Annual Report
of
Accomplishments and Results

FY 2004

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

UNIVERSITY OF MINNESOTA

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Executive Summary

This report of research progress and accomplishments for 2004 discusses the scope of MAES research funded in five colleges of the University of Minnesota. It also includes joint reporting with Extension under selected themes, as we have done in this annual report in previous years.

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.**

Ornamental/green agriculture is an important segment of Minnesota agriculture, and this year we report progress in helping our nursery industry thrive, as well as new techniques to help producers deal with the short growing season in northern Minnesota. Several crop diseases, both long standing and newly emerging, have received considerable research attention and we report on several of these efforts, including progress in dealing with rust diseases of cereals, potato viruses, soybean aphid, and alfalfa blotch leafminer. Soybean rust has been receiving some pre-emptive focus, and we report on that collaborative work. Research on animal health efforts this year has helped understand both nutrient balance and reproductive efficiency issues to improve the sustainability of both dairy and beef cattle enterprises. Under the jointly reported themes of Agricultural Profitability, and Agricultural Competitiveness, a wide range of research and extension efforts have helped Minnesota's agricultural sectors maintain profitability and competitiveness. Some of this work could have also been reported under the theme of Plant Health, or Animal Health; they are included under the economic themes when the impact of the work especially pointed toward those benefits.

<u>Total Expenditures by Source of Funding</u>
Hatch--$229,625; MRF--$43,091; State--$1,658,623; Other Federal--$923,904; Other Non-Federal--$1,729,597

Total (Experiment Station only): $4,548,840
FTE's (Experiment Station only): 63.3

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.)**

To control food-borne diseases, long-term research on Salmonella and E. coli has developed several new strategies, and the range of food safety research has led to the development of a successful Extension program—Food Safety for Food Service Workers. Also reported this year are promising new methods for pasteurization of dry foods such as almonds, as well as processing techniques to eliminate E. coli and Salmonella from ready to consume acid foods.

Total Expenditures by Source of Funding
MRF--$781; State--$311,826; Other Non-Federal--$73,309

Total (Experiment Station only): $385,916
FTE's (Experiment Station only): $3.7

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.)**

Among the findings reported under this goal are the discovery of grain-derived compounds that may modulate inflammatory responses in the body, and work using genomic technologies to answer key questions about a dairy culture important for maintaining health in the human large intestine.

Total Expenditures by Source of Funding
Hatch--$47,450; MRF--$797; State--$121,887; Other Federal--$81,146; Other Non-Federal--$45,327

Total Funds (Experiment Station only): $296,607
FTE's (Experiment Station only): $3.4

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

Last year we also reported progress in this goal under the themes Agricultural Waste Management and Water Quality. Some of the same research is continuing to develop results and impact. For example, odor problems from animal confinement buildings is a continuing focus of research, and this year we can report that Minnesota researchers joined scientists from five other states to determine baseline pollutant emission rates for common types of animal confinement buildings from different sections of the U.S. and Minnesota studies are going to be used as a template for EPA work. Water quality issues are of increasing concern to Minnesota citizens and policymakers. The knowledge gained from several MAES research projects is helping to inform efforts to improve such important Minnesota waterways as the Minnesota River, the Red River, and urban waterways such as Minnehaha Creek in Minneapolis, Lake Minnetonka and the Mississippi River. One of the more unusual research projects reported on this year describes how U of M research on wood products is being used to better understand deterioration processes that affect ancient woods and this work has been applied to protect and conserve a variety of national treasures across the country.

Total Expenditures by Source of Funding
Hatch--$63,564; State--$870,256; Other Federal--$537,328; Other Non-Federal--$242,095

Total Funds (Experiment Station only): $1,713,243
FTE's (Experiment Station only): 23.1

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.)**

A wide range of research is reported this year under this goal, including research to increase the options for family-appropriate rental housing for low income renters, promoting life strengths among elders, research to help build the parenting strengths of fathers, youth civic engagement research that has shown international impact, and work in the growing field of restorative justice.

Total Expenditures by Source of Funding
Hatch--$15,175; State--$258,749; Other Federal--$90,599; Other Non-Federal--$184

Total Funds (Experiment Station only): $364,698
FTE's (Experiment Station only): 4.1

Key Theme: Ornamental/Green Agriculture (Research)

MAES Plan of Work: Goal 1, Program 11

Increasing Production Efficiency and Health of Nursery Grown Crops

Description: This project has advanced considerably in 2004 with continued research in elm tree evaluations, propagation, media amendments, and stem-girdling roots. In addition to determining which practices should be adopted by the nursery industry, researchers also determine which are unnecessary or not worth devoting time and money to. Elm tree evaluations have detected the development of Dutch elm disease on the elm cultivar 'Accolade'. Additionally, a large number of elms previously assessed in the nursery were moved out into the landscape to see how they would fare. The project has moved towards assessments of American elm cultivars rather than hybrids because few hybrids have the same characteristics as American elms. Researchers also investigated whether the slicing of stem-girdling roots in pot-bound plants before planting in the field encouraged rooting more than not cutting them before planting. The 2004 harvest of sliced- and non-sliced pot-bound plants showed no difference in rooting development.

Impact:
The research being conducted on stem-girdling roots is already resulting in attention from the nursery and landscape industry, who are learning to not plant pot-bound trees regardless of whether the ball is sliced or not. Also, planting depths are being reduced by many firms, in response to research results, and it is expected that this trend will increase. A number of nurseries are currently using, or considering the use of soluble silicon products for disease control, based on older University of Minnesota research that is just starting to be recognized by the industry. In addition, the mix of elms that are being planted in Minnesota is changing and University research has been a big part of this change, altering the mix of elms that growers are using.

High Tunnel Method for Growing Tomatoes

Description: The short growing season in northern Minnesota has always meant that raising tomatoes and other warm season crops in the field is a race against time for both commercial growers and backyard gardeners. In an attempt to protect these crops from cold damage, both in spring and fall, researchers grew them in "high tunnel" plastic enclosures, which are portable and use no electricity or regular heat, though propane heaters may be used during cold periods. Tomato plants were grown closer than the usual field spacing and management was slightly more intensive.

Impact:
Results of the research for both 2003 and 2004 were extremely beneficial: production of the high tunnel tomatoes was 25 to 60 days earlier than unprotected tomatoes, and early cultivars were ready to market in the last half of July. Also, fruit size was larger, marketable fruit was of better quality and yields were excellent. One tunnel-protected treatment alone produced 20 pounds of tomatoes per plant. High tunnels gave growers a five- to six-week planting advantage and also allowed late-season cultivars, which have a greater yield potential than those normally grown in northern Minnesota, enough time to ripen. High tunnels also resulted in better control of tomato diseases. Several growers in different areas of Minnesota are now using high tunnels and are very satisfied with their results. A manual summarizing the research results and discussing the concept is available and researchers have had inquiries from other states. Although high tunnels may chiefly benefit commercial growers, home gardeners can also use them.

