industry's strategic planning efforts.

"There is a lot of diversity and independence within this industry, but this taskforce is one point where we all work together," Patrick O'Connor, acting director of the Michigan Apple Committee, says. "That in itself is a big accomplishment. The creation of the taskforce has been a great example of how the university research, extension and apple commodity boards mesh together for the common good. Don Ricks has taken the lead with the strategic planning, which would have been difficult for the industry because of the limited resources of both time and money. Don isn't just an outside resource, he's truly part of the industry."

O'Connor says after seeing the strides the apple industry taskforce was making, the national cherry industry and the New York Apple Committee started their own taskforces.

"They say that the true test of success is when others imitate what you've done," he says. "Another important part of this taskforce is it allows the different groups within the industry, such as the fresh shippers, cider makers and growers, direct what research could benefit the industry."

Growing Edible Chestnuts

A value-added opportunity for Michigan

Growing edible chestnuts is making a comeback among both commercial and smaller fruit growers looking to blight-resistant Chinese chestnuts for an alternative high-return crop. Michigan currently has more than 100 growers and more than 15,000 trees of a variety developed in California called "Colossal".

MSU researchers from several departments are working together to investigate and identify alternative markets so producers who have invested several years in growing a chestnut grove have profitable markets when their trees come into production. Researchers are also determining the best methods to process, store and package chestnuts.

"Growers are in two camps – growing forests of chestnuts or growing them as orchards with the aim of producing nuts," says Dennis Fulbright, MAES plant pathologist. "Extension specialists came to researchers at MSU to get answers about chestnuts and how best to grow them in the state."

"Research has shown us there's a market for chestnuts with upscale chefs in the state," says Thomas Kalchik, MSU Extension value-added agent, "but chefs want a peeled product, not a whole chestnut they have to shell themselves."

In 2002, 12 chefs from around Michigan were asked to take 10 pounds of chestnuts and create dishes that they would serve in their restaurants. The chefs not only found uses for the chestnuts, but were eager to get more.

"Chestnut ice cream, bonbons, vegan chestnut pate, fish with chestnut crumbles and chocolate mousse with chestnuts are just a few of the dishes created by the chefs," says Bridget Behe, MAES professor of horticulture. "When asked, about half said they had used chestnuts in their restaurants, and those that didn't said they would now if they could buy them peeled."

Growers don't want to spend time shelling chestnuts any more than chefs do, so the Michigan Nut Producers Council (MNPC) imported a shelling machine from Italy to do the work for them.

Bruce Smith, president of the Midwest Nut Producers Council, expects upwards of $2 million in annual direct crop sales over the next five years. He anticipates the return will be substantially greater once peeled and packaged chestnuts, rather than the fresh, unshelled nuts, can be commercially supplied to the food service industry.

Capital Area Innovative Farmers
Partnership serves as model for problem-solving

A unique partnership developed between the Capital Area Innovative Farmers (CAIF), a group of mid-Michigan farmers, and Michigan State University researchers and MSU Extension specialists may serve as a model for solving future industry problems.

Deciding to validate a claim that a particular sprayer design could reduce herbicide application rates for weed control, the CAIF designed and constructed an innovative system that could operate as both a conventional sprayer and with a special nozzle system. The system was used to make a direct and fair comparison of herbicide application methods during a two-year test period. The CAIF conducted in-field experiments and consulted with MSU researchers during the evaluation phase.

Despite the fact it was found that the sprayer had no advantages over conventional sprayer equipment, the partnership that grew between the university and the farmer group was invaluable.

"This partnership is a model of how a farmer group can work cooperatively with university researchers to solve important problems facing Michigan agriculture," says Jim Kells, MAES professor of crop and soil sciences and a consultant on the sprayer project. "Now that this relationship has been developed, it may lead to working on more studies together."

Bruce Noel, a farmer from Leslie and member of the CAIF, says that the relationship between the university and farmers has been a growth experience for all involved.

"The CAIF approached Jim Kells to help us develop some well thought out, well executed research on validity of the claims made about this equipment, and he said that it could be possible with Project GREEEN," Noel says. "This program is important, because, as has happened in the past, once you lose an outreach program, it's gone. We are trying to keep outreach programs for farmers because we've lost a lot of them."

Noel also says this project has been the springboard for more.

"Now that we've done this project and have built the relationships with not only the university but with USDA, MDA and other groups, the CAIF has grown to include farmers from five counties representing all sizes of operations, from less than 500 acres to many thousands of acres, as well as agricultural business members," he says. "Once we started working with academia, the opportunities for networking grew. I am now on the National Corn Board on its renewable fuel standards committee, which was a direct result of my involvement."

The CAIF has also formed two other groups – a farmers' investor group and a cooperative, which is looking into research to develop corn starch into plastics.

"Funding from Project GREEEN (Generating Research and Extension to meet Environmental and Economic Needs, the state's plant agriculture initiative) made the development of this cooperative relationship possible," Kells adds. "It was only possible because of the commitment from both parties. Either group could not have done it by themselves."

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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**
__X__ **Integrated Activities (Hatch Act Funds)**
_____ **Integrated Activities (Smith-Lever Act Funds)**

	Actual Expenditures				
Title of Planned Program/Activity	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Integrated Appts.	$0	$78,628	$157,199	$157, 199	$157,199
Total	$0	$78,628	$157,199	$157, 199	$157,199

Michigan Agricultural Experiment Station — **Director**
March 1, 2003 — **Date**

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