Annual Report
of
Accomplishments and Results

FY 2006

Plan of Work for Agricultural Research
And Extension Formula Funds (AREERA)

Minnesota Agricultural
Experiment Station

UNIVERSITY OF MINNESOTA

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Executive Summary

This report of research progress for 2006 summarizes Minnesota Agricultural Experiment Station (MAES) research organized by key themes under the five AREERA goals. As in last year's report, joint Research/Extension efforts are discussed under selected key themes. This year those are: *Agricultural Profitability, Agricultural Competitiveness, Green Agriculture, Food Safety, Human Health, Agricultural Waste Management, Water Quality and Forest Management.*

This year's Accomplishment Report documents research progress and impacts of MAES funded research for 2006. This is the last report covering the MAES Plan of Work for Research 2000-2004, which was updated in 2004 to cover 2005-2006. It was impossible, in the process of gathering data for reporting this year, not to be struck by the developments in research demands, priorities and methods that have occurred since the first Plan of Work cycle began. In past years it has often been difficult to sort the selected MAES research projects into just one key theme. For example, several crop research projects could fit under *Agricultural Profitability, Agricultural Competitiveness, Plant Health*, and/or *Risk Management*. However, now such research programs may have impact in *Biofuels, Global Climate Change, Genomics, Human Health, Water Quality*, or others. This indicates the increasing integration of research across content areas, as well as the increasing complexity of research. The planning that created MAES' first Plan of Work has accurately described the scope and responsiveness of its research programs in five colleges. However, research continues to grow along with the complexity of the world and the human condition.

***Goal 1*: Through research and education, empower the agricultural system with knowledge that will improve competitiveness in domestic production, processing and marketing. (An agricultural system that is highly competitive in the global economy.)**

MAES funded research has contributed to advances toward achieving this broad goal in many targeted ways. As in past years, the largest amount of Federal formula funding dollars MAES receives is reported under this goal. This report describes how that funding has been used to address new and long-standing animal and plant health issues, to support Minnesota's growing green agriculture industry, and to provide commodity crop and animal producers with the information and tools to be productive and profitable.

Total Expenditures by Source of Funding:
Hatch--$404,269; MRF--$70,107; State--$2,825,108; Other Federal--$2,787,622; Other Non-Federal--$5,131,952
Total (Experiment Station only): $17,645,637
FTE's Experiment Station only: 100.7

Goal 2: **To ensure an adequate food and fiber supply and food safety through improved science based detection, surveillance, prevention and education (A safe and secure food and fiber system.)**

Research has focused on rapid detection methods of pathogens to help the food industry. To control food-borne diseases, long-term research has led to the development of a successful Extension program.

Total Expenditures by Source of Funding
Hatch--$9,033; Other Federal--$29,274; Other Non-Federal--$140,323
Total (Experiment Station only): $356,493
FTE's Experiment Station only: 3.8

Goal 3: **Through research and education on nutrition and development of more nutritious foods, enable people to make health-promoting choices. (A healthy, well-nourished population.)**

The emphasis on human health research has been increasing as the public grows increasingly concerned not just about the safety of the food consumed, but also interested in the health benefits of food to reduce risks such as cancer, diabetes and heart disease. Researchers are also looking at the health needs of specific groups, such as under-served audiences, youth and mothers.

Total Expenditures by Source of Funding
Hatch-- $54,835; MRF--$3,082; State Funds--$494,330; Other Federal--$593,181; Other Non-Federal--$301,919
Total (Experiment Station only): $1,537,347
FTE's Experiment Station only: 17.1

Goal 4: **Enhance the quality of the environment through better understanding of and building on agriculture's and forestry's' complex links with soil, water, air and biotic resources. (An agricultural system that protects natural resources and the environment.)**

This goal has had the largest growth in research impacts over the course of reporting on the 2000 to 2006 Plan of Work. MAES was involved in helping provide the research base necessary to develop Minnesota's ethanol industry back in the early 1980s, and certainly water quality and the environment has always been important to Minnesotans. However, no one could have known how important those issues would become today. The research accomplishments reported here include application of new technologies, research to develop TMDLs and other policy recommendations, and long-term and applied research to maintain Minnesota's natural resources, while supporting new opportunities for biomass and biofuels.

Total Expenditures by Source of Funding
Hatch--$130,018; MRF--$55,752; McIntire-Stennis--$23,862; State Funds--$1,573,906; Other Federal--$2,286,787; Other Non-Federal--$1,369,057
Total (Experiment Station only): $5,439,382
FTE's Experiment Station only: 62.8

Goal 5: **Empower people and communities, through research-based information and education, to address the economic and social challenges facing our youth. Families and communities. (Enhanced economic opportunity and quality of life for Americans.)**

The population of Minnesota has grown more diverse over the past seven years, and MAES research has focused on community and family needs created by that change. Long term research continues, at the same time, to study family systems and the policies, and education support them. Research also continues to provide information to help Minnesota families manage their financial resources to improve their economic stability and quality of life. The results of MAES family research have informed legislative policymakers and led to educational programs and greater public understanding of family issues.

Total Expenditures by Source of Funding
Hatch--$12,250; State Funds--$297,587; Other Federal--$541,474; Other Non-Federal--$328,090
Total (Experiment Station only): $1,161,401
FTE's Experiment Station only: 13.0

Key Theme: Agricultural Profitability (Joint)

MAES Plan of Work: GOAL 1, Programs 2, 7

Description: Red River On-Farm Yield Trials continue their dual purpose as an Extension program and performance testing of released cultivars and advanced lines. These results continue to be an important information tool used by Extension crop specialists in their work with producers across the state. Research continues to develop winter wheat as a possible alternative to spring wheat and barley. In related work on small grains, researchers are validating the WheatScout decision aid for management of grass weeds in spring wheat.

a. Impacts

The adaptation of producers of the appropriate timing of fungicides is improving disease control, grain quality, and food safety. As a sign of the impact of work to develop winter wheat as an alternative to spring wheat and barley, a significant increase was reported in winter wheat acreage in 2005.

b. Source of funding: Hatch
c. Scope of funding: State, multi-state

Description: Small grain producers rely heavily on herbicides for weed control, however growers continue to search for methods to reduce herbicide inputs. Field experiments were conducted to evaluate the efficacy of reduced herbicide rates, crop rotations, cultural methods and tillage on weed control in small grains. Data from these trials were made available to the public in the Minnesota Extension publication *Cultural and Chemical Weed Control in Field Crops.* Wild oat remains the number one weed control problem in small grains in Minnesota. Research was conducted to evaluate the emergence pattern of wild oat, and determine if emergence can be predicted using soil growing degree days and/or hydrothermal time.

a. Impacts

The results of research to develop a wild oat control predictive model for use by agricultural crop consultants to date have enabled small grain producers to reduce wild oat herbicide rates an average of 10 percent.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

Extension 2004-06 Plan of Work: Goal 1, Program 1: Farming for Tomorrow
Program Component: Agricultural Financial Management

Description: Agricultural producers face uncertain markets with narrow margins, as well as complicated management decisions about land ownership. Research-based information helps producers weigh the cost and benefits of risk management approaches to protect their businesses from adversity while maintaining profitability. We provide educational programs and software tools that educate producers and professionals about risk management concepts, tools to mitigate risk, the historical returns of risk management approaches, and sound practices in estate planning.

In 2006, this program (which makes yearly impact reports to CSREES) continued to attract sponsors and producers because of its reputation for impact-driven education. In addition, In 2006, Winning the Game programs were offered in more than ten states.

a. ***Impact:***

- **Behavior Change and Economic Impact:**
  Pre-harvest Marketing Workshops. Follow-up evaluation survey results indicated that farmer-participants changed marketing practices as a result of attending the program. These changes enabled them to increase net farm income by $8,067 per farm, on average.

  Post-harvest Marketing Workshops. Follow-up evaluation survey results indicated that farmer-participants changed their post-harvest marketing practices as a result of attending the program, enabling them to increase their net farm income by $6,280 per farm, on average.

  Farm Transfer Workshops. In a six-month post meeting survey after participating, 57% of participants said they had started their farm business transfer plan and 59% said they had started their personal estate plan.

  Farm Transition Plans. Focusing only on the 37 farm units that stated they had completed their farm transition plan, multiplied by the FINBIN farm balance sheet asset value of $1.125 million, the total financial impact is $41.6 million or $79,460 per program participant. The financial impact of the program (combining farm transition and estate planning asset management done by 178 survey respondents) is $220.5 million or $420,726.07 per the 524 program participants. Accounting for program costs, the benefit per participant per dollar spent on this educational program is $16.25.

b. ***Source of funding****:* Smith-Lever 3b&c, state, county, sponsorship fees, grants
c. ***Scope of impact:*** State, Multi-state

MAES Plan of Work: Goal 1, Program 4

Description: Over the course of reporting accomplishments and progress on the MAES Plan of Work, results and impacts of the various commodity crop breeding programs

have been noted. This year in soybean breeding and in oat breeding there are new achievements to note.

a. Impacts:

Several cultivars of soybeans developed by the Minnesota Agricultural Experiment Station are grown extensively. Recently released general purpose and special purpose Minnesota cultivars contributed approximately $1,000,000 in increased farm income in 2006 compared with yield of older cultivars. Two new cultivars were released in 2006. One cultivar had very high yield and one contained soybean cyst nematode resistance. An oat variety, MN02234, was approved for final increase, and projected release in early 20087. This line has equaled or bettered every entry in the multiple year summaries of our *Minnesota Varietal Trials* beginning with 2003. Moreover, its crown rust resistance appears more durable than many other lines. The Oat Milling Industry has expressed interest in its possible production of MN02234 in western Canada, a first in recent memory for a Minnesota line.

b. Source of funding: Hatch

c. Scope of impact: State, multi-state

Key Theme: Agricultural Competitiveness (Joint)

MAES Plan of Work: GOAL 1, Program 1, 2, 9 and 13

Description: Research to support Minnesota's dairy industry has focused on milk quality, dairy cattle health and productivity. Extension uses the information derived from this research to help small and medium-sized Minnesota dairies in its Dairy Modernization program.

a. Impacts

Examples of recent research results and impacts:

- Researchers developed a model to predict future herd performance using 2003 and 2004 data from 1,500 Upper Midwest herds in the MilkLab database. The use of the model predicted with greater than 80 percent accuracy whether a herd will violate a specified somatic cell count quality standard in the next 30 days. These results help producers detect mastitis in their cows and prevent low quality milk from entering the bulk tank.
- Two Holstein sires comprise approximately 30 percent of the global Holstein gene pool, and so there is concern about inbreeding. Deterioration of female fertility, in particular, has created renewed interest in crossbreeding to capitalize on hybrid vigor to improve female fertility and, consequently, length of herd life. Two-thirds of cows at Minnesota's West Central Research and Outreach Center, Morris, and the St. Paul campus are crossbreds of Holstein, Jersey and Montbeliarde. Comparisons to the

other one-third documents potential gains from crossbreeding of dairy cattle for improvement of traits related to reproduction, health, and fitness, which could have tremendous economic consequences for dairy producers domestically and internationally.

- A multi-site, multi-herd controlled field study is validating the efficacy and quantifying the cost-benefit of incorporating an on-farm culture system for strategic treatment of clinical and subclinical mastitis. This could promote more judicious and strategic use of antimicrobial to treat mastitis cases, improving animal health and well-being, improving economic sustainability of dairy farms, and improving dairy food safety and quality.

b. ***Source of funding***: Hatch

c. ***Scope of impact***: State, multi-state

<u>Extension 2004-06 Plan of Work:</u> Goal 1, Program 1: Farming for Tomorrow
Program Component: Dairy Modernization

Description: The UMN dairy team continues to have an impact on the health and economic welfare of the dairy industry by working with dairy producers and partners. An ongoing program effort, reported yearly to AREERA, is the *Quality Counts* program. This collaborative effort increases dairy income by reducing somatic cell counts. The Dairy Modernization program proved an additional impact this year as progress was made to house dairy cows in compost dairy barns. Compost dairy barns use dry wood shavings and sawdust as bedding in order to enhance the health and longevity of cows.

a. Impact

Behavior change:
- Dairy farmers continued to use best practices that controlled somatic cell counts.
- Dairy farmers moved approximately 1,500 cows to compost dairy barns in order to utilize new technologies in improving the cow's health and longevity of dairy cattle.

Improved health for milk-producing herds:
At the beginning of the decade, Minnesota was among the dairy states with the highest average somatic cell counts. According to UMN scientists, these high counts robbed farmers of nearly $53 million in potential income every year. Extension, UMN and statewide partners took action to improve cell counts. In 2006, efforts related to *Quality Counts* possibly resulted in a reduction of 50,000 somatic cell counts for herds attending the program. The research will could result in 3,500 per herd or a program impact of approximately $350,000.

Research findings about utilization of compost dairy barns:
By collecting information numbers on cow health, the dairy team worked to better understand the impact of compost dairy barns on cow health and longevity.

In relation to hock injuries, 0.97% of cows had swollen hocks. That compares with 1.8% for sand stalls and 14.1% for mattress stalls in a study conducted at UMN last year. Even more dramatic are results discovered for lameness prevalence. Only 7.8% of the cows were lame, with two herds having no lame cows at the time of our visit. That compares very favorably to 24.6% lameness prevalence in a UMN study conducted with cows housed in free stalls. This is a strong indication that cow comfort is improved in compost dairy barn facilities.