Impact of Temperature and Light on Flowering

Description: Flowering and yield of floriculture and vegetable crops are reduced by non-optimal temperatures. Often the effect of non-optimal temperatures on flowering is also affected by how much light a plant is grown under and/or day length. This project aims to better understand the physiological basis for temperature and irradiance effects on flowering and photosynthesis by using model plants and utilizing this information to optimize flowering and growth. Studies showed that both abscissic acid and heat shock proteins were involved in the high temperature tolerance of flower development. Researchers also found that short-term exposure to high temperatures of 35C. had a long-term effect on photosynthesis. Researchers are evaluating a variety of species for their

potential as new floriculture crops and the impact of irradiance and photoperiod on flowering of those species is being ascertained.

Impact:
Research on high temperature effects on flower development is generating screening protocols to hasten breeding for high temperature tolerance in floriculture and vegetable crops. Information researchers learned regarding photoperiod and irradiance effects on flower initiation of floriculture crops is being used to optimize and schedule flowering in the North American bedding plant industry. Recent information on variation in impact of irradiance on numerous bedding plant crops is resulting in new management strategies for supplemental lighting that is reducing input costs (electricity) without appreciable effects on product quality.

Source of Funding: Hatch
Scope of Impact: State, Multi-State

Key Theme: Plant Health (Research)

MAES Plan of Work: Goal 1, Programs 7, 8, 9, 12, 13

Rust Diseases of Cereals

Description: Small grains (wheat, oats, and barley) are grown on more than two million acres in Minnesota, with an estimated value of over 350 million dollars in 2004. Rust diseases of small grain cereals annually cause losses of $100 million in the U.S. even though wheat stem rust has been effectively controlled using resistant cultivars since the 1950's. Constant monitoring and early detection of virulence changes in cereal rust populations in the U.S. are essential for maintaining stem rust resistance in wheat and improving resistance to other cereal rusts.

Impact:
Research results are being used by wheat breeders and pathologists to diversify the leaf rust resistance genes present in wheat breeding lines. Identification of leaf rust resistance genes in wheat lines also helps to interpret changes in leaf rust races in the different wheat growing regions of the U.S. Durum isolates of leaf rust now found in California were most likely introduced from the population in Mexico. These isolates could threaten durum production in the U.S. if they become established in the areas that grow durum wheats. Collections of the oat crown rust fungus P. coronata from throughout the United States since 1989 have also been tested for virulence to oat crown rust differential lines. This information has helped to interpret the increased rust severity on several oat cultivars in Minnesota and the Dakotas that was caused by an increase of crown rust races with virulence to the resistance genes in these cultivars. In recent years, breeding lines of oat with an apparent non-specific resistance to crown rust have been identified by scientists at the USDA Cereal Disease Lab and the University of Minnesota. These

sources are currently being used as sources of crown rust resistance by oat breeders in Minnesota and elsewhere.

Site Specific Management of Potato Virus Vectors

Description: Potato Virus Y (PVY) and Potato Leaf Roll Virus (PLRV) are aphid-vectored viral diseases of potatoes and have contributed to a 40% decrease in acreage entered into certified programs. In addition, many growers have suffered outbreaks of green peach aphid, the most important vector, which can also cause yield losses of 7 tons/ac. This project studied site-specific management for aphid virus vectors to improve control of aphid populations while decreasing pesticide inputs in the cropping system. Green peach aphids (GPA) initially colonize potato fields at the edges and subsequently disperse across the field. The timing of dispersal is such that a window of 10-14 days exists for targeted application of insecticides to control this first flight. Subsequent immigration flights are not amenable to targeted application. This technique has been adopted by a number of growers in the region. A validation trial has provided data that indicates this technique is as effective in controlling the incidence of virus as is whole-field insecticide treatment.

Impact:
If this technique of targeted application were adopted by most of the seed producers in the region as is expected, it would result in a decrease of 11 metric tons of active ingredient being applied annually. This would both improve production economics and decrease insecticide exposure risk.

Management of Insects and Insect Vectors of Plant Pathogens

Description: Although aphid-transmitted potato pathogens are costly to potato growers, it was not known whether soybean aphid, a new and abundant insect now found throughout North America, was a vector for potato viruses. Since its discovery in ten Midwestern states in the summer of 2000, soybean aphid, Aphis glycines, has been the subject of much research as yield reductionsin soybean have exceeded 45% in some replicated trials. This aphid is also an efficient vector of several other plant viruses including Tobacco vein-banding mosaic virus, a presumed variant of Potato virus Y. Research also continued on other plant pathogens and vectors, including green peach aphids. In 2004, researchers evaluated cultural control practices to stimulate the early onset of fungal pathogens that attack soybean aphid.

Impact:
In 2004, researchers determined that soybean aphid is a vector of potato virus Y and they are advising seed potato growers who have soybean adjacent to seed potato fields to consider managing aphids in soybean. Results of the border study in the Red River Valley to control green peach aphid showed that the aphids can be effectively controlled in seed potato fields by treating field edges only, instead of the entire field. This research demonstrated on 27 grower fields that treating field edges alone can save 75% in treatment costs for the first application of insecticide to control green peach aphid. An

interview of all participating growers showed that all are planning on using border application in 2005. The substantial cost savings realized will pay for the increased scouting costs associated with detecting when aphids first arrive in the field. In other work during 2004, researchers characterized advanced potato breeding lines for resistance to aphids and viruses. Sources of this resistance are being characterized so that more crosses can be made in an interdisciplinary effort to use wild potato germplasm as a source of resistance to aphids and the viruses they transmit.

Dynamic Soybean Pest Management

Description: The soybean aphid is causing widespread damage to soybean. No known cultivar adapted to the North Central U.S. is resistant or tolerant of soybean aphids and producers are beginning to use insecticides to control pests, such as soybean aphids, that traditionally did not need to be treated. Because seed treatment at the time of planting with systemic insecticides will be registered for use on soybean in 2005, researchers evaluated the insecticide hiamethoxam in a two-year study to determine the efficacy of seed treatment on soybean aphid population growth in field plots.