Two problems – air quality and maintenance of bedding – were discovered through the study. The Dairy Team has submitted grant proposals to conduct follow-up studies.

Results were disseminated at the annual Minnesota Dairy Days held in January at nine locations around the state and were posted on the internet.

Business retention and profitability:
The Minnesota Dairy Initiative seeks to make dairy a more viable industry in Minnesota. From 2005 - 2006, there was an increase in production per cow of 2.5%, or $29,016,000 from Minnesota's 450,000 cows. Minnesota's overall milk production in total pounds went up 496 pounds per cow and each pound of production is worth an additional thirteen cents. Because it was an especially hot summer, informed management practices in maintaining climate, feed, water and infrastructure, were important to this productivity.

b. Source of funding: Smith Lever 3b&c, state, county, State of Minnesota Dairy Initiative program, Minnesota Department of Agriculture, Sponsorships, Dairy Associations
c. Scope of impact: State, Multi-state

MAES Plan of Work: Goal 1, Program 2

Extension 2004-06 Plan of Work: Goal 1, Program 1: Crops
Program Component: Soybean Aphid Management

Description: The soybean aphid arrived in Minnesota in 2001. By 2003 the aphid was causing an estimated $188 million yearly loss and since then aphids have spread into new areas. MAES researchers developed a computer simulation program called the Soybean Aphid Growth Estimator (SAGE). The model informs growers as to how quickly an aphid population can exceed the economic threshold in their specific locations, and has helped prevent over-treatment of fields with systemic insecticides. A team of researchers and Extension specialists have been working closely with farmers and crop consultants to develop recommendations. The Soybean Aphid Growth Estimator model continues to evolve. Future versions will factor in temperature, rainfall, planting date, plant growth stage, variety, soil type and natural predators. Growers can combine the computer

prediction of aphid growth with real-time data observed with field scouting to do the right thing in the field at the right time.

a. Impacts

Profit retention:
The Minnesota Extension and Experiment Station soybean aphid response has attracted national recognition. The use of the SAGE model combined with field scouting and Extension advice has prevented an estimated $200 million in crop losses and reduced pesticide needs in one year alone.

Development of natural prevention agents:
Pesticide applications are a short-term solution; researchers have been studying the potential of natural soybean aphid control. Working within the MAES Insect Quarantine Facility on the St. Paul campus, researchers have been testing the potential of a sting-less wasp as a natural predator of the soybean aphid. They found that the wasp is effective and will not harm things other than soybean aphids and a few of its close relatives. The U.S. Department of Agriculture and the North American Plant Protection Organization are evaluating the research before approving release of the beneficial insect. If approval is received, the sting-less wasp will be released on 30 small plots throughout Minnesota in 2007, and Extension and campus researchers will work together with farmers to evaluate this new tool in the field.

b. Source of funding: Smith-Lever, Hatch
c. Scope of impact: State

<u>MAES Plan of Work</u>: Goal 1, Program 9

Description: MAES sugar beet research on nitrogen guidelines are important to sugar beet growers to keep their input costs low while maintaining sugar beet quality. Field experiments at 13 sites were conducted to test the effect of previous crop on nitrogen guidelines and validate and extend the area of inference of the new Minnesota N guidelines.

a. Impacts:
The results indicate that the new N guidelines for are working very well. Nitrogen management in sugar beet production from this research has reduced nitrogen applications over 120,000 acres by 30 pounds per acre.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

Key Theme Ornamental/Green Agriculture (Joint)

MAES Plan of Work: GOAL 1, Program 11

Description: The apple breeding program funded by MAES had its first success with the release of Haralson in 1922 which remains a Minnesota favorite. But it's Honeycrisp that has become the major success story for Experiment Station apple breeders. Honeycrisp is not a hard apple, but it's crisp. And it keeps well—up to eight months with proper refrigeration. However, it is an apple that is susceptible to bruising, because what makes it so "explosively crisp" also means the apple must be picked and packed carefully. Extension provides education to producers to address this concern. Fruit breeders have also been building on the success of Honeycrisp with a new release—Zestar—an early maturing apple.

a. Impacts

Honeycrisp was named the official state apple, courtesy of a class of fourth graders in a St. Paul suburban school who pushed through legislation last year, and has gained worldwide popularity. Sold in Europe as Honeycrunch, the apple has been in demand from Nova Scotia to South Africa. Today more than 300 farms in Minnesota produce 40 million Honeycrisp apples a year. Extension horticultural specialists work with growers to help them handle the Honeycrisp apple with care and increase their profits. In 2006, growers planted Zestar for the first time. It will fill a needed niche in the early-apple market. Sales of root stock more than doubled expected demand.

b. Source of funding: Hatch, Smith-Lever
c. Scope of impact: State, multi-state

Extension 2004-06 Plan of Work: Goal 1, Program 2: Bountiful Horticulture: Gardens & Foods
Program Component: Commercial Vegetable and Fruit Production

Description: Minnesota's cold climate challenges the state's potential to develop a fruit and vegetable industry. Plant breeders at the UMN Experiment Station have overcome this challenge through the breeding of cold hardy plants. Extension horticulture programs work closely with producers to create a viable industry that use these Minnesota breeds.

a. Impact

Economic impact from UMN-bred apples:
But for the research of the University of Minnesota faculty, the plausibility of an apple industry for Minnesota would be slight. Extension horticulture programs work closely with over 100 apple orchard producers to grow new and old Minnesota cold hardy varieties. In 2006, the apple industry is worth approximately $20 - $25,000,000. Eighty

percent (80%) of the orchard acres are growing University of Minnesota-bred apples.

b. Source of funding: Smith-Lever b&c, Hatch, State
c. Scope of impact: State, Multi-state

MAES Plan of Work: Goal 1, Program 4

Description: Last year's Accomplishment Report documented the progress of the MAES wine-grape breeding program, specifically the release of the much-anticipated Marquette, a cold-hardy, disease-resistant grape that yields a pinot noir-like red wine comparable to that produced in California. Marquette was the fourth variety released in six years by the University's grape-breeding program, a program which has been largely responsible for the development of an emerging Minnesota wine industry.

a. Impacts:
The most widely planted red-wine variety in Minnesota is 'Frontenac,' bred specifically for red wine production in the Midwest. It has caught on quickly and is grown from the Dakotas to Maine and down to Texas. Twenty years ago, there was one commercial winery in Minnesota. Now there are 16 wineries, about 50 commercial vineyards, and more than a hundred small hobby vineyards. Well over half of the grapes they grow are varieties developed at the University. As a result of this research and the new industry it helped create, Extension educators saw an opportunity for tourism. They have developed a successful Minnesota winery tour.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

(Note: The Extension education and impacts resulting from this research are reporting in their accomplishment report under Goal 5: Tourism)

Ref. 2004-06 Plan of Work) Goal 5, Program 3: Community Economics
Program Component: Tourism Development for Minnesota's Wine Industry

Description: The University of Minnesota's Horticulture Research Center (an Experiment Station) has been breeding cold-hardy grapes since the mid '80's. So far, the center has released four varieties and there are 19 small wineries in Minnesota. Wine-making can diversify rural economies through production, sales, and the attraction of tourism. In 2006, Extension's Tourism Center identified five wineries that could incorporate the principles of regional marketing to form a wine trail. Each was recruited to invest in a regional tourism initiative. The goal was to use research about tourism development to increase tourism profits for each vineyard through joint marketing, and to increase tourism profits throughout the region. Extension provided consultation, education, facilitation and organization to the group.

a. ***Impacts***

Regional collaboration:
The five-vineyard collaboration quickly grew to seven. The collaboration developed joint brochures, a web site, and kick-off events to draw attention to the trail. The kick-off events, coupled with attraction to the University of Minnesota's role in growing grapes and growing the industry, resulted in media articles in high-profile magazines, radio shows and newspapers.

Profits:
Though owners were reluctant to release detailed fiscal impacts, they reported in follow-up discussions that they experienced an increase of visitors (both new and return) throughout the year because of the wine trail. One winery reported doubled sales during the June and December events organized by the collaborative, compared to the same events the previous year.

MAES Plan of Work: GOAL 1, Program 11

Description: Perhaps it is a function of Minnesota's such long winters that makes home gardeners appreciate the flowers that grace the summer. The MAES funded Herbaceous Perennial Breeding Program works to fill that need. The program has concentrated both on developing new varieties of flowers that can thrive in the northern zones such as chrysanthemum and developing cold hardy varieties of flowers such as roses.

a. Impacts:
Four new garden chrysanthemums are being patented, tested in Canadian trials and commercial production trials for release this year. Seven Mammoth series of garden shrub-type chrysanthemums are now on the market. Three polyantha rose cultivars have been named and will be released to the public this year under an exclusive licensing arrangement with a large local nursery. The University is currently negotiating a license agreement for the marketing and sales of a USDA Zone4a hardy Kentucky wisteria cultivar. The development of improved landscape plant cultivars hardy to USA Plant Hardiness Zones 3 and 4 provides a backbone for the Upper Midwest U.S. nursery and landscape industry.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

Description: To support both the nursery and landscape industry and home gardeners, horticultural researchers have been working to increase the production efficiency and health of nursery grown crops. One such study is looking at a system to grow large trees hydroponically. The advantages of this system is it offers large effective root systems and easy to move trees. Researchers have also established that current techniques used to slice root systems are not effective at promoting root development beyond the original root ball.

a. Impacts:
The work with both pot-bound plants and stem girdling roots has had effects throughout Minnesota as landscapers realize that their planting techniques may need to be altered in order to ensure a quality root system. The knowledge gained from the work in this laboratory has led to the production of a book, *The Truth about Garden Remedies.* Over 10,000 copies of the book have already been sold.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

Key Theme: Plant Health (Research)

MAES Plan of Work: GOAL 1, Programs 7, 8, 9, 11,

Description: Soybeans planted on 7 million acres in 2006 provided approximately 20 percent of farm income and, along with corn, continue to be the state's most important crop. Soybeans have become increasingly important in central and in northwestern Minnesota and have now surpassed small grains in acreage in those regions. A survey of soybean diseases conducted in collaboration with the Minnesota Department of Agriculture provided a comprehensive overview of soybean diseases occurring in Minnesota. Soybean diseases and soybean cyst nematode caused yield losses estimated at 12 percent statewide. These yield losses represent as much as $146 million in lost income for Minnesota soybean producers.

a. Impacts:
The survey has given important information to farmers, as well as supporting research directions on soybean disease. For example, in 2006 Sudden Death Syndrome of soybean was confirmed to be present in seventeen counties in southern Minnesota. This discovery led to research to identify a simple accurate greenhouse test for resistance or tolerance to SDS. Collaborative research investigating crop rotation effects on soybean cyst nematode populations and iron deficiency chlorosis had determined that rotational crops such as canola, sugar beet or buckwheat reduced the severity of iron deficiency chlorosis. This research on the biology and ecology of soybean pathogens is leading to more effective methods of controlling soybean diseases and thereby increasing profitability of soybean production for Minnesota farmers

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

Description: *Fusarium* head blight, commonly known as scab, remains a top research priority at the University of Minnesota. Combined losses due to scab for Minnesota wheat and barley producers are estimated at approximately $2 billion since 1993. MAES

molecular geneticists are identifying the genes and genetic mechanisms by which scab resistance can be developed in wheat and barley.

a. ***Impacts***:

Progress includes mapping and characterizing genes involved in resistance to scab and to its toxins, and incorporating such genes into wheat and barley lines. Timely information has helped wheat and barley producers in Minnesota apply fungicides more effectively to suppress scab.

b. ***Source of funding***: Hatch

c. ***Scope of impact***: State, multi-state

Description: Soybean rust, recently introduced into the U.S., poses a new threat to soybeans both nationally and in Minnesota. Any potential risk to soybean is important in Minnesota, which derives 20 % of its annual farm income from the crop. Current recommendations for management of SBR rely on fungicide application, a practice that will increase to the cost of soybean production. Timely, cost-effective fungicide application will require accurate forecasts of SBR risk coupled with early, accurate detection of SBR by trained observers.

a. ***Impacts***:

MAES researchers, collaborating with others in the North Central U.S., have established a system of sentinel plots to provide early indication of soybean rust infection and to develop a disease forecasting system to provide growers with sufficient warning for timely fungicide applications.

b. ***Source of funding***: Hatch

c. ***Scope of impact***: State, multi-state

Description: Minnesota potatoes are worth $120 million a year. Late blight and Verticillium wilt are among the most costly potato diseases. Chemical control of late blight costs Minnesota growers $16-$32 million a year and has negative environmental impacts. Previous accomplishment reports have discussed work funded by MAES in potato breeding and genetics to tackle these disease problems.

a. ***Impacts***:
Among the results and scientific impacts of this work the past year:

- University of Minnesota researchers produced over 600 new hybrid cross combinations, evaluated over 40,000 new hybrid first year seedlings and

exchanged over 40,000 seedling tubers with Colorado, Idaho, Oregon, North Dakota, and Wisconsin.

- The U of M is one of three national selection sites for characterizing elite germplasm for resistance to common scab. U of M has the only national selection site for characterizing resistance to aphids, viruses, and virus expression in foliar tissue.
- Researchers have identified about 300 clones have strong resistance to late potato blight.
- Researchers have transferred late blight resistance genes identified in a wild potato species to cultivated potato via somatic hybridization.

b. ***Source of funding***: Hatch

c. ***Scope of impact***: State, multi-state

Key Theme: Animal Health (Research)

<u>MAES Plan of Work</u>: GOAL 1, Program 4, 5 and 6

Description: Ongoing work on Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) has been discussed in previous Accomplishment Reports. Since 1987, the U.S. and global swine industries have experienced major economic losses from the disease. It has proved to be a particularly difficult problem to control. Outbreaks among herds have been unpredictable and varied. Even herds that have been considered purged of the disease experience recurrent outbreaks as it frequently mutates into new strains. It has required an integrated and multi-faceted research approach to understand and develop control strategies.

a. ***Impacts:***

A PRRSV database has been developed in cooperation with the National Pork Board PRRS Initiative and developed by members of a North Central project funded by the USDA National research Initiative that provides easy sharing of information on the fundamental biology of PRRSV. It contains over 5,400 PRRSV nucleotide sequences. The database can be mined for places an isolate has been found and when and where it first appeared. This helps identify and differentiate PRRS viruses that are virulent or vaccine-derived, and have genetic difference that are important in making vaccine choices. The publicly available database offers the industry a new tool for understanding virus spread.

But there has been another major impact of the lessons learned from this work: in developing an integrated response to a new disease. Post weaning multisystemic wasting syndrome (PMWS) is the most significant swine disease to emerge since PRRS. PMWS was first reported in 1996 in Canada and has since caused major epidemics and large financial losses to swine industries worldwide. PMWS has been reported as a sporadic and generally mild problem in North American for a decade. However an epidemic of

severe PMWS has occurred over the last 18 months in eastern Canada, and in recent months similar clinical presentations have been observed in North Carolina and Kansas. Learning from the problems and difficulties in responding to PRRS during its emergent phase, an integrated research project has been funded by MAES-administered Rapid Agricultural Response funding to tackle PMWS before it arrives and has a major negative effect on the industry.

b. ***Source of funding***: State, Regional
c. ***Scope of impact:*** State, multi-state

Key Theme: Food Safety (Joint)

<u>MAES Plan of Work:</u> Goal 2: To ensure an adequate food and fiber supply and food safety through improved science based detection, surveillance, prevention, and education

Description: The development and use of "real-time" assays for food pathogens is a boon for the food industry in controlling potential food borne outbreaks associated with listeria and salmonella. Last year's Accomplishment Report discussed success in developing a listeria assay as a quick and sensitive detection method.

a. Impacts

Use of the listeria assay has increased in the commercial world as more firms recognize the concept of using the test to identify presumptive positive samples to be followed up with more intensive diagnostics. This approach permits rapid screening to be done cost-effectively. Since then, researchers have been using this approach to develop a single step salmonella indicator broth. The assay performed comparably multi-step diagnostic test kits currently available. Researchers are taking the version to a beta test with a commercial partner this year.

b. Source of funding: Hatch
c. Scope of impact: State

Description: MAES research is focusing on the time it takes the disease-causing bacterium *Lsteria monocytogenes* to grow to dangerous levels in foods such as deli meats and hot dogs. The current food labeling system with phrases like "best if used by" and "sell by" are not accurate to prevent food borne illness. It would be better if those labels where based on safety standards like temperature history and potential levels of disease-causing bacterium.

a. Impacts

Researchers developed a system that allows manufacturers to evaluate the safety of their products. Small chemical and electronic food label tags can track the time-temperature history of food products during their journey from processing plant to supermarket. This allows more accurate labels with statements such as "use by the date indicated, unless the time-temperature history tag turns red." Food companies can use these tags in Europe, but it will be up to the U.S. government to mandate their use to help improve food safety in the United States.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

<u>Extension 2004-06 Plan of Work:</u> Goal 2, Program 1: Food Safety: Producer to Consumer
Program Component: Pests and Pest Management Inspections in Food Processing Facilities

Description: Through collaborative efforts of the Department of Entomology and Extension, information on pest management is provided to farmers, industry professionals, and food processing organizations. This year, the collaboration responded to requests to expand outreach of this educational programming – moving education from food safety inspectors to the retail food service facilities that they inspect.

a. Impact

System improvement:
As a result of training, 72% of food safety inspectors applied what they learned when inspecting food facilities. Their priorities include educating firm operators and reviewing pest control management documents to alleviate pests in food processing facilities.

Inspectors recommended that a similar course be conducted for retail certified food managers. Funding was procured and a conference for the industry was held on September 20, 2006.

The program was recommended and developed for inspection personnel at local health agencies with a delegation agreement with the Minnesota Department of Agriculture so that inspections are done in a consistent and uniform manner.

b. ***Source of funding:*** Smith Lever 3b & c, state, county, sponsorship fees, US Food and Drug Administration
c. ***Scope of impact:*** State

MAES Plan of Work: GOAL 3

Description: One of the difficulties in diagnosing an E. coli outbreak lies in the fact that there are many enterohemorrhagic E. coli (EHEC) strains that are not detectable by current tests. MAES Food safety researchers have developed a two-step process to detect those organisms using traditional culture methods.

a. Impact

As a result of this work the researchers are now collaborating with the Minnesota Department of Health which is sending samples for testing to the researchers' lab. The next step is to shorten the testing time which now takes two days. The goal is to provide results within the same day. The implications for public health are very important. At this time official figures of the number of cases from these organisms is estimated to be about 35,000 a year, but that is likely a low estimate. With an accurate test it would be possible both to have better information about the scope and frequency of the incidents, as well as a way to move more quickly to remediate the problem once identified.

b. Source of funding: Hatch

c. Scope of impact: State, multi-state

Extension 2004-06 Plan of Work: Goal 2, Program 1: Food Safety: Producer to Consumer
Program Component: ServSafe for Spanish-speaking Food Service Workers

Description: In 2005, we reported on a major program effort to create cultural and linguistic adaptations to our successful food safety program for food service workers so that Latino service workers could be certified by the National Restaurant Association. That was accomplished in 2006. The program was designed through collaborative work with food service regulatory agencies and businesses. The course format was spread over four weeks rather than a one-day course, responding to feedback from Latino food service workers.

a. Impact

Equity in knowledge gain and certifications:
The test results of Spanish-speaking food service workers taking the National Restaurant Association exam were remarkable. Nine of ten passed the exam; the average passing score was 93.19%; the highest passing score was 99%. In earlier versions of the test, no more than 40% of Spanish-speaking workers had a passing score and the average of those that passed was only 78%. It is logical to assume that more knowledgeable workers create safer food conditions in the service industry.

b. *Source of funding:* Smith Lever 3b & c, state, county, participant fees

c. *Scope of impact:* State

Key Theme: Human Health (Joint)

<u>MAES Plan of Work:</u> Goal 3: Through research and education enable people to make health-promoting choices.

Description: Current food service approaches in some public schools contribute to unhealthy eating among children. Budget constraints force schools to purchase mass-produced, low-cost foods that are offered through large food distributors—pizza, frozen and fried chicken fingers, frozen French fries, and fruit juices with high-fructose corn syrup. Beginning in 2004, MAES applied economics researchers have been collaborating with Independent School District 2870 in Hopkins, Minnesota to analyze the economics of student food choices, the school budget environment, and the impact of state and federal programs on school feeding programs. The goal was to demonstrate an economically viable school lunch program that would encourage healthful eating habits and increase local sourcing of nutritionally sound food.

a. Impacts

The resulting food service program (called "Royal Cuisine") has received much attention from the media as well as nutritionists and food service directors nationwide. Data for 330 Minnesota school districts was analyzed to derive recommendations for improving the nutritional quality of school lunches. The study found that lunch sales do not decline when healthier meals are served, and more nutritious lunches do not necessarily cost more – both widely held views. The research provides specific policy recommendations for school lunch programs that will help tackle the growing problem of obesity in children.

b. Scope of funding: Hatch
c. Scope of impact: State, multi-state

Description: In another project, researchers completed plate waste studies in two St. Paul elementary schools to examine consumption of partial whole grain foods—a 50:50 blend of red whole wheat/refined flour for pizza and French bread. The study revealed consumption was similar for both of the pizzas.

a. Impacts

Results of this small but targeted study showed that incorporation of whole grain flour into grain-based foods is a method that families and school lunch program managers can use to increase whole grain intake, and get children accustomed to whole grain products.

b. ***Scope of funding:*** Hatch
c. ***Scope of impact:*** State, multi-state

Description: Researchers have been investigating the dietary habits of minority and at-risk populations. One study surveyed and measured height and weight and calculated the body/mass index on 280 mother/child pairs living in urban homeless shelters. Results showed that almost 80 percent of the mothers classified as overweight or obese and approximately 46 percent of the children were classified as at risk for overweight or overweight. The researchers also studied the environmental factors that influence the mothers' and their children's dietary habits. Another study evaluated the dietary behaviors and nutrition among inner-city, multi-ethnic youth attending a 10-week garden program.

a. Impacts
The first study found that limited cooking and storage facilities in the shelters influenced shopping and dietary behavior of women and their children. Women spent more money to buy small food packages to fit into hotel size refrigerators. After sharing findings with the shelters, one has replaced small refrigerators with a full-sized one. In the garden program it was found that boys significantly increased their fruit and vegetable intake by the end of the program, while girls significantly increased consumption of meat. The conclusion was that garden programs do have the potential to positively impact inner-city youth nutritional education and food choices.

b. ***Source of funding:*** Hatch
c. ***Scope of impact:*** State

<u>Extension 2004-06 Plan of Work</u>: Goal 3, Program 1: Health and Nutrition Education
Program Component: Obesity Prevention in Communities

Description: With Smith-Lever funding, the team of regional educators and campus staff provide education and facilitation to parents, teachers, coaches, and decision-makers who affect the diet, exercise and health of young children. The goal is to stimulate system changes that affect environments where children get their messages about health and nutrition. In 2006, Extension utilized a package of resources to guide local decision-makers in the development of School Wellness Policies. Tools include meeting guides, needs assessment tools, sample and model policies, background information on student health, examples of successful school health initiatives, action plans and policy monitoring tools.

a. Impacts
Local policy changes:

Among schools provided with facilitation, 100% adopted new policies that promote wellness. These policies incorporated information presented during facilitated sessions. Schools made changes that include removing sugary beverages from vending machines, offering only 1% or skim milk for school meals, offering non-food rewards in classrooms, and serving whole grain foods in the classroom. Their new policies were selected as a result of information and facilitation from Extension. The policies they developed were significantly more detailed than those advocated by Minnesota's model School Board Wellness Policy.

b. ***Source of funding:*** Smith-Lever b&c, State
c. ***Scope of impact*****:** State

MAES Plan of Work: Goal 3: (Note: Farm safety research is coded in the MAES database under Goal 3. Extension work connected to this research is reported under Goal 5.)

Description: Agriculture now has one of the highest death rates of all U.S. industries, and injuries and fatalities cost the industry close to $5 billion annually. MAES research have collected detailed data related to fatal farming work-related injuries in Minnesota. Research to determine fatality risk factors have also been complemented by collaborative research with the School of Public Health examining agricultural injury risk factors in a multi-state region.

a. Impacts:
Annual fatality numbers have been found to range from 22-to-31 with the largest number still occurring as a result of tractor overturns. The fatality and injury investigative work has guided research and development. For example, sensor systems were developed to detect people working near rotating powered farm equipment, and in some cases, actually shut machines off to prevent entanglement. Significant work was also conducted to estimate the economic costs of downtime associated with agricultural injuries during critical planting and harvest periods. All of the research has directly guided Extension educational activities aimed at preventing agricultural injuries, fatalities and occupational disease.

b. Scope of funding; Hatch
c. Scope of impact: State and multi-state

MAES Plan of Work: Goal 3

Description: Ongoing research on the interactions between diet and reproductive hormones in humans aims to find dietary recommendations to help prevent hormone-dependent cancers such as breast and prostate cancer. Recent research has focused on

phytoestrogens. These naturally-occurring compounds found widely in fruits, vegetables, and legumes, are hypothesized to protect against cancer, heart disease and osteoporosis, in part as a result of these hormonal effects. The most concentrated sources of sources of phytoestrogens in human diets are soybeans. An ongoing study of soy effects in men at high risk of prostate cancer has included the first clinical intervention study in high risk men, in which prostate biopsies where taken before and after an intervention study.

a. Impacts:
Results of this study show that soy products can lower prostate cancer risk. The study confirms the beneficial effects of soy consumption in men at high risk of prostate cancer and points to dietary recommendations for prostate cancer prevention.

b. Source of funding: Hatch
c. Scope of impact: State and multi-state

Description: Adding probiotics to the diet for improved health is a concept that is beginning to attract the U.S. consumer. This involves adding live bacterial cultures, particularly in dairy foods, to enhance intestinal and overall health. MAES scientists have focused on *bifidobacterium longum*, which is believed to be an important bacterium for maintaining a healthy large intestine. But the problem is how to handle these cultures so they retain their health promoting properties when put in foods. Researchers are using a genomics approach to understand the characteristics of bifidobactera.