Impact:
Through 2004 studies, researchers determined that an economic threshold of 250 aphids per plant with more than 80% of plants with aphids will be therecommended threshold throughout the region. Soybean aphid caused an estimated $188 million loss in 2003 in Minnesota alone so this information should help growers avoid losses caused by soybean aphid. The culmination of the research on temperature and population growth rate was the development of the Soybean Aphid Growth Estimator (SAGE), which was available in the spring of 2004. The inputs into the model include an estimate of the aphid population in a field and the forecasted high and low temperatures for the next seven days. The output is a prediction of the maximum population growth rate. This model can be used to inform growers how quickly an aphid population can exceed the economic threshold in their specific location and will help prevent over-treatment of fields if temperature and other natural controls will prevent an aphid population from building to damaging levels. The model is available at:
www.soybeans.umn.edu/crop/insects/aphid/aphid_sagemodel.htm.
Researchers also developed Speed Scouting, which is a sequential sampling plan that maximizes sampling efficiency by allowing fewer plants to be sampled when aphid populations are very low or very high. Speed Scouting worksheets can be downloaded from a website: www.soybeans.umn.edu/crop/insects/aphid/aphid_scouting.htm. It is anticipated that it will take only 15 minutes to make a treatment decision using Speed Scouting.

Mycotoxins in Cereal Grains

Description: Fusarium Head Blight (FHB), a fungal disease, caused $870 million in losses to wheat and barley growers from 1998 through 2000, and the total economic impact from FHB was estimated at $2.7 billion in the United States for the same period. FHB can cause illness in animals who ingest deoxynivalenol (DON), a mycotoxin

produced by Fusarium species, and it can also ultimately impair health in humans. In addition, barley with a DON level above half a part per million is rejected by maltsters, thus causing growers to lose the premium paid for malting barley. The detection of ergosterol, an indicator of fungal biomass, in Fusarium-infected grain provides a tool to study the disease mechanism and to assist researchers in developing FHB-resistant cultivars.

Impact:
In 2004, researchers modified and improved a gas chromatograph/mass spectrometry method (GC/MS) for determining ergosterol, an indicator of fungal biomass. The modified method has a detection limit of 18.5 parts per billion (ppb). The ability to detect low levels of ergosterol could help to study the disease mechanism. The method can easily handle multiple samples simultaneously, which makes it suitable for the breeding programs to screen resistance to FHB.

Development of Pest Management Strategies for Forage Alfalfa Persistence

Description: In recent years, the alfalfa blotch leafminer (ABLM) has caused considerable damage to the 2.4 million acres of alfalfa grown in Minnesota and surrounding states. Some fields experienced 90-100% infestations, with resulting yield reductions of up to 20 percent. Researchers experimented with several different methods to control ABLM, including the use of resistant alfalfa cultivars, parasitic wasps for biological control and conventional insecticides.

Impact:
The study determined that biological control was the most effective management tool. Researchers found that the parasitic native wasp, Chrysocharis lyriomyzae, was most likely responsible for the drastic decline in ABLM infestations in alfalfa in 2003-2004. Conventional insecticides provided only moderate control of ABLM and only a few of the 86 alfalfa cultivars and six commercial alfalfa varieties showed some resistance to ABLM. This project has resulted in new Integrated Pest Management (IPM) guidelines for control of ABLM, which rely on biological control and minimal insecticide use, for sustainable forage production.

Soybean Rust: A New Pest of Soybean Production

Description: This project addresses the possible introduction of soybean rust from South or Central America. Soybean rust, a fungal disease, is a serious problem because of the lack of resistance in soybean varieties grown in North America, and resulting potential for yield loss, with possible yield losses of up to 80% or more, as evidenced by the experience of soybean growers in areas where soybean rust is present. The purpose of the project is to coordinate regional research projects intended to develop control measures and provide information to soybean growers in order to limit the impact of soybean rust if it is introduced into the U.S. These projects include a Soybean Rust Working Group consisting of representatives from the Minnesota Department of Agriculture (MDA),

MAES, University of Minnesota, and MSRPC, which was established to coordinate training, outreach, and research efforts in Minnesota.

Impact:
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. Although low winter temperatures, distance from perennial sources of SBR inoculum, and the short growing season may limit the likelihood of SBR infection, the potential risk for epidemic development in Minnesota is unclear. Current recommendations for management of SBR rely on fungicide application, a practice that will add 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. Survey procedures have been developed in cooperation with the MDA Plant Pest Survey and training was conducted to familiarize MDA survey personnel with symptoms of Soybean Rust and procedures to be followed if suspected symptoms of SBR are found. A mock discovery exercise, coordinated by the MDA, was conducted to test response plans and procedures in the event of the introduction of soybean rust. Training of SBR first detectors is being scheduled for crop consultants, Regional Extension Educators, and Pest Survey personnel. Materials were developed to aid in distinguishing SBR from other foliar diseases that could be confused with soybean rust, and included information about fungicide types, application methods, and application recommendations for management of SBR. Additionally, information about SBR was disseminated through the media and on University websites. Website pages dedicated to SBR information and links are maintained at http://www.soybeans.umn.edu/home.htm. Collaborative research projects have been established with researchers in the North Central U.S. to establish 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.

Source of Funding: Hatch and Multi-State
Scope of Impact: State, Multi-State

Key Theme: Animal Health (Research)

MAES Plan of Work: Goal 1, Programs 4, 5, 6

Biological and Economic Efficiency of the Beef Cattle Enterprise

Description: This research project aims to better understand nutrient balances and factors that have an impact on nutrient output among beef cows and feedlot steers, in order to assess the impact of nutritional and management factors on production efficiency (pounds of calf weaned/cow exposed or feed/gain ratios) and the environment. In one study, which ended in 2004,researchers administered daily oral preparations of polyclonalantibodies (PAPs) in varying concentrations to steers on a corn-silage diet. The PAPs are designed to target rumen bacteria, which break down grain components,

causing excess acid and, ultimately interfering with weight gain. Although bacteria cannot be completely eliminated from the rumen, a reduction in bacteria may be healthier for the animal. Rumen fluid samples were collected before and after feeding to determine concentrations of S.bovis. One of the PAP preparations was shown to reduce the rumen bacteria S. bovis by 92%.

Impact:
These findings are significant because it is the first time that manipulation of bacterial populations with the use of oral antibodies was confirmed by microbiology measurements and substantiated effects observed in the feedlot. The PAPs promoted a reduction of .2 kg feed required per kg. gain. This amounts to a savings of $5 to $9 per steer during its time in the feedlot. With some feedlots containing thousands of animals at a time, the savings would be considerable: a feedlot marketing 10,000 steers would save $50,000 to $90,000 by using PAPs. Cost of the PAPs is minimal and comparable to other feed additives. Because steers gain weight faster aided by PAPs, they can cycle faster through the feedlots, which means that feedlots can turn over sooner. Four large feedlots are now field-testing the PAPs and results are expected midway through 2005.