a. Impact:
The research has identified and conclusively confirmed the genomic characteristics that cause the bacterial cultures to lose efficacy once in the large intestine. The impact of this finding is that researchers have used a genomics approach to predict that bifidobacteria cultures will adapt in fermentation environments by losing DNA regions it no longer needs in these environments. This finding will help refine commercial fermentation procedures to limit this adaptation response of bifidobacteria cultures so that they retain their ability to compete in the human colon.

b. Source of funding: Hatch
c. Scope of impact: State and multi-state

Description: It may seem unusual to discuss the results of research focusing on apparel design under the theme of Human Health. However, MAES researchers have been using an innovative research facility; the Human Dimensioning Laboratory at the University of Minnesota, which was established in 2003 with a National Science Foundation Grant, to do MAES sponsored research in several areas, including developing products for health and safety.

a. Impacts:

Working with the University of Minnesota Extreme Environments Laboratory, researchers developed an improved liquid cooling ventilation garment that maintains a safe body temperature for astronauts. A collaborative project with four other universities is developing improved protective clothing for pesticide applicators using body scan data and motion capture assessment to evaluate prototypes.

b. ***Source of funding:*** Hatch
c. ***Scope of research:*** State and multi-state

Key Theme: Agricultural Waste Management (Joint)

MAES Plan of Work: GOAL 4, Program 6

Description: Manure nutrients in excessive amounts are a growing issue for animal producers, especially in areas where cropland is limited. Researchers have been studying the use of sequencing batch reactors to reduce nitrogen, phosphorus, and carbon simultaneously from manure in a single reactor.

a. ***Impacts***
The outcome of this project provides valuable insight on the use of one of agriculture's most abundant bio-resources for energy production. The research showed that the sequencing batch reactors system can successfully carry out the nitrification process with liquid swine manure, resulting in a nearly complete removal of ammonium nitrogen. The scientific impact of this research is the foundation to scale up the reactor so that it can be used at the farm level. Outreach efforts are providing producers, engineers, Extension educators, and technical staff practical and technical information on systems that not only help animal producers deal with manure management issues, but provide potential alternatives to fossil fuel-based energy sources.

b. ***Scope of funding:*** Hatch
c. ***Scope of impact:*** State and multi-state

Extension 2004-06 Plan of Work: Goal 4, Program 1: Environmental Safety & Management
Program Component: Manure Management

Description: From February 2003 to March 2006, 843 participants in eighty Extension workshops prepared two-field nutrient management plans for their farms. The three-hour workshops were hosted by county feedlot officers, conservation districts, Extension offices or livestock producer organizations. Most participants were non-CAFO (Concentrated Animal Feeding Operation) livestock producers who must comply with manure management requirements under state rules.

a. Impacts

Behavior change:
A survey was sent to 669 participants following the cropping season when the Nutrient Management Plans would have first been implemented. Of the 50% who responded, 55% had completed their plans for the entire farm as a result of the sessions; 3% were still completing their plans, and 6% had completed them prior to the sessions. Of respondents, the increase in practice adoption from pre-workshop to post-season was 10% for soil testing, 21% for testing manure, 22% for calibration of spreaders, 29% for crediting nutrients in manure and 33% for keeping records of manure applications. An additional 10-20% indicated that they intended to adopt the practice within two years.

Cost savings:
In the sessions, 86% of participants calculated that they would save $6 or more per acre in fertilizer purchases if they followed their new plan and 56% would save more than $10 per acre. The total crop area managed by all producer participants is estimated to be 609,000 acres. Conservatively, the program created a cost-savings for the field of $3,654,000.

b. Source of funding: Smith-Lever 3b&c,, State, County, MN Pollution Control Agency, USDA, EPA, MN Department of Agriculture.
c. Scope of impact: State, Multi-state

Key Theme: Forest Management (Joint)

<u>MAES Plan of Work</u>: GOAL 4, Program 1

Description: Major forest research has been studying local and national wildfire by analyzing homeowners, communities, and neighborhood associations.

a. Impacts
The studies led to the development of outreach to support land managers and community leaders who work and live in fire-prone ecosystems. Minnesota's contribution has a national impact. The product is a model for studying community wildfire preparedness with short case studies emphasizing lessons that might be used by communities confronting similar problems. A neighborhood association study has its first publication, with insights about working with community leaders for improved homeowner preparedness.

b. Scope of funding: McIntire-Stennis

c. ***Scope if impact:*** State, multi-state

Description: MAES forest research has a 20-year history in model development and associated application for analyzing statewide timber supply. Models help identify how management can be coordinated to sustain timber production while also protecting the environment. Results are especially useful for large public ownerships, but management of private lands is also important and more difficult to control. To better understand the likely impact of private forest landowners on statewide timber supply, methods have been developed to include in the modeling system of series of constraints describing general private landowner behavior.

a. ***Impacts***
Statewide applications have suggested industry expansion involving species other than aspen. In one example, model applications were central for analyses of a $600-$700 million pulp mill expansion in northern Minnesota.

b. ***Scope of funding:*** McIntire-Stennis
c. ***Scope of impact:*** State

Description: Research on the distribution and use of private forest land in Minnesota has benefited both private forest landowners and public land use managers. Forest researchers have studied the extent and ecological, social, and economic implications of parcelization of forest land in north central and northeastern Minnesota. They expanded the research to investigate watershed improvement programs targeting private landowners.

a. ***Impacts:***
The research has shown that parcelization happened at a significant rate in the early 2000s. The location of new parcels was mapped in relation to physical attributes and used to predict indicators of parcelization. Meetings are being held with country land commissioners and planning and zoning administers to redevelop research plans to accommodate community and county needs. The research has shown a number of state-sponsored programs are available to assist landowners in improving local water resources, but very few participate. In light of the more than 1,000 impaired waters and streams in Minnesota, private landowner assistance programs could provide a critical alternative to addressing an escalating problem.

b. ***Scope of funding:*** State
c. ***Scope of impact:*** State

<u>Extension 2004-06 Plan of Work:</u> Goal 4, Program 2: Natural Resource Management and Utilization
Program Component: Urban Landscapes

<u>Description:</u>
Urban landscapes programs educate home owners and tree service professionals in urban and small communities to manage Minnesota's trees, improve tree selection and care for trees effectively.

a. Impacts

Knowledge change:

- 60% of participants in renewable energy programs indicated they had more knowledge about markets that exist for biomass, impacts of biomass harvesting, and other benefits of producing biomass, such as carbon sequestration. (Carbon sequestration provides natural ways to pull carbon out of the atmosphere in order to mitigate global warming.)
- 87% of participants successfully completed the Tree Inspector Certification exam.

Change in local infrastructures that protect the environment:
Due to leadership and education provided by Extension educators and campus specialists, communities are taking action to protect the environment.

- Agroforestry programming in Wadena, MN resulted in development of a grassroots organization to develop a carbon sequestration pilot project.
- The Minnesota Agroforestry Cooperative was revived. Its proposal to create a renewable energy economy in Minnesota based on perennial plants is being promoted by the Minnesota Department of Agriculture.
- A Community Wildfire Protection Plan was created in heavily-forested Itasca County.
- With leadership and consultation from U of MN Extension, USDA CSREES launched a new reporting and accountability system for Renewable Resources Extension Act funds.
- Urban landscapes educational programs derive economic benefits due to cost savings in managing water quality; reducing storm water processing, air pollution and energy needed for heating and cooling homes and building; and increasing property values. A recent study proves that annual, net community benefits for well-maintained trees are: $3 - $5 per small tree, $4 - $34 per medium tree, and $58 - $76 per large tree.
- Over 2,000 trees and shrubs were planted as a resource for ethanol production.

b. Source of funding: Smith-Lever 3b&c, State, Natural Resources Research Institute
c. Scope of impact: State, Multi-state

Key Theme: Water Quality (Joint)

MAES Plan of Work: GOAL 4, Program 5

Description: A large project using remote sensing to monitor water quality of Minnesota's 10,000 lakes has been completed and provides an unprecedented assessment of lakes in terms of number of lakes and their water clarity. Classifications of more than 10,000 lakes for 1985, 1990. 1995, 2000 and 2005 provide a visual record and comparable data of the changes in Minnesota's most celebrated water resources.

a. Impact

Detailed analyses are now possible for individual lakes, as well as by county, watershed and lakeshed. The data for all lakes and years are available in a web-based mapping tool at www.water.umn.edu. The results of this research are being used by state agencies as inputs to land and lake management and policy decisions.

b. Source of funding: Hatch

c. Scope of impact: State

Description: The Minnesota River, which snakes roughly 350 miles from northern South Dakota before connecting to the Mississippi River just southwest of St. Paul, remains among the most polluted rivers in the U.S. The Minnesota River is the state's largest contributor to overall nutrient pollution, killing marine life as far away as the Gulf of Mexico. Research has shown this pollution is about 80 percent non-point-source. In Minnesota, more than 90 percent of the land through which the river flows is associated with agricultural activity, primarily corn and soybeans. An inter-disciplinary team of researchers have been devising solutions to this problem through modeling and field work. Among the ways to improve the river's water quality is to develop third crops alternatives to corn and soybeans.

a. Impacts

Among the results of this research and its impacts:

- A model was used to simulate stream flow changes with different scenarios of conversions and wetland restoration. It showed that improving stream channel stability and replacing crops on portions of the landscape can enhance water quality.
- Learning groups focusing on hazelnut, native seed production, healthy meats/Omega 3, and woody florals are making alternative crops more feasible.
- Researchers developed policy briefs addressing the benefits of agroforestry/perennial cropping systems and policy changes needed to enhance adoption. These were presented to individuals and organization that influence negotiations for the 2007 Farm Bill.
- The research has provided leverage to expand perennial cropping systems in the tributaries of Blue Earth basin of the Minnesota River Basin.

- WATER, a simulation tool, was developed and improved to help develop realistic Total Maximum Daily Loads.

b. ***Source of funding:*** McIntire-Stennis
c. ***Scope of impact:*** State, multi-state

Description: Several drainage studies have been ongoing to improve drainage design and management alternatives to improve water quality.

a. ***Impact:***
Model simulation has provided important insights into the role of drainage on hydrology of agricultural landscapes in Minnesota. Over an 85-year historical record, computer modeling indicates that approximately 40 percent of precipitation ends up leaving the landscape through subsurface drainage system. This research is quantifying the potential for reducing unwanted environmental effects associated with subsurface drainage systems. It is helping state agency officials make decisions regarding the allocation of conservation program funds toward improved drainage practices. A gravel filter study has shown how farmers can increase the longevity of the filters. Many tax-funded programs in Minnesota use this data to justify providing cost share dollars to install gravel filters to replace open tile inlets.

b. ***Source of funding:*** Hatch
c. ***Scope of impact:*** State, multi-state

Description: Research to quantify the costs of converting from a corn-soybean rotation to perennial vegetation to reduce water pollution provided important real-world analysis and information to farmers. It estimated the risk premium farmers would require to adopt alternative crops. Researchers surveyed farmers who participated in three learning groups—on hazelnuts, native seeds and woody florals, which the University of Minnesota Extension Service set up with assistance from Clean Up the River Environmental, Blue Earth River Basin Initiative and other local contacts.

a. ***Impacts:***
To lessen agricultural stresses on the Minnesota River it will be necessary to provide realistic alternatives to conventional farming. The survey showed that 77 percent of the farmers surveyed were willing to adopt an alternative crop (in fact, approximately 40 percent have already chosen to do so) but farmers are also concerned about the capitol conversion costs and wanted a capital subsidy to make those investments. The findings are providing important guidance for those designing programs to increase the planting of perennial crops to reduce water pollution.

b. ***Source of funding:*** Hatch
c. ***Scope of impact***: State and multi-state

Description: A large project using remote sensing to monitor water quality of Minnesota's 10,000 lakes has been completed and provides an unprecedented assessment of lakes in terms of number of lakes and their water clarity. Classifications of more than 10,000 lakes for 1985, 1990, 1995, 2000 and 2005 provide a visual record and comparable data of the changes in Minnesota's most celebrated water resources.

a. Impact:
Detailed analyses are now possible for individual lakes, as well as by county, watershed and lakeshed. The data for all lakes and years are available in a web-based mapping tool at www.water.umn.edu. The results of this research are being used by state agencies as inputs to land and lake management and policy decisions.

b. Source of funding: Hatch
c. Scope of impact: State

Description: And lastly, a study on the agricultural impacts on water quality has been using a robotic methodology for analysis of pesticide degradation. Results have shown the robotic system is capable of effectively measuring enzyme activity in sols.

a. Impacts:
The robotic system cuts labor costs associated with such analyses by a factor of ten. Another focus of the research team--a paired watershed project completed last year and discussed in a previous Accomplishment Report--was selected as one of the watershed project success stories by USDA-CSREES.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

Extension 2004-06 Plan of Work: Goal 4, Program 4: Water Resource Management
Program Component: Citizen Measurement

Description: Minnesota's 2,560,299 acres of deep water lakes, waters and streams are vulnerable to disease-causing organisms that can be harmful to the ecosystem and to human health. However, very few watersheds have been tested for e-coli bacteria that may indicate contamination. No infrastructure or funding exists to develop this data base.

From 2004-2006, UMN Extension was the lead investigator for a six-state research project to learn whether citizens of Minnesota's lakes and rivers could become volunteer agents to test waters. The project compared the quality of data collected by trained volunteers using inexpensive test kits to data collected by professionals and sent to laboratories.

The project determined that data collected by trained volunteers is viable. This finding means that tests can be performed for a nominal cost, rather than at a cost of $400 per test if professionals are used. (Each completed test requires five water samples.) This finding opens new opportunities for local and state government interested in water quality.

a. Impact

Inexpensive alternative for testing water quality:
This pilot study collected a data base of samples from 27 Minnesota lakes. In this pilot test, the trained volunteer method provided Minnesota's lakes with a service that would have cost almost $11,000 if managed professionally. Ultimately, the value for Minnesota's "10,000 lakes" could be over $4,000,000.

Volunteers engaged in this pilot study contributed 1,072 hours. This is a value of $19,296 contributed to the monitoring of the health of Minnesota lakes and streams.

The results of the study are being disseminated to all state and local agency stakeholders interested in water quality. Findings are also being disseminated throughout the six-state region. Extension is currently seeking funds to determine what infrastructures could be utilized to train and manage volunteers to develop a statewide data base.

Informed public policy:
Data collected through the project was used by local units of government. These informed actions demonstrate the usefulness of investing in water testing. For example, volunteers identified unauthorized discharges from the wastewater treatment plant in Pine City. Several lake associations invested in additional monitoring equipment and have implemented targeted bacteria testing in tributaries. One county has authorized further bacterial monitoring as a result of the work of volunteers.

b. ***Source of Funding:*** Smith-Lever 3b&c, State, County
c. ***Scope of Impact:*** State, Multi-state

<u>Extension Plan of Work 2004-06:</u> Goal 4, Program 4 Water Resource Management Program Component: Assessing the Impact of Arsenic Contamination on Dairy Operations

Description: The Department of Health estimates that 8% of water wells in West Central Minnesota exceed guidelines for human health exposure to arsenic. (See map below for visual of Minnesota's arsenic concentration.) Dairy producers and researchers wondered if dairy cows that drink a great deal of water containing high levels of arsenic produce milk and other dairy products with levels of arsenic. A multi-disciplinary Water Resource Team investigated. The study was completed in 2006, and findings are being distributed to local elected officials, dairy farmers and Minnesota's dairy industry.

a. Impacts

Discovery of accurate biomarker:
In humans, hair, fingernails, urine and blood are useful indicators of arsenic exposure. Until this study, no biomarker had been identified to determine arsenic levels in cattle. Researchers determined that cow's urine is a good indicator of exposure to arsenic. The amount of arsenic in urine correlated well with the level of arsenic in the water they were drinking. This important discovery will be useful to future studies.

Dairy products determined safe:
No arsenic was detected in milk or cheese from cows that drank water high in arsenic. This peace of mind improves the relationship between Minnesota's dairy industry and its consumers.

Safer Wells:
The study sampled water from over 100 wells in Otter Tail and surrounding counties and invited producers with elevated arsenic levels to participate in the study. Well owners, most of whom had never tested their well water for arsenic, were provided the results. 51% had arsenic levels greater than the 10 ppb recommended by the USEPA for safe drinking water. When presented with this information, most well owners took action to decrease their families' exposure to arsenic.

Future studies:
A second phase of the research will test meat and organ tissue to determine whether arsenic shows up in meat products or damages organs in dairy cattle in their early years. Discoveries from these studies could improve the safety of food and the productivity of the dairy industry.

b. Source of funding: Smith-Lever, 3b&c, State
c. Scope of impact: State

Key Theme: Biofuels (Research)

<u>MAES Plan of Work:</u> GOAL 4, Programs 3, 4

Description: As production of ethanol increases in Minnesota, more distillers dried grain (DDG) will be available for feeding to dairy cattle. However, variation in the nutrient content and availability to animals has been of concern to livestock nutritionists, because different plants often use different methods of production, so the nutritional value can vary from one supply to the next. MAES researchers have been evaluating the nutrient variation in DDG across eight ethanol-producing producing plants to determine its

viability as a feed supplement and to provide a more consistent product to the livestock industry.

a. Impacts:

Research has found that the crude protein content of DDG ranged from 24 percent to 35 percent across various ethanol plants. These levels are generally lower than soybean meal (with 44 percent crude protein) which is the most commonly fed protein supplement, but DDG remains advantageous because of its 10 percent average fat content (compared to just 1-2 percent for soybean feed.) Some farmers have saved as much as 20 cents per cow per day in feed costs. Research results have also dramatically increased the use of distillers dried grain in swine diets in the U.S. and internationally. This product has provided ethanol producers with an opportunity of additional income.

a.. Source of funding: Hatch

c. Scope of impact: State, multi-state

Description: High interest in the potential of biofuels and bioproducts for Minnesota, has led to the establishment of a rural "laboratory" at the MAES Research and Outreach Center in Morris that is studying the production of cellulosic ethanol, bio-diesel and bio-hydrogen energy and researching the production and processing of other bio-products.

a.. Impacts:

The Minnesota State Legislature has funded a pilot project at the West Central Research and Outreach Center to convert wind energy into hydrogen that can be used for anhydrous ammonia fertilizer. The project aims to provide a renewable alternative that can be locally produced to replace part of the $300 million of anhydrous ammonia derived from fossil fuels currently used as nitrogen fertilizer in Minnesota agriculture. The Minnesota Renewable Energy Research and Demonstration Center at Morris features community-scale renewable energy research and demonstration systems including a Hybrid Wind System and a Biomass Gasification System. As a result of the renewable energy work here, USDA and the Department of Energy awarded a $1.9 million grant to the University of Minnesota-Morris. Researchers are working with six different types of biomass, or plant material, and the information obtained from test burns will be used to create a "biomass toolbox" which will include standard operating procedures, best management practices and templates for contracts and pricing structures.

b. Source of funding: State

c. Scope of impact: State, multi-state

Description: Nearly 100 ethanol plants consuming corn have sprung up across the country. However, University of Minnesota researchers estimate that converting the entire U.S. corn crop into ethanol would replace only 12 percent of our gasoline consumption. At the same time, world demand for both fuel and food is projected to double in the next 50 years.

a. Impacts:

MAES researchers are looking at the potential of a diverse mixture of prairies grasses to make ethanol. The grasses not only can produce more net energy per acre than corn but they also act as a sponge for greenhouse gases before being harvested, soaking them out of the air and into their roots and surrounding soil. The last trait could prove an economic bonus for farmers if businesses one day are able to cash in "credits" for removing greenhouse gases from the air, as many predict. There are many reasons to support a more diversified agricultural landscapes and the current interest in biofuels is supporting that interest. Among the specific scientific impacts of various research projects focusing on biofuels:

- Researchers have completed a comprehensive county level database for Minnesota of the quantities of existing crop and agricultural biomass that can be harvested for energy. This is assisting policy makers and energy planners in determining if proposed biomass energy plant sites are realistic.
- An economic analysis of producing pyrolysis oil from samples of native prairie grasses, including switch grass and big bluestem show that production of bio-oils for fuels could be competitive.
- Bioengineering research has developed methods to convert solid biomass to liquid and gases, and further convert the liquefied biomass to biofuels and bioproducts. Microwave treatment is a new, environmentally friendly, technique for the production of gas and liquid biofuels from agricultural wastes.

b. Source of funding: Hatch

c. Scope of impact: State, multi-state

Key Theme: Global Climate Change (Research)

MAES Plan of Work: GOAL 4, Programs 3, 4

Description: Biosystems engineering research has used a "lifecycle assessment" approach to quantify the environmental effect of products and services, taking into account all the materials and energy used to create a product or a service throughout its lifecycle. The study analyzed 44 emissions generated by service industries--retail, hospitals or real estate, for example--which comprise more than 60 percent of the U.S. gross domestic product and are an increasingly large part of the U.S. economy. Some leading development economists have the idea that the total amount of greenhouse gases emitted will be reduced as the economy shifts toward more services and less heavy industry, because service industries are "cleaner." However, the study showed that while service industries directly create only about 5 percent of total greenhouse gas emissions themselves, when the entire life cycle of a service-related product is taken into account the picture changes dramatically. Such industries consume large quantities of electricity, natural gas, transportation, building installations and manufactured goods, which generate greenhouse gases.

a. Impacts:

The research showed that the shift toward a service-based economy will not automatically reduce the amount of greenhouse gases in the air. This contradicts assumptions about global warming often preferred by some economists and national policy experts. This information has informed the debate around global warming and contributed to public policy. In one specific outcome, the research findings regarding Life Cycle Assessment have been applied to eco-industrial park in South Korea, where traditional industrial complexes are being transformed into resources-efficient systems.

b. Source of funding: Hatch

c. Scope of impact: State, multi-state

Description: Northern latitude forests are one of the primary sinks for atmospheric carbon. But the long-term sustainability of current net carbon gain by these forests is not certain. Understanding has been impeded by a lack of sampling across the full range of conditions and in complex landscapes. Researchers using a combination of models and methods, including remote sensing, have determined that forest stands become sinks after the first 4 to 7 years of growth, with sink strength greatest at between 35 and 72 years, until at least 350 years, much later than previously reported.

a. Impacts

The scientific impacts of this research have provided important input to policy development. The measuring systems tested and used in this research have been shown they capture variability across a wide range of forest and wetland areas and climate difference. This research substantially improves estimates of forest carbon pools and fluxes and reduces uncertainty in estimating forest condition.

b. Source of funding: McIntire-Stennis

c. Scope of impact: State, multi-state

Description: Research on maintaining the quality of trout streams that provide high quality sport fishing in the Minneapolis/St, Paul metropolitan area has led to using aquatic insect data to set TMDLs for dissolved oxygen in trout streams. Researchers calculated temperature and oxygen needs for 82 insect species from Brown's Creek in Washington County and this was used to produce a model for setting levels of TMDL to protect target levels of species richness in the streams. The model is significant because the insects are the primary food for trout during winter and early spring, an important time in the reproductive cycle of the fish. In the process of this work, researchers have discovered that there are species of aquatic insects that occur in the trout streams that are highly adapted for winter development and emerge as adults during periods when air temperatures are below freezing. They have documented the cold-tolerance mechanisms of larvae and adults and are now collecting samples from the streams and rivers of the St. Croix River basin.

a. Impacts

The knowledge gained from this research is being used to assist in regulating trout streams to maintain trout sport fishing in urban streams that are highly vulnerable to disturbance related to urbanization and changing water temperatures. In the process, the researchers have discovered a key resource to assist in climate warming affects—the winter-active aquatic insect species, which appear to be least tolerant of reduced oxygen, and the most vulnerable to changing thermal conditions of trout streams.

b. Source of funding: State

c. Scope of funding: State

Description: MAES has a long history of monitoring the climate to help Minnesota farmers make decisions and to inform research. Now, monitoring networks using new measurement technologies that more precisely track variability in climate and carbon cycling have been established in the MAES Research and Outreach system. MAES has been cooperating with the National Weather Service, Federal Aviation Administration, Minnesota Department of Transportation, Minnesota Department of Natural Resources, the Meteorological Service of Canada, and the University of British Columbia. This work has been studying carbon cycling and other greenhouse gases such as methane, nitrous oxide and water vapor between the land surface and the atmosphere. Laser spectroscopy measurement of isotopic carbon dioxide exchange was extended to include oxygen isotopes in carbon dioxide, which will provide a new opportunity to study carbon cycling processes.

a. Impact

The collaborative nature of this research has provided a way for government and universities to share resources and information. The knowledge base gained is beginning having an important impact within the scientific community and general public. For example, results shared at national and international conferences are questioning the long-held optimistic view that reduced soil tillage can result in large carbon sequestration. Critical evaluation of the physical, chemical and biological dynamics of the climate system continues.

a.. Source of funding: Hatch

c. Scope of impact: State, multi-state

Key Theme: Impact of Change on Rural Communities (Joint)

MAES Plan of Work: GOAL 5

(Extension Ref. 2004-06 Plan of Work) Goal 5, Program 3: Community Economics
Program Component: Retail Analysis and Development

Description: By surveying 174 independent retailers located in nine counties, research sought to understand what factors make business environments seem benign or hostile to independent retailers, as well what business strategies managers make when environments are perceived to be hostile. Finally, the study worked to identify which strategies were related to high performance. Nine educators statewide are promoting community-based responses to retail performance by delivering studies of retail sector performance and discussing small store success strategies.

a. Impacts

The study showed that the factor most related to perceived hostility was store patronage by local customers rather than presence of a big box store. As perceived hostility of the business environment increased, retailer performance decreased and retailers emphasized a store strategy (e.g., store layout, merchandise representation). The business strategy most related to high retailer performance was financing and operation, suggesting that independent retailers need to focus on maintaining profitability by controlling costs, prices and cash flow.

b. Source of funding: Hatch, Smith-Lever 3b&c, State, Sponsorship Fees
c. Scope of impact: State