Managing Reproduction in the Dairy and Beef Cow-Calf Operation

Description: Reproductive inefficiency through the mismanagement of resources and/or failure to adopt appropriate technologies is one of the most costly and production-limiting problems facing both the dairy and beef cow-calf industries. Reports have indicated that the use of artificial insemination (AI) in the beef industry remains low (only 5 to 8% of producers use it) because of factors such as labor, time and convenience. Recent research has demonstrated that lack of ovulation is an increasing problem in lactating dairy cows. Also, as many as 40 to 60% of beef cows are not in heat at the beginning of the breeding season. To help deal with these problems, University researchers developed breeding protocols to maximize fertility in lactating cattle, with special emphasis on anovulatory or anestrous cattle. Researchers also studied using a progesterone- coated vaginal implant (CIDR - Controlled Interval Device Release) to enhance pregnancy rates at a synchronized breeding in cattle and to resynchronize the first eligible estrus in non-pregnant cows after a previous insemination.

Impact:
In 2004, researchers developed two short (less than 10 days) estrus synchronization systems that can be utilized by producers that result in exceptional pregnancy rates. One of those systems (CO-Synch+CIDR) is a fixed-time AI system that requires no detection of estrus, thus providing a protocol that reduces the time associated with detection of estrus in beef herds. The other system is the Select Synch+CIDR and TAI protocol that utilizes some estrus detection prior to a timed AI to all cows not exhibiting estrus by 84 hours. This system most consistently results in the greatest pregnancy rates over other tested systems. An additional area of research has focused on the synchronization of the return estrus in non-pregnant cows, which has application in herds that utilize a second AI. Concentrating the percentage of non-pregnant cows returning to estrus within a short window reduces the time associated with daily estrus detection. Results demonstrated

that cows can be effectively resynchronized with a CIDR and inseminated within a short window of time after CIDR removal. Overall a greater proportion of calves sired by AI in a short window enhances the genetic base of cowherds and enhances profitability of cattle operations. From an economic standpoint, for every opportunity missed that a cow is in estrus it costs the producer an extra 21 days before that cow returns to estrus again. This results in a calf that is 21 days younger at sale time. A calf grows about 2.5 pounds a day and can be marketed at about $1.10 per pound. The result may be a loss in income of about $57.75 per cow (2.5lbs x $1.10 x 21 days). This is significant when you consider that the average cow nets between $50 and $150 per year for the average beef producer.

Source of Funding: Hatch and Multi-State
Scope of Impact: State, Multi-State

Key Theme: Agricultural Profitability (Joint)

EXTENSION Plan of Work: Goal 1, Program 1
MAES Plan of Work: Goal 1, Program 1, 2, 7, 8, 9, 10, 12, 13

Business Management and Marketing – Winning the Game

Description: The mission of the Center for Farm Financial Management is to improve farm financial management through educational software and training programs. The Center serves farmers and ranchers, University / Technical college educators, agricultural lenders, veterinarians and other public agencies and businesses who can use information to make the ag economy more profitable. This program is built upon research and data base construction that was described in our Report regarding Hatch funds in 2003.

Outcome: The Winning the Game program, delivered in four phases, was evaluated for impact in 2004. Parts 1 and 2 participants demonstrated better understanding of grain price seasonality, how to utilize the price seasonality to price grain and the utilization of revenue based crop insurance to reduce and transfer production and price risk. In the third phase, Winning the Game participants reported a better understanding of post-harvest price trends, costs of storage and selling the carry in the market. A participant survey of marketing clubs showed significant increases in skill adoption: use of marketing plans (163%), writing a marketing plan (391%), and technical analysis (153%).

Impact:
Behavior Change: A study of the Center's Farm Transfer/Estate Planning workshops reported that the strongest impacts were achieved regarding goal-setting for transfers, transfer strategies, financial issues, assets and tax issues. As a result of attending the workshop, 92% of participants stated that they were going to develop a transfer and estate plan or update their current plan. At one multi-state seminar, 56% of attendees indicated that they planned to actively make changes in their business based on information gleaned. A successful asset transfer for even half of the program's participants would affect $93.3 million of the agricultural economy in Minnesota.

Economic Impact*:* A study of the first two phases of the Wining the Game Program showed that participants increased their net farm income by $5,000 to $11,000 per farm participant. Total financial impact of the program statewide in Minnesota was $5.3 million. A study of Winning the Game Marketing Clubs showed a financial impact per farmer participant of $20,401 in additional net farm income.

Improving the Capacity for Nitrogen Fixation of Crop, Pasture and Prairie Legumes

Description: Nitrogen supply can hurt the production of many crops. However, in the case of legumes such as bean and soybean, needed nitrogen can be fixed from the air through a symbiotic relationship with bacteria called rhizobia, thus eliminating the need for nitrogen fertilization. Fixation rates can be more than 100 kg ha-1, and are more sustainable and environmentally friendly than fertilizer N application. Unfortunately, not all soils contain the right rhizobia, so in new areas of crop production it is commonly necessary to add these organisms to the soil at the time of seeding. This research project is aimed at improving nodulation and nitrogen fixation in several different Minnesota legumes by testing both plants and rhizobia strains for their performance, and by ensuring that seeding practices do not inhibit rhizobia added as inoculants. In addition to the more traditional beans and soybeans, researchers are studying prairie legumes, including the purple prairie clover and Illinois bundle flower.

Inoculation of bean and soybeans is of increasing interest to farmers in the Central Lakes region of Minnesota, where yield increases of as much as 1000kg ha-1 have been obtained in two years of testing with soybeans. A website http://www.rhizobium.umn.edu provides details of recent study results.

Impact:
With fertilizer N prices increased 25% since 2001, and currently close to 30 cents per pound for anhydrous ammonia, inoculation of crop and pasture legumes is increasingly attractive to farmers. Cost of a one-time inoculation with an appropriate rhizobia is about $10 ha-1, and done properly can supply essentially all of the plant's need for nitrogen, replacing N fertilizer needs while reducing the possibility of environmental N pollution.

Maintaining Genetic Variation in Corn

Description: In recent years, there has been concern that maize varieties are becoming more elite but less diverse. Theoretical computer models have long indicated that, as inbreeding increases, genetic variance for a quantitative trait such as yield will decrease at a linear rate. Accordingly, in addition to seeking new sources of useful germplasm, researchers are studying the role of different types of gene actions and numbers of parents in determining hybrid performance and in maintaining genetic variation in breeding populations of maize.