Key Theme: Strengthening Families (Research)

MAES Plan of Work: GOAL 5

Description: A long term project to determine the kind of adoption patterns which are most effective in helping to create strong families continues to provide important and surprising information to policy makers and the public. A major part of this work has been a longitudinal study of children adopted as infants in the U.S. under different arrangements of post-adoption contact: confidential adoptions, in which there was neither contact nor sharing of identifying information; mediated or indirect contact, in which communication was routed indirectly through the adoption agency; and full disclosed open adoptions, in which the adoptive families and birthmothers had direct contact, typically face-to-face. The children recruited into the study in the 1980s are now in their 20s and are being interviewed again.

a. Impacts
Studies published this year addressed issues of mental health in adoptees, comparing adolescents who had been in confidential adoptions since birth with those who had been in ongoing fully-disclosed adoptions since birth. On all measures of adjustment, there were no significant differences between the two groups, which ran counter to the common concern that children in open adoptions would be confused and suffer from identity problems. This study continues to contribute valuable empirical research findings to the national debate about "the best interest of the child" in cases of adoption. The findings are already shaping and changing agency and state policies and public perceptions about contact between adoptive and birth family members.

b. Source of funding: Hatch
c. Scope of impact: State, multi-state

Description: Research to develop successful family-based intervention programs for African American families in Minneapolis has had practical results.

a. ***Impacts***:

- The findings are being used by Hennepin County in planning for family-based health and mental health service.
- A center that will provide mental health services to residents of North Minneapolis, the majority of whom are persons of color, will use models and practices developed in this research.
- As a result of connections made with community leaders in the African American community and from the Hennepin County government, an enthnographic study of African American families in North Minneapolis has now begun.

b. **Source of funding**: Hatch
c. **Scope of impact**: State

Key Theme: Family Resource Management (Research)

MAES Plan of Work: GOAL5

Description: The news media is full of reports of the dangers of subprime home mortgage loans and the stresses such loans place on family economics and the larger community. MAES researchers have been studying the scope and distribution of subprime home mortgage loans in urban and rural Minnesota and interviewing homeowners holding subprime mortgages to track the impact on their household finances.

a. ***Impacts***:
The research found that homeownership patterns are being affected by a large number of subbprime and predatory mortgage loans. These issues are especially evident in low-income minority areas of the Twin Cities. Foreclosures are an increasing problem and the number of foreclosures has tripled in the last year. The findings are being used to develop more effective educational efforts to ameliorate the impact of subprime home loans and to prevent foreclosures. The findings are being used by community organizations and are being used in developing important state legislation that will address the problems surrounding subprime and predatory lending.

b. ***Source of funding***: Hatch
c. ***Scope of impact***: State

Description: Research on Minnesota family businesses has as its goal identifying strategies for families to use to increase the success of both their business and their family. Findings show that when family and business resources are intermingled, an

assessment of the well-being of one system is incomplete without assessing the other system. Researchers have found when family structures and relationship overlap business management there are significant effects on gross revenue and owner's perceived success.

a. Impacts:
A family business would gross more than $16,000 more revenue when a residential family member such as a spouse is employed in the business. If family business owners were to spend one more hour a week in the business, family incomes from these businesses would increase by $22 million annually.

b. Source of funding: Hatch
c. Scope of impact: State

Description: Research on the consequences of child support decisions has provided information for policy decision makers concerning Minnesota court order establishing financial support for children of divorces and unmarried parent. The Minnesota Legislature changes the state formula for child support guidelines in 2006 from a percent of net income formula to a cost-shares formula. This policy change takes effect this year. Minnesota is the only state to adopt a cost-shares formula and this has caused concerns for several stakeholder groups.

a. Impacts
Data derived from this research project and an income equivalence worksheet that the researchers developed have been shared with the Minnesota Bar Association., Family Law Section as they are calculating the effects of old and new formulas on particular types of child support cases. The researchers are assisting with a policy analysis that examines the effectiveness of the state child support guidelines in meeting the income needs of children.

b. Source of funding: Hatch
c. Scope of impact: State

Report on Stakeholder Input Process

Actions taken to seek stakeholder input that encourages their participation

MAES seeks stakeholder input in a variety of venues, to reach a broad spectrum of stakeholder groups. New efforts this year include the formation of a Plant Licensing Committee—a group of commodity crop stakeholders who advised on the principles and processes for licensing of MAES new varieties. Their input on the interests and needs of their industry has been helpful to the Experiment Station. The information-sharing within the group has also led to better understanding of how MAES supports its research through plant licensing, and garnered their support.

In an another important effort to gain more immediate and direct stakeholder input into MAES research decision, agricultural stakeholders were invited to be part of the yearly Rapid Agricultural Response Fund review and selection process.

An Agricultural Working Group, consisting of members of 22 agricultural groups representing all the major commodities in Minnesota met every other month during 2006 to work together to develop a shared vision for research with MAES administration and the deans of the colleges of Veterinary Medicine, and Food, Agricultural and Natural Resource Science.

This concerted effort to seek input from stakeholders in MAES research has created more opportunities to discuss problems and ideas and share concerns. As a result, there are more cooperative research projects and support for research. As one agricultural leader said, "The communication between the University and agricultural groups is much improved." As a result of this improved dialog, the Minnesota State Legislature is considering increasing the amount of State Special funding to MAES by $8 million this year.

All of the five colleges that receive MAES funding: The colleges of Food, Agricultural and Natural Resource Sciences (CFANS), Veterinary Medicine, Education and Human Development, Design, and Biological Sciences (CBS) have process in place to provide stakeholder input into research direction, selection and review.

Advisory committees for each of MAES' Research and Outreach Centers connect research to the specific needs of the region and provide a mechanism for citizen input into the research agenda.

Brief statement of the process used to identify individuals and groups who are stakeholders and to collect input from them.

Stakeholders are identified in many ways—college advisory councils, mailings lists from Experiment station and college publications, mailing lists for under-

represented/underserved populations, departmental and faculty contact lists, web site contacts.

Statement of how the collected input was considered

The deans and associate deans for research in the five colleges meet as an Experiment Station Executive Council to identify research priorities, set research policies, plan programs, and discuss stakeholder input for inclusion in the policy and planning decisions.

Statement regarding the usefulness of the stakeholder input process in refocusing and reaffirming priorities or in identifying emerging issues.

The stakeholder input process is a continuing process of feedback and response that often leads to new research focus. Stakeholder interest has encouraged research directions to respond to new crop and animal disease problems, and to new opportunities for agricultural products. Another good example of how stakeholder input is used to refocus priorities or identify emerging issues is through the use of the Rapid Agricultural Response Fund—a fund established by the Minnesota State Legislature and managed by MAES to support research on critical and emerging agricultural issues. All proposals for funding must seek stakeholder input and contain letters of stakeholder support. A plan to bring the results of the proposed research back to those stakeholder groups is also required.

Update on Program Review Process

The review process for Hatch supported projects has not changed since the original Plan of Work was updated. New strategies to bring stakeholder input into the research program review process have been described.

The Minnesota Agricultural Experiment Station and University of Minnesota Extension has collaborated on a joint Plan of Work for the next planning cycle, which has been submitted and approved.

Evaluation of the success of multi-state, multi-institution, and multidisciplinary activities, and joint research and extension activities.

Success of multi-state, multi-institutional and multidisciplinary activities

Faculty in the Minnesota Agricultural Experiment Station participated in 139 multi-state projects and committees this reporting year, an increase of 10 from last reporting year. CRIS progress reports have been filed to document Minnesota's participation in the projects, and this Accomplishment Report has described some of that work, including multi-state collaborative research on potato aphid and soybean rust.

Inter-disciplinary work on energy and the environment is supported by the Institute for Renewable Energy. Two colleges—CFANS and CBS--are working together to develop an integrated teaching, research, and outreach program in ecosystem science and sustainability. The aim is to provide fundamental scientific knowledge about the environment and hands-on learning about research on ecosystems and sustainability.

The Multi-state Mississippi River Basin initiative has led to the Green Lands, Blue Water project, and a long-term comprehensive effort to support a new generation of agricultural systems in the Mississippi River Basin. A multi-state consortium of land-grant instructions in the Mississippi Basin, non-profit organization and governmental agencies are responsible for overall project planning and monitoring. The total budget is $105 million over 10 years.

The Data-Linkage Project, in the School of Social Work, is a partnership between the School, CHE, the University and state and local governments. Data have been collected which documents issues of child welfare, aging, chemical dependency, metal health, and developmental disabilities, and a broad array of data from the Minnesota Department of Health.

The University of Minnesota is uniquely positioned as a national leader in food and health promotion, being one of only two U.S. universities to integrate five key components on one campus: agriculture, human ecology, medicine, public health, and veterinary medicine. This has led to the multi-disciplinary University of Minnesota Obesity Prevention Center.

Information generated from multi-disciplinary genome projects in CFANS, CBS and CVM is fuel for fundamental advances in life sciences in the 21st century. The understanding of gene function and regulation obtained from genomic approaches is leading to research with impacts on human, animal and environmental health, agricultural practices, food safety and production of biomaterials. As one example, Experiment Station animal genomics research has led to the development of bioinformatics hardware and databases including Locusmap, Pedigraph and MiniInbred. These tools are used internationally by researchers mapping the genetics of many species.

Success of joint research and extension activities

Extension connection to Experiment Station research is confirmed by the fact that all Extension programs, following an organization-wide review, are required to demonstrate the research connection for their outreach efforts. One hundred and forty specialized regional educators are at work throughout Minnesota, while partnerships with five colleges fund 118 faculty members and forge a strong link between research and outreach.

The University of Minnesota Extension Service defines and refines its program review process to support priorities in each of the five capacity areas: (1) Agriculture, Food and Environment; (2) Community Vitality; (3) Family Development; (4) Natural Resources and Environment and (5) 4H and Youth Development. Yearly audits of program status are done by program teams which consist of educators and campus specialists. From these audits, program business plans are developed.

Specific example of progress in integrating research and Extension activities are described in the join themes sections of this report.

Faculty with Joint Appointments (Research/Extension)

Fiscal Year: ***2006***

College / Department	Research	Extension	Teaching	Total
AGRICULTURAL,FOOD,ENVIRONMENTAL SCIENCES				
NWROC - CROOKSTON				
Hollingsworth,Charla R	70.00	30.00	0.00	100
Macrae,Ian Vance	54.00	46.00	0.00	100
WCROC - MORRIS				
Johnston,Lee Jay	80.00	20.00	0.00	100
Rudstrom,Margaretha V	67.00	33.00	0.00	100
NCROC - GRAND RAPIDS				
Lamb,Graham Clifford	77.00	23.00	0.00	100
SROC - WASECA				
Fritz,Vincent A	70.00	30.00	0.00	100
Baidoo,Samuel Kofi	80.00	20.00	0.00	100
Zhu,Jun	80.00	20.00	0.00	100
BIOSYSTEMS AND AGRICULTURAL ENGINEERING				
Jacobson,Larry Dean	25.00	75.00	0.00	100
Shutske,John M	25.00	75.00	0.00	100
Wilcke,William F	50.00	50.00	0.00	100
Sands,Gary Robert	35.00	65.00	0.00	100
AGRONOMY AND PLANT GENETICS				
Hicks,Dale Ray	8.00	92.00	0.00	100
Naeve, Seth L.	25.00	75.00	0.00	100
Gunsolus, Jeffrey L.	28.00	72.00	0.00	100
Becker,Roger Lee	25.00	75.00	0.00	100
Peterson,Paul Richard	25.00	75.00	0.00	100
APPLIED ECONOMICS				
Lazarus,William Frankl	35.00	65.00	0.00	100
Kalambokidis,Laura TJachim	32.00	58.00	10.00	100
Stinson,Thomas F	46.00	44.00	10.00	100
Hurley,Terrance Michae	40.00	30.00	30.00	100
Fruin,Jeremiah E	50.00	50.00	0.00	100
Parliament,Claudia	13.00	50.00	37.00	100
Olson,Kent D	33.00	37.00	30.00	100
Taff,Steven James	50.00	50.00	0.00	100
ANIMAL SCIENCE				
Endres,Marcia Ines	25.00	75.00	0.00	100
Linn,James Gary	15.00	75.00	10.00	100
Noll,Sally	15.00	75.00	10.00	100
Shurson,Gerald C	5.00	30.00	65.00	100
DiCostanzo,Alfredo	19.00	71.00	10.00	100
ENTOMOLOGY				
Ragsdale,David Willard	64.00	10.00	26.00	100
Krischik,Vera	35.00	65.00	0.00	100
Spivak,Marla S	59.00	13.00	28.00	100
Kells, Stephen A	40.00	60.00	0.00	100
Hutchison,William Dale	66.00	34.00	0.00	100
Ostlie,Kenneth R	40.00	60.00	0.00	100