Impact:
A study of corn showed that genetic variance for grain yield did not decrease with each generation of inbreeding. A second study showed greater genetic variance for grain yield when populations were formed from two parents instead of four parents. These two studies suggested that genetic mechanisms that conserve genetic variation may be present. Researchers believe that metabolic control is one possible mechanism. The determination that yield does not always decrease with inbreeding means current breeding methods will not deplete genetic variation for important traits in the near future. However, researchers continue to test new germplasm, such as the Cateto population from South America, in an effort to increase corn diversity and to improve Minnesota corn. The website associated with this project is http://stemmapress.com

Soybean Breeding and Genetics

Description: Many of the nearly three million hectares (about 7.4 million acres) of soybeans grown annually in Minnesota are cultivars developed by the Minnesota Agricultural Experiment Station to meet various goals, including higher yield, earlier maturity, disease resistance and special purposes such as increased protein and oil content. In 2004, researchers continued working to develop soybeans with resistance to soybean cyst nematode, phytophthora root rot, white mold and brown stem rot resistance. Losses to diseases are very significant and vary from year to year but are more than $100 million almost every year. Cooperative work with other scientists in the United States and internationally continues, as does developing cultivars complementary to those developed by the private sector.

Impact:
In 2004, researchers released one new cultivar with soybean cyst nematode resistance, which was selected using molecular markers, a new technique first suggested by University of Minnesota researchers. A second release contains the glyphosate resistance gene. Two others were conventional general purpose varieties. Researchers also released five special purpose varieties, which are more valuable than general purpose varieties. How much more depends on the intended purpose and whether the varieties are grown with herbicide use or organically. Special purpose soybeans sell for from about 20% more to triple the price of regular general use varieties. The price depends on the availability of the special use varieties. Special purpose varieties are used for things such as tofu, natto, miso, soy sauce, soymilk, high protein flour, and high protein concentrate. They may also be eaten when green(edamame), used in place of dry beans in cooking, for infant formula, and to produce more healthful vegetable oils. Most people believe the use of special purpose varieties will increase in the future. The impact of these University of Minnesota soybean releases is both immediate and long-term. In 2004, yield from recently released Minnesota cultivars brought in $1 million more in profit than yield from older cultivars.

Barley Breeding and Genetics

Description: Barley production has declined in Minnesota in recent years, primarily due to Fusarium Head Blight (FHB) disease, which results in grain contaminated with the mycotoxin deoxynivalenol (DON), making it undesirable to use as malting barley. Most maltsters reject barley if it has DON of more than half a part per million (0.5 ppm). Since malting barley sells at a dollar a bushel more than feed barley, FHB can cause severe economic losses to growers. Although FHB, also known as scab, fluctuates due to different environmental conditions, it can affect up to 80 percent of the barley crop in a bad year. Researchers continue to develop barleys with FHB-, Septoria speckled leaf blotch- and net blotch-resistance and also barleys with improved field performance and malting quality.

Impact:
Work on FHB-resistant varieties continued in 2004, with one variety candidate accumulating about half the level of toxin of Robust, the most widely grown malting barley in the Midwest. Researchers say that if this variety candidate passes industry evaluation, it may be released in approximately three years. Its release would help growers ensure that their barley would get the malting barley premium. In other work, one variety candidate (M109)--potentially attractive to growers as it is higher yielding and lower in grain protein than currently grown varieties---is being evaluated for brewing quality by the brewing industry. The most recent University malting barley release, Lacey, yields about 12 percent higher than Robust and has an increasing share of the acreage grown, both of these mean increased profits for growers. For example, Robust yielding 50 bushels per acre on 100 acres at $2.50 per bushel would bring in $12,500, while 100 acres of Lacey yielding 56 bushels per acre at the same price would bring in $14,000.

Impact of Climate and Soils on Crop Selection and Management

Description: Computer models and databases with information on climate and weather forecasts can help farmers and others associated with agriculture. With shrinking profit margins and the deployment of precision agricultural technologies, crop producers require better guidance on the temporal probabilities for suitable soil and climatic conditions. In conjunction with other states and the Midwest Climate Center, Minnesota Agricultural Experiment Station scientists are developing online databases for evaluating crop and pest models and for examining temporal probability distributions for soils and climate conditions.

Impact:
In agriculture, crop and livestock producers are striving to better manage their operations in the context of tighter profit margins and respect for the environment. To do so, they are making better use of reports, databases, climatic probabilities and weather forecasts, many of them done as part of University research, to manage their enterprises. Use of researchers'web-based training modules, climatic data and information continues to grow, averaging about 1200 users per day. Soil moisture models and measurements were

used in 2004 to predict field working days so that farmers might better plan weekly workload and field operations. One specific aspect of University research is the website training module for assessing the control of blowing snow http://www.climate.umn.edu/snow_fence/Components/Design/introduction .htm) along roads. The website has continued to be heavily used, up to 2000 times in 2004. It served as a basis for negotiations between the Minnesota Department of Transportation and landowners (primarily agricultural) regarding the use of unharvested, standing rows of corn stalks as a snow fence to protect roadways. This corn stalk snow fence procedure has met with some success in the agricultural landscape, especially during winters with heavy snow cover. The training module on snow drift control has been valuable for a number of cities that have persistent snow control problems. This research and training module continues to provide a basis to negotiate contracts to set aside land for living snow fences. Farmers usually receive a fair payment, plus they are allowed to harvest the remaining crop. This arrangement also insures safer driving conditions. Assessment of climatic trends and improved deployment of observational networks and measurements enhance the use of precision agricultural techniques, reducing the threat of compaction when fields are too wet, and improving the efficacy of agricultural chemicals that are applied under prescribed environmental conditions that meet label restrictions.
Better decision-making and better advice from crop consultants is likely attributable to these efforts.

Source of funding: Hatch, Smith-Lever 3b&c, state, county
Scope of impact: Multi-state, integrated research and Extension

Key Theme: Agricultural Competitiveness (Joint)

EXTENSION Plan of Work: Goal 1, Program 1, 2
MAES Plan of Work: Goal 1, Program 1, 2, 3, 5, 12

Dairy Modernization

Description: The Dairy Modernization program works with dairy producers to improve the profitability of dairy businesses. A key goal of the Dairy Modernization program is to maximize profit in light of record low milk prices during the year. Recommendations ranged from improvements in facilities, changes in milking protocol, improvements in herd health, enhancements to record keeping systems, and improvement in the feeding program.