College / Department	Research	Extension	Teaching	Total
COAFES - FOOD SCIENCE AND NUTRITION				
Feirtag,Joellen	3.00	94.00	3.00	100
HORTICULTURAL SCIENCE				
Hoover,Emily Esther	17.00	24.00	59.00	100
Erwin,John E	70.00	30.00	0.00	100
Meyer,Mary H	15.00	85.00	0.00	100
Tong,Cindy Bow San	50.00	50.00	0.00	100
Horgan, Brain P	40.00	60.00	0.00	100
SOIL, WATER, & CLIMATE				
Moncrief, John	40.00	60.00	0.00	100
Seeley,Mark W	21.00	79.00	0.00	100
Rehm, George	18.00	79.00	3.00	100
Anderson,James L	1.00	88.00	11.00	100
Rosen,Carl Jay	24.00	57.00	19.00	100
Lamb, John	55.00	20.00	25.00	100
COLLEGE OF HUMAN ECOLOGY				
FAMILY SOCIAL SCIENCE				
Bauer,Jean W	20.00	59.00	21.00	100
Danes,Sharon M	30.00	70.00	0.00	100
Stum,Marlene Sue	40.00	60.00	0.00	100
DESIGN, HOUSING, & APPAREL				
Bruin,Marilyn J	30.00	60.00	10.00	100
Yust, Becky L	10.00	10.00	80.00	100
CHE - FOOD SCIENCE AND NUTRITION				
Reicks,Marla M	22.00	69.00	8.00	99
Hassel,Craig Alan	26.00	63.00	11.00	100
SOCIAL WORK				
Quam,Jean Kathleen	25.00	7.00	68.00	100
COLLEGE OF NATURAL RESOURCES				
FISHERIES AND WILDLIFE				
Blair,Robert B.	10.00	64.00	26.00	100
Oberhauser,Karen S	5.00	36.00	58.00	99
FOREST RESOURCES				
SCHNEIDER, INGRID	38.00	50.00	12.00	100
BAUGHMAN, MELVIN J	9.00	91.00	0.00	100
BLINN, CHARLES R	23.00	70.00	7.00	100

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated Activities
(Attach Brief Summaries)
Fiscal Year: 2006

Select One: ☐ **Interim** ☐ **Final**
Institution: University of Minnesota
State: Minnesota

	Integrated (Hatch)		Multistate Extension (Smith-Lever)		Integrated (Smith-Lever)	
Established Target %	25%	**%**	0%	**%**	0%	**%**
This FY Allocation (from 1088)	$3,769,170.00		-		-	
This FY Target Amount	937,049.00		-		-	
Title of Planned Program Activity						
Agricultural Risk Management	10,675.00		-		-	
Commercial Vegetable and Fruit Production	182,928.00					
Commodity Crop Production	390,037.00					
Family Resource Management	16,066.00					
Food Safety	9,033.00					
Health and Nutrition Education	52,383.00					
Natural Resources Management and Utilization	104,560.00					
Nursery and Plant Health	43,263.00					
Parent Education	8,779.00					
Poultry Production and Health	95,983.00					
Water Resource Management and Policy	83,522.00					
Total	997,229.00		-		-	

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

Beverly R. Durgan

Director

March 29, 2007
Date

Fiscal Year 2005 / 2006 Financial Data
Integrated Research and Extension Activities
University of Minnesota
Agricultural Experiment Station
Minnesota Extension Service

Plan of Work Components

EXTENSION PROGRAM	RESEARCH PROJECT		HATCH $
Goal 1. An Agricultural System That is Highly Competitive in the Global Economy			
Agricultural Risk Management	14-022	ENHANCING THE FINANCIAL AND ENVIRONMENTAL SUSTAINABILITY OF MINNESOTA FAMILY FARMS	212,632
	14-029	EFFICIENT TECHNOLOGY AND RESOURCE MANAGEMENT CONSIDERING RISK AND THE ENVIRONMENT	
	14-052	MODELING AND ANALYSIS OF TRANSPORTATION AND LOGISTICS SYSTEM REQUIREMENTS FOR AG COMMODITIES AND BIOMASS FOR FOOD, FUEL, AND RAW MATERIALS	246,386
	14-064	ENVIRONMENTAL AND TRADE COMPETITIVENESS ISSUES IN AGRICULTURE	
	14-076	ECONOMIC ANALYSIS OF LIMITED PROPERTY RIGHTS TRANSFER	
Beef Production	16-044	FACTORS AFFECTING BIOLOGICAL AND ECONOMIC EFFICIENCY OF THE BEEF CATTLE ENTERPRISE	
Commercial Vegetable and Fruit Production	21-019	POTATO BREEDING AND GENETICS	10,967
	21-028	INVESTIGATIONS OF APPLE FRUIT CRISPNESS AND THE EFFECT OF BLUE LIGHT ON POTATO TUBERIZATION	30,479
	21-055	BREEDING, EVALUATION & SELECTION OF HARDY LANDSCAPE PLANTS	104,622
	21-060	IMPACT OF TEMPERATURE AND LIGHT ON FLOWERING	47,954
	21-064	MOLECULAR ANALYSIS OF FLORAL GENE EXPRESSION	46,882
	21-082	NEW PLANTS AND PROCESSES TO INCREASE THE EFFECTIVENESS OF ORGANIC PRODUCTION SYSTEMS	29,292
	25-084	IMPROVING NUTRIENT USE EFFICIENCY IN VEGETABLE AND FRUIT CROPS	
Commodity Crop Production	13-019	OAT BREEDING AND GENETICS	82,169
	13-022	MOLECULAR CYTOGENETICS IN PLANT IMPROVEMENT	88,828
	13-028	GENETICS AND BREEDING OF ALFALFA FOR NEW USES AND FORAGE QUALITY	
	13-030	BARLEY BREEDING AND GENETICS	109,989
	13-033	LEGUMES IN CROPPING SYSTEMS	110,575
	17-034	STRATEGIES FOR MANAGING CORN ROOTWORM PROBLEMS IN ROTATED CORN	25,785
	17-042	POTATO INSECTS: BIOLOGICAL AND CULTURAL CONTROL	25,785
	17-049	MANAGEMENT OF INSECTS AND INSECT VECTORS OF PLANT PATHOGENS	25,785
	17-060	IN VITRO PRODUCTION AND GENETIC MANIPULATION OF A BACTERIAL AGENT FROM A PLANTHOPPER	25,789
	22-015	COMPARATIVE GENOMICS OF LEGUMES	25,235
	22-018	ECOLOGY AND EVOLUTION OF PLANT-ASSOCIATED MICROBES IN AGRICULTURAL AND NATIVE HABITATS	24,397
	22-020	DISEASE RESISTANCE IN SMALL GRAIN CEREAL CROPS AND THEIR WILD RELATIVES	
	22-026	MANAGEMENT AND CONTROL OF DISEASES OF SOYBEANS	4,480
	22-036	BIOLOGY AND MANAGEMENT OF FUNGAL AND OOMYCETE DISEASES IN A SOYBEAN-CORN CROPPING SYSTEM	
	22-044	PLANT NEMATODES INHABITING THE SOILS OF A PORTION OF MINNESOTA'S CENTRAL LAKES REGION: THEIR OCCURRENCE & POTENTIAL SIGNIFICANCE	3,208

EXTENSION PROGRAM		RESEARCH PROJECT	HATCH $
Commodity Crop Production	25-057	NUTRIENT MANAGEMENT IN MINNESOTA CROPPING SYSTEMS	57,100
	25-069	CHARACTERIZING ACTIVE SOIL ORGANIC MATTER POOLS CONTROLLING SOIL N AVAILABILITY IN MAIZE-BASED CROPPING SYSTEMS	
	70-030	MOLECULAR ANALYSIS OF THE VIRULENCE GENES OF AGROBACTERIUM TUMEFACIENS	33,322
	71-043	THE ROLES OF RFI2 IN THE INTEGRATION OF LIGHT AND CIRCADIAN SIGNALING WITH PHOTOPERIODIC FLOWERING	28,916
	71-044	GENETIC ANALYSIS OF THE SECRETION MACHINERY OF GREEN PLANTS	29,175
Dairy Modernization	16-032	STATISTICAL PROCESS CONTROL USE FOR MANAGEMENT DECISION MAKING TO IMPROVE MILK QUALITY, DAIRY CATTLE HEALTH AND PRODUCTIVITY	
	16-039	WELL-BEING, BEHAVIOR, AND MANAGEMENT OF GROUP-HOUSED DAIRY CATTLE	
	16-048	METHODS FOR ACHIEVING OPTIMAL PROTEIN UTILIZATION IN RUMINANTS	
Nursery and Plant Health	21-049	INCREASING PRODUCTION EFFICIENCY AND LONG TERM HEALTH OF NURSERY GROWN CROPS	48,916
	21-050	BREEDING AND GENETICS OF FLORICULTURAL CROPS: GERMPLASM ENHANCEMENT, RISK ASSESSMENT OF INVASIVENESS POTENTIAL	14,986
Poultry Production and Health	16-034	IMPROVING TURKEY PRODUCTION PERFORMANCE THROUGH NUTRITION AND MANAGEMENT	529,917
Swine Production Technology	14-040	ECONOMIC ANALYSIS OF LIVESTOCK INDUSTRY MARKETING, PRICES, PRODUCTION AND POLICY	
	14-057	AN ECONOMIC ANALYSIS OF U.S. LIVESTOCK SECTOR FACING DEMAND AND SUPPLY STRUCTURAL CHANGES	
	16-076	GENOMIC CHARACTERIZATION OF GROWTH AND CARCASS COMPOSITION, FEED CONVERSION EFFICIENCY AND MEAT QUALITY TRAITS IN SWINE	
	62-022	MONITORING STRATEGIES FOR EARLY DETECTION OF PRRS OUTBREAKS	
		Total Hatch Dollars - Goal 1.	**$ 2,023,571**
Goal 2. A Safe and Secure Food and			
Food Safety	18-037	CHARACTERIZATION AND CONTROL OF THE ACID RESISTANCE OF ENTEROHEMORRHAGIC ESCHERICHIA COLI	34,658
	18-074	APPLICATION OF CHEMILUMINESCENT ANTIBIOTICS AS PLATFORM TECHNOLOGY FOR DEVELOPMENT OF RAPID PATHOGEN DETECTION	
		Total Hatch Dollars - Goal 2.	**$ 34,658**
Goal 3. A Healthy, Well-Nourished Population			
Health and Nutrition Education	12-017	FOOD SYSTEM WORKPLACE INJURY, DISEASE, AND HOMELAND SECURITY RISK CONTROL STRATEGIES	
	12-027	INJURY PREVENTION AND HEALTH PROMOTION RESEARCH FOR PRODUCTION AGRICULTURE	15,451
	18-020	INCORPORATING WHOLE GRAIN FOODS INTO THE US FOOD SUPPLY	49,545
	18-026	IDENTIFICATION OF FACTORS PREDICTING CONSUMPTION OF SELECTED DIETARY CONSTITUENTS	20,036
	18-029	EXAMINATION OF NUTRITIONAL STATUS AND DIETARY BEHAVIOR AMONG THE GENERAL POPULATION, INCLUDING MINORITY POPULATIONS	5,217
	18-034	DIETARY REGULATION OF SEX HORMONE SYNTHESES AND METABOLISM	28,354

EXTENSION PROGRAM		RESEARCH PROJECT	HATCH $
Health and Nutrition Education	18-053	BODY COMPOSITION, ENERGY EXPENDITURE, AND NUTRITIONAL STATUS ACROSS THE CLINICAL SPECTRUM: FROM OBESITY TO WASTING	9,953
	18-055	ANALYSIS OF BACTERIOPHAGE RESISTANCE AND BACTERIOCIN PRODUCTION OF LACTOCOCCI, AND PROBIOTIC CHARACTERISTICS OF BIFIDOBACTERIA	
	18-064	DEFINING A DESIRABLE DIETARY FIBER INTAKE	23,171
		Total Hatch Dollars - Goal 3.	**$ 151,727**

Goal 4. An Agricultural System Which Protects Natural Resources and the Environment

Natural Resources Management and Utilization	14-034	PROFITABILITY AND ADOPTION OF NEW TECHNOLOGY AND IMPLICATIONS FOR AGRICULTURAL POLICY	
	16-064	THE USE OF DISTILLER'S DRIED GRAINS WITH SOLUBLES AND PHYTASE IN MANURE PHOSPHORUS MANAGEMENT FEEDING PROGRAMS FOR SWINE	
	22-069	BIOLOGY, CONTROL, AND BIOTECHNOLOGICAL USES OF FOREST MICROBES	56,743
	25-020	SOIL RESOURCE ASSESSMENT AND INTERPRETATIONS FOR MINNESOTA LANDSCAPES	57,100
	41-015	COLONIAL WATERBIRD MONITORING AND PIPING PLOVER POPULATION DEMOGRAPHICS IN THE U.S. GREAT LAKES	32,259
	41-077	ECOLOGY AND MANAGEMENT OF FISHERY RESOURCES OF LARGE LAKES IN THE UPPER MIDWEST	
	41-078	INFLUENCE OF FISHERIES MANAGEMENT PRACTICES ON GENETIC RESOURCES OF FISH POPULATIONS	
	41-084	GEO-REFERENCED CONSERVATION DATABASES: INTEGRATING BIODIVERSITY CONSERVATION & SUSTAINABLE DEVELOPMENT	
	42-070	UTILIZATION OF FOREST GENETIC RESOURCES TO ENHNACE PRODUCTIVITY OF FORESTED LANDS	
	42-074	OVERSTORY AND UNDERSTORY EFFECTS ON TREE REGENERATION: EXPERIMENTS EXPLORING THE IMPORTANCE OF ABOVE- VERSUS BELOWGROUND COMPETITION	22,264
Water Resource Management and Policy	12-040	INVESTIGATING DRAINAGE DESIGN AND MANAGEMENT ALTERNATIVES FOR MEETING BOTH ENV. AND AGRO. OBJECTIVES	14,162
	14-089	EXAMINING POLICIES AND INSTITUTIONS FOR THE CONTROL OF INVASIVE SPECIES AND FOR THE PROTECTION OF MINNESOTA'S LAND AND WATER RESOURCES	212,632
	41-070	IDENTIFICATION AND FUNCTIONAL CHARACTERIZATIONS OF SEX PHEROMONES IN CYPRINID FISH	45,232
	42-037	REMOTE SENSING OF LAND, VEGETATION, AND WATER RESOURCES	27,393
		Total Hatch Dollars - Goal 4.	**$ 467,785**