Impact:

1. Improved profits for dairy farms: Statewide, total improved profits reported from the Minnesota Dairy Initiative were $5,798,184. This was achieved through improved production, decreased costs, improved animal health and reduced culling. Central Minnesota hosts the most prolific dairy processing economy in the state. A study in that region reported the following comparison of profitability from farms not in the program to farms in the program.

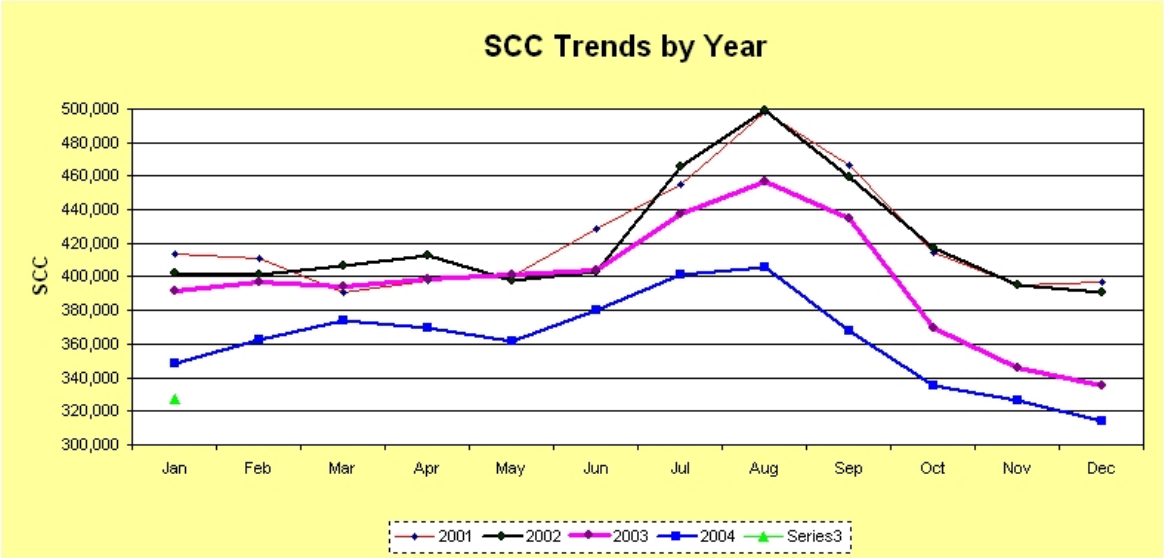
Table 3: Financial Impact of Dairy Modernization Initiative, University of Minnesota Extension, 2004

Item	CMDPT[1] Farms	Non-CMDPT Farms	Difference
Gross Return	$2638.66	$2514.84	+$123.82
Return over direct expense	$1057.77	$979.93	+$77.84
Milk produced per cow	20,405 lbs.	18,755 lbs.	+1650 lbs.
Average milk price	$13.07	$12.99	+$0.08

The total number of cows on farms enrolled in the Central Minnesota Dairy Profit teams is 14,978 and an average return over direct cost advantage of $77.84 for cows on the program, the total dollars of additional profit generated because of this program is $1,165,887.52 (14,978 x $77.84).

2. Improved health for milk-producing herds: The Quality Counts Milk Quality initiative that started in the summer of 2003 continues to make dramatic improvements on the quality of milk that leaves the farm, as well as the productivity of the dairy industry, -- including less treatment of infection, fewer gaps in production and a stronger attractiveness of the industry to the quality of the milk. The goal of this program was to reduce Somatic Cell Counts to below 300,000 by June 2005. Credit for impacts should be shared with The Department of Agriculture. The Department mandates educational interventions in order to lower the somatic cell counts and, thus, infections. The chart below marks Extension's progress.

Table 4: Somatic Cell Counts Trends, Dairy Modernization Program, University of Minnesota Extension, 2004



[1] CMDPT: Central Minnesota Dairy Profitability Teams

Alternative Crops and Specialized Management Technologies

Description: A small but growing Extension effort helps the farm economy diversify into organic and improved farming technologies. Between 1997 and 2001, certified organic acreage in Minnesota grew to about 103,000 acres – the sixth highest of any state.[2] Minnesota is the top U.S. producer of organic corn, soybeans and rye, and second in organic buckwheat. The market for organic products is also growing rapidly and consistently. Recent federal guidelines that standardize organic labeling are expected to fuel even greater consumer interest and confidence in organic foods. These alternative crops require specialized management techniques such as field inspections and contract stipulations. Extension's response has been to keep Minnesotans informed of organic and specialized production research results.

Impacts:

Behavior Change: Because of multi-site workshops and plot tours, farmers learned to identify crop traits that provide economic returns. Farmers reported that they selected varieties based on that information. For example, participants in one training reported they had not added weed control agents that are marketed but are not effective.

Economic Impact:

- Producers not adding gympsum for weed control saved nearly $15,000 cumulatively.
- Two newly organic certified farmers increased their profits by approximately $15,000 a piece.
- If 50 farmers with each with 50 acres selected the right variety to increase yields by one bushel per acre, the price would be $5 per bushel. Thus the impact of this part of the project would be $12,500.
- Selecting the right soybean variety will have an impact. Fifty farmers with 50 acres and one bushel more soybean yield at $12 would create an impact of $30,000.

Honeybees in Northern Climates

Description: Research conducted and reported to CSREES two years ago developed new ways to reduce the amount of pesticide and antibiotic use in honey bee colonies for control of two harmful destructions: 1) the parasitic mite, Varroa Destructor, and 2) the highly contagious bacterial disease, American foulbrood. In 2004, educational materials guide beekeepers to make sound treatment decisions. The project works with commercial beekeepers to breed for traits that allow the bees to actively resist diseases and mite pests. The breed of honey bees that results suppresses mite reduction. A web-based course for beekeepers is being developed that emphasizes treating colonies for diseases and mites only as a last resort.

[2] Atlas of Minnesota: Social and Economic Characteristics of the North Star State. A join project of the Center for Rural Policy and Development, the Blandin Foundation and the University of Minnesota Extension Service. 2003.

Impact:
Behavior Change: In 2004, beekeeping supply businesses and bee breeders report that they are selling tens of thousands of queens from the Minnesota hygienic line all over the United States and Canada.

Economic Impact: Using pesticides increases costs; moreover, labor is required to apply them. Colony losses have more than doubled in many cases even with the use of the pesticides due to re-infestation and increase in the overall stress imposed by the mites. If beekeepers half the number of treatments they apply by using resistant bee stock, operating costs are halved. Reduction in pesticide use by beekeepers will enhance environmental quality and economic viability of individual beekeeping operations, strengthen an agricultural system based on small and moderate-scale owner operated farms, protect human health and safety by preventing the risk of contaminating honey and hive products and promote the well-being of the world's vital pollinators of crops, gardens and wildflowers.

Economic Assessment of Changes in Trade Arrangements, Bio-terrorism Threats and Renewable Fuel Requirements on the U.S. Grain and Oilseed Sector

Description: Three external forces--trade arrangements, bio-terrorism threats, and renewable fuels requirements--will impact the U.S. grain and oilseed sectors. Five universities, including the University of Minnesota, are doing research on corn, soybeans, rice, wheat, and biofuels/added value, and are creating models to analyze international trade agreements to determine impacts on grain and oilseed trade flows between the United States and the European Union and among NAFTA partners-U.S., Canada and Mexico--and the expansion of NAFTA to form the Free Trade Area of the Americas (FTAA). Minnesota researchers focused on the renewable fuels requirements. The U.S. Energy Information Agency estimates that U.S. imports of oil will rise from 64% to 77% of consumption between 2004 and 2025. Research was carried out both for biodiesel and for ethanol. In the biodiesel study, usage patterns of diesel fuel and heating fuel oil were calculated to establish county and monthly use by various classes of machines, vehicles, and boilers. An Excel workbook was developed that allows policymakers and fuel distributors to determine the monthly amounts of 100% biodiesel that will be needed in each county in each month of the year to serve particular classes of vehicles or machines.

Impacts:
With data for the usage patterns in this workbook, policymakers can identify situations when using biodiesel blends would be most effective in reducing emissions of particulates and volatile organic compounds (VOCs). This research suggests economical ways to reduce harmful emissions by using blends of biodiesel in both diesel fuel and fuel oil. Minnesota statutes require 2% biodiesel in most diesels sold in the state in 2005.The biodiesel workbook is available for use by policymakers at the following website: http://www.lrrb.org/pdf/MNBiodieselPolTool120904.xls .
Using the ethanol cost of production research, risk management strategies can be designed and loan repayment schedules calculated for established ethanol plants and those that might be soon. In 2004 81 ethanol plants in 20 states produced 3.41 billion

gallons, representing a 21% increase in a single year. Currently 16 new plants and 2 major expansions are underway in the U.S.

Factors Influencing Process Cheese Functional Properties

Description: The dairy industry is a vital part of the rural Minnesota economy. The objective of this basic research program is to help the industry identify formulation and processing parameters that influence the characteristics of natural and process cheese.

Impact:
In 2004, the application of this research has substantially shortened the time and cost required to develop new dairy products. Researchers developed a new manufacturing process for cottage cheese, which has been commercialized. It allows manufacturers to improve the quality and texture of cottage cheese. This process is currently being used by Cabot Creamery in Vermont and is being tested in two additional dairy plants this year. In addition, the research resulted in the ability to produce process cheese with targeted melting and appearance characteristics. This research on process cheese has been used to produce a new process cheese that can be exposed to high temperature sterilization without the development of flavor or appearance defects.

Source of funding: Hatch, Smith Lever 3b & c, state, county
Scope of impact: State and Multi-state integrated research and Extension

Key Theme: Food Safety (Joint)

EXTENSION Plan of Work: Goal 2, Program 1
MAES Plan of Work: Goal 2

Food Safety for Food Service Workers

Description: The Food Safety for Food Service Workers program utilizes a web site, courses, certification renewal courses, mini-poster series and other events. Extension's food safety and food service program offers four training courses on food safety for the food industry. (1) ServSafe was developed by experts in the food service industry to meet mandatory Food Manager Certification requirements. (2) Extension works with the National Restaurant Association and University of Nevada Las Vegas on a research project by offering the ServSafe on-line course and serving as test proctors. (3) Serve It Up Safely is a food manager certification renewal workshop course developed by Extension. It includes information on emerging trends, cleaning, sanitizing, food borne illness and personal hygiene. It was also developed into an on-line course. Certified Food Managers need four clock hours every three years to renew their certification with the Minnesota Department of Health. (4) The Food Safety Employee training course is geared toward food service workers and was piloted with three groups of vocational high school students in 2005.

Impact:
Behavior change:
94% of participants reported behavior changes in settings at risk for food borne illnesses.

1. They use gloves more often.
2. They followed food safety regulations.
3. They used better hand-washing procedures.
4. They made proper use of thermometers and monitoring of temperatures of food.
5. They used color-coded cutting boards to separate foods from each other.
6. They used better sanitizing methods for equipment.
7. They implemented a cleaning schedule.
8. They changed how food was stored and rotated.
9. They strictly enforced rules that sick staff do not work with food.
10. They established a Hazard Analysis Critical Control Point plan on file in case a food borne illness outbreak occurred in their facility.

Safer Food Service Establishments: Minnesota Department of Health staff report that there has been an 18-20% decrease in critical violations during health inspections of food service establishments that employ a Certified Food Manager.

Advanced Technology for Biological, Agricultural, and Food Engineering

Description: Among the multiple aims of this research project is the development of novel technologies for non-thermal pasteurization (NTP) and sterilization of foods. Conventional pasteurization, through technologies that employ heat, can have adverse effects on the quality, safety and end characteristics (e.g., tasteof foods). NTP pasteurization and sterilization technologies are particularly suitable for processing of heat-sensitive liquid foods such as fruit juice. NTP-based technologies will also be developed for cost-effective control of odorous and hazardous gases, and solid and liquid wastes. NTP- based technologies will be more efficient and cleaner than conventional ones.

Impact:
In 2004 researchers developed new non-thermal plasma (NTP) reactors for pasteurization of dry foods such as almonds. Using this process, researchers achieved a five-log reduction (99.999%) of E. coli and salmonella with little damage to almond quality. Recently, there have been outbreaks of both pathogens in almonds. Salmonella and E. coli can cause illness, and very occasionally death, in humans consuming contaminated food. The young and the old are especially vulnerable. The California Almond Board has expressed interest in the NTP process. California, largest producer of almonds in the U.S., had 550,000 bearing acres of trees in 2004.

Enhancing Food Safety through Control of Food-Borne Disease Agents

Description: Food- and water-borne diseases are a major public health concern because more than 70 million people in the U.S. are affected and approximately 5,000 individuals die each year. A variety of different food-borne disease agents, including bacteria, viruses, parasites, protozoa and others, are responsible for food-transmitted infections.