Goal 5. Enhanced Economic Opportunity and Quality of Life

Family Resource Management	52-054	THE CONSEQUENCES OF FINANCIAL SETTLEMENT AND CHILD SUPPORT: DECISIONS IN MINNESOTA	6,835
	52-055	FAMILY ECONOMIC WELL-BEING: TRANSITIONS FOR FAMILIES	23,290
	52-073	THE IMPACT OF SPOUSAL INCLUSION ON FAMILY BUSINESS START-UPS	6,811
	52-077	ECONOMIC WELL-BEING OF DIVERSE FAMILIES RESIDING IN THE UNITED STATES AND SPECIFICALLY IN MINNESOTA	5,326
	52-080	UNDERSTANDING FAMILY RESOURCE DECISIONS AND ASSET ACCUMULATION THROUGH MULTI-CULTURAL LENSES	5,838

EXTENSION PROGRAM		RESEARCH PROJECT	HATCH $
Parent Education	52-079	FAMILY PROCESSES INFLUENCING THE DEVELOPMENT OF PSYCHOPATHOLOGY AMONG RURAL ADOLESCENTS	7,120
	52-082	UNDERSTANDING THE STRENGTHS OF CULTURALLY DIVERSE FAMILIES: DEVELOPING CULTURALLY-EFFECTIVE, FAMILY-BASED RESEARCH PROGRAMS	5,808
	52-084	IMPLEMENTING THE PARENTING THROUGH CHANGE PROGRAM WITH LATINA SINGLE MOTHERS	7,009
	52-085	A FAMILY-BASED APPROACH TO UNDERSTANDING YOUTH RISK-TAKING AND EXPERIMENTATION	6,347
Tourism Development	42-039	SUSTAINING RURAL COMMUNITIES IN NATURE-BASED TOURISM AREAS OF NORTHERN MINNESOTA	
		Total Hatch Dollars - Goal 5.	**$ 74,384**
		Total Hatch Dollars - All Goals	**$2,752,125**

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Fiscal Year 2005/2006 DETAIL OF EXPENDITURES

Goal / Theme	Project	Hatch	MRF	McIntire Stennis	Animal Health	State Funds	Other Federal	Other Non-Fed	Total Funds	FTE's
Goal 1										
Agricultural Competitiveness	16-020	0	40,226	0	0	73,836	0	0	114,062	1.2
	16-032	0	0	0	0	17,612	0	0	17,612	0.3
	16-039	0	0	0	0	64,387	0	27,546	91,933	1.2
	25-057	1,999	0	0	0	81,769	17,816	146,288	247,872	3.0
	25-076	0	0	0	0	120,292	46,768	31,130	198,190	2.1
		1,999	**40,226**	**0**	**0**	**357,896**	**64,584**	**204,964**	**669,669**	**7.8**
Agricultural Profitability	03-017	0	980	0	0	0	0	0	980	0.0
	13-019	41,307	0	0	0	118,647	20,278	150,464	330,696	4.6
	13-022	44,649	0	0	0	293,073	664,508	58,220	1,060,450	10.4
	13-024	0	0	0	0	49,058	0	192,021	241,079	2.0
	13-027	0	0	0	0	139,178	110,013	737,717	986,908	14.6
	13-028	0	0	0	0	0	20,906	8,384	29,290	0.6
	13-029	0	0	0	0	58,093	22,080	149,957	230,130	4.0
	13-033	55,587	0	0	0	123,409	52,319	164,489	395,804	5.3
	13-053	0	0	0	0	170,049	199,823	104,706	474,578	6.7
	13-054	0	0	0	0	3,141	0	121,443	124,584	1.1
	13-079	0	0	0	0	57,821	0	7,915	65,736	0.8
	16-034	95,983	0	0	0	30,291	19,766	283,602	429,642	4.3
	16-044	0	0	0	0	24,296	0	47,832	72,128	0.5
		237,526	**980**	**0**	**0**	**1,067,056**	**1,109,693**	**2,026,750**	**4,442,005**	**54.8**
Animal Health	16-073	0	609	0	0	0	0	0	609	0.0
	60-015	7,963	27,536	0	0	4,051	0	0	39,550	0.2
	63-024	0	0	0	0	85,077	0	0	85,077	1.2
		7,963	**28,145**	**0**	**0**	**89,128**	**0**	**0**	**125,236**	**1.4**
Green Agriculture	21-016	0	0	0	0	239,689	23,449	144,233	407,371	4.8
	21-022	0	0	0	0	158,897	0	4,560	163,457	2.5
	21-024	0	756	0	0	0	0	0	756	0.0
	21-025	0	0	0	0	45,983	0	4,232	50,215	0.6
	21-049	33,117	0	0	0	7,596	9,590	64,703	115,006	2.3
	21-050	10,146	0	0	0	60,349	0	13,811	84,306	1.1
	21-055	70,831	0	0	0	168,051	0	62,723	301,605	3.5
		114,094	**756**	**0**	**0**	**680,565**	**33,039**	**294,262**	**1,122,716**	**14.7**
Plant Health	21-019	7,425	0	0	0	89,273	51,414	57,455	205,567	2.0
	22-018	22,691	0	0	0	65,772	0	15,065	103,528	1.6
	22-019	8,404	0	0	0	687	769,540	0	778,631	0.5
	22-020	0	0	0	0	76,895	332,413	195,469	604,777	7.7
	22-026	4,167	0	0	0	141,268	23,289	103,044	271,768	3.5
	22-028	0	0	0	0	125,769	16,302	59,251	201,322	2.7
	22-059	0	0	0	0	43,253	184,111	21,251	248,615	2.9
	22-093	0	0	0	0	87,546	0	27,933	115,479	1.1
		42,687	**0**	**0**	**0**	**630,463**	**1,377,069**	**479,468**	**2,529,687**	**22.0**
Goal 1 Total		**404,269**	**70,107**	**0**	**0**	**2,825,108**	**2,584,385**	**3,005,444**	**8,889,313**	**100.7**
Goal 2										

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Goal / Theme	Project	Hatch	MRF	McIntire Stennis	Animal Health	State Funds	Other Federal	Other Non-Fed	Total Funds	FTE's
Food Safety	18-037	9,033	0	0	0	72,760	29,274	8,785	119,852	1.5
	18-072	0	0	0	0	101,840	0	121,264	223,104	2.3
	18-074	0	0	0	0	3,263	0	10,274	13,537	0.0
		9,033	**0**	**0**	**0**	**177,863**	**29,274**	**140,323**	**356,493**	**3.8**
Goal 2 Total		**9,033**	**0**	**0**	**0**	**177,863**	**29,274**	**140,323**	**356,493**	**3.8**
Goal 3										
Human Health	12-027	13,038	0	0	0	34,612	26,362	7,083	81,095	0.8
	14-048	0	0	0	0	88,421	0	120,948	209,369	2.6
	18-020	12,913	0	0	0	8,896	0	44,621	66,430	1.2
	18-026	5,222	0	0	0	16,464	347,184	37,178	406,048	4.3
	18-028	0	1,563	0	0	0	0	0	1,563	0.0
	18-029	5,187	0	0	0	67,282	0	1,467	73,936	0.9
	18-034	7,390	0	0	0	80,242	200,957	42,081	330,670	3.2
	18-055	0	0	0	0	67,380	0	98,393	165,773	2.2
	18-058	11,085	549	0	0	39,302	0	38,531	89,467	0.9
	53-040	0	970	0	0	0	0	0	970	0.0
	53-083	0	0	0	0	91,731	18,678	1,617	112,026	1.0
		54,835	**3,082**	**0**	**0**	**494,330**	**593,181**	**391,919**	**1,537,347**	**17.1**
Goal 3 Total		**54,835**	**3,082**	**0**	**0**	**494,330**	**593,181**	**391,919**	**1,537,347**	**17.1**
Goal 4										
Agricultural Waste Management	12-084	54,005	36,338	0	0	90,032	30,730	50,896	262,001	2.8
	14-025	0	0	0	0	18,003	0	0	18,003	0.2
		54,005	**36,338**	**0**	**0**	**108,035**	**30,730**	**50,896**	**280,004**	**3.0**
Biofuels	12-093	8,741	0	0	0	105,473	0	502,146	616,360	5.9
	13-052	0	0	0	0	156,814	3,711	77	160,602	1.4
	14-034	0	0	0	0	36,007	30,502	2,414	68,923	0.8
	14-059	0	747	0	0	0	0	0	747	0.0
	16-064	0	0	0	0	32,393	15,284	77,445	125,122	2.0
		8,741	**747**	**0**	**0**	**330,687**	**49,497**	**582,082**	**971,754**	**10.0**
Environmental Health	43-050	0	0	0	0	96,480	358,990	3,740	459,210	6.2
		0	**0**	**0**	**0**	**96,480**	**358,990**	**3,740**	**459,210**	**6.2**
Forest Management	42-032	0	0	0	0	60,099	1,751	0	61,850	0.7
	42-033	0	0	1,653	0	27,016	48,930	16,641	94,240	1.7
	42-034	0	0	0	0	13,348	50,654	0	64,002	0.6
	42-046	27,603	0	0	0	71,017	61,153	74,425	234,198	3.4
		27,603	**0**	**1,653**	**0**	**171,480**	**162,488**	**91,066**	**454,290**	**6.4**
Global Change and Climate Change	17-018	0	0	0	0	68,982	58,587	61,769	189,338	1.7
	25-079	0	0	0	0	87,505	418,233	6,516	512,254	4.4
	42-036	0	0	10,085	0	42,759	605,007	53,985	711,836	5.5
		0	**0**	**10,085**	**0**	**199,246**	**1,081,827**	**122,270**	**1,413,428**	**11.6**
Water Quality	12-040	11,951	0	0	0	28,038	6,332	27,889	74,210	1.0

AREERA
Fiscal Year 2005/2006 DETAIL OF EXPENDITURES

Goal / Theme	Project	Hatch	MRF	McIntire Stennis	Animal Health	State Funds	Other Federal	Other Non-Fed	Total Funds	FTE's
Water Quality	12-055	0	18,667	0	0	54,558	289,259	137,422	499,906	6.4
	14-089	4,945	0	0	0	112,630	0	0	117,575	1.0
	25-059	0	0	0	0	39,943	0	99,846	139,789	1.8
	28-030	0	0	0	0	264,760	0	0	264,760	5.0
	41-025	0	0	12,124	0	19,051	15,867	0	47,042	0.6
	42-035	0	0	0	0	110,983	195,896	120,040	426,919	5.8
	42-037	22,773	0	0	0	38,015	95,901	133,806	290,495	4.0
		39,669	**18,667**	**12,124**	**0**	**667,978**	**603,255**	**519,003**	**1,860,696**	**25.7**
Goal 4 Total		**130,018**	**55,752**	**23,862**	**0**	**1,573,906**	**2,286,787**	**1,369,057**	**5,439,382**	**62.8**
Goal 5										
Family Resource Management	52-054	2,283	0	0	0	28,276	0	0	30,559	0.3
	53-072	0	0	0	0	28,309	0	0	28,309	0.3
	53-073	5,686	0	0	0	34,726	0	83,043	123,455	1.7
		7,969	**0**	**0**	**0**	**91,311**	**0**	**83,043**	**182,323**	**2.3**
Impacts of Change on Rural Communities	53-076	0	0	0	0	83,415	0	3,627	87,042	1.3
		0	**0**	**0**	**0**	**83,415**	**0**	**3,627**	**87,042**	**1.3**
Strengthening Families	52-065	0	0	0	0	41,141	290,185	36,264	367,590	4.0
	52-072	0	0	0	0	21,518	37,857	205,156	264,531	3.3
	52-082	1,940	0	0	0	41,342	0	0	43,282	0.3
	52-084	2,341	0	0	0	860	213,432	0	216,633	1.8
		4,281	**0**	**0**	**0**	**104,861**	**541,474**	**241,420**	**892,036**	**9.4**
Goal 5 Total		**12,250**	**0**	**0**	**0**	**279,587**	**541,474**	**328,090**	**1,161,401**	**13.0**
Grand Total		**610,405**	**128,941**	**23,862**	**0**	**5,350,794**	**6,035,101**	**5,234,833**	**17,383,936**	**197.4**