Food-borne pathogenic bacteria cause more than 4 million infections and they cost the American economy $6.9 billion per year. Among these bacteria, Salmonella and E. coli are two of the most important bacterial pathogens. Foods contaminated with Salmonella and E. coli are frequently linked to outbreaks of acute gastroenteritis. These pathogens are easily killed in processed foods, but they can survive in raw, fresh, and minimally processed products. These pathogenic bacteria are normally present in the gastrointestinal tract of livestock and they can easily be transmitted via fecal material and animal manure. Because fresh and minimally processed foods do not have a kill step in their process, it is critical to develop methods of control at the farm level to stop the dissemination of these bacteria from animals. Manure and livestock drinking water have been identified as sources for environmental spread of these pathogens. Researchers experimented with using different strains of E. coli to decrease the number of another strain (O157:H) a disease-causing bacteria that is shed in the fecal matter of cattle. Subsequently, after treatment with colicinogenic strains of E. coli., the number of O157:H7 present in calves fell to 44% of intestinal tissue samples, compared to 64% of the control samples

Impact:
2004 results have shown that feeding colicinogenic E. coli can reduce the fecal shedding of serotype O157:H7. A novel mixture of colicinogenic strains has been developed that can be used to treat cattle to reduce fecal shedding.

Processing and Storage Effects on Stability of Nutraceuticals

Description: There is an increasing use of dietary supplements and fortified foods to decrease health care costs. Little is known about the stability of the active agents in these products. According to proposals by the FDA, processors must guarantee label values for their ingredients, including nutraceuticals, which can be defined as nutrients or non-nutrient compounds that are added to foods to maintain healthy conditions in the body. This research project focuses on the use of an easy-to-swallow, milk-based beverage made stable at room temperature by ultra high thermal processing (UHT).

Impact:
Work in 2004 showed that in thermal treatment (pasteurization) and storage, soy isoflavones, creatine and lactoferrin are very stable. Researchers developed a mathematical model to predict the temperature profile under UHT, which permits evaluation of the overall degradation kinetics of these nutraceuticals at each stage of the heating treatment. These studies of UHT, together with work done by collaborators at other universities, can also be used to predict inactivation of bioterror agents such as ricin, anthrax and botulinum toxin. In addition, together with Penn State researchers, the means to eliminate the non-enzymatic browning off flavors produced under UHT processing conditions were determined. Several foodgrade antioxidants seem have the ability to block the reaction and are being investigated further.

Elimination of E. Coli and Salmonellae from Ready to Consume Acid Foods

Description: While processing techniques such as acidification/fermentation, cooking and freezing are successful in killing pathogens such as Salmonella sp, Listeria sp. and Escherichia coli 0157:H7, some of them may survive in ready to consume foods and thus pose a health risk. In this project, researchers demonstrated that the use of selected antimicrobial-producing lactococci for cheese making can enhance food safety by accelerating the death of these pathogens in buttermilk and Camembert or Cheddar cheese. Similarly, a combination of natural acids in apple cider and freezing for two weeks can cause severe damage to E. coli 0157:H7.

Impact:
The method may be an alternative to pasteurization as stipulated by the U.S. FDA. Researchers also developed a bacteriological medium and test process that would permit recovery of sublethally injured Salmonella sp. and E. coli 0157:H7 that would otherwise not be detected.

Source of funding: Hatch, Multi-State, Smith Lever 3b & c, state, county
Scope of impact: State and Multi-state integrated research and Extension

Key Theme: Human Health (Joint)

EXTENSION Plan of Work: Goal 3, Program 1
MAES Plan of Work: Goal 3

Obesity Prevention in Communities

Description: In 2004, activities in this goal focused on the development and delivery of programming. The business and curriculum plan has designed strategies to address the unique needs of different cultures. "Food" and "culture" are intricately tied to each other. Extension has created curricula sensitive to the links between food choices and life in a culture. The mobilization of natural helpers who can work within a culture to change food habits is emphasized. The social function of food is discussed, the health impact of food, gender roles in food preparation, as well as how religion and spirituality links to food habits. The educational goal is to make people conscious of why they make the choices they make, and to promote understanding of the choices of other cultures.

Impact:
Behavior change:

- In just one school setting where the program delivered information, Kindergarteners are bringing and choosing healthy snacks that adhere to new school guidelines. Those kindergarteners (95%) took advantage of opportunities to sample new fruits and vegetables provided by the school food service for snacks. Parents of these kindergarteners reported they were working to model positive eating behaviors when joining their children for lunch.

- In addition, 670 participants reported increased skill in reading food labels checking for fat content, and 453 reported having made food selections with lower fat amounts after reading food labels.

Institutional Change

- In the kindergarten where the intervention was piloted. The cafeteria environment changed to be more conducive to positive eating experience by Kindergarten students. Tables were separated. Noise absorbers were installed. Guidelines were adopted at the school for healthy snacks.
- Four counties and two Indian reservations are working together on a regional planning effort to prevent obesity. This collaboration was initiated through a joint meeting between Extension and Community Health Services

Whole Grains Processing and Nutritional Quality

Description: Agricultural economic returns may be coming at the cost of decreased human nutrition and health. This project examines whole grains and the effect of their processing and nutritional impact on the human diet and health. Specific research assessed their potential uses in helping the immune system fight such problems as cancer and inflammations.

Impact:
In 2004, researchers developed a cell culture system to test whether and by how much cereal grain components stimulated the mammalian immune system helping the body defend itself against bacterial, viral and pathogenic organisms. Researchers found that these grain-derived compounds may also modulate inflammatory responses in the body. The compounds stimulate macrophages, which are part of the innate immune system in all mammals. Researchers believe that the grain compounds might support patients during and after surgery and cancer treatments and might improve the immune system of all Americans. Their ability to decrease inflammation may be their most useful contribution, as inflammation is now becoming well known as one of the underlying problems common to chronic diseases, such as hypertension, obesity, heart disease, diabetes, and cancer. Preliminary studies show that patients on certain anti-inflammatory agents have decreased risks for several degenerative chronic diseases.

Safety for Young Hmong Farmers

Description: More than 200 Hmong families living in the Twin Cities area raise vegetables to sell. Children work alongside parents in the fields and at farmers' markets. Almost all labor is done by hand; rototillers are often the only machines used. Though this type of farming differs greatly from more mechanized operations, safety is a concern for both. Since the Hmong have an oral rather than a written culture, merely translating standard written safety information does not effectively convey precautions, and the content is often not relevant to Hmong farming methods. After researchers found that parents relayed instructions to children via stories, they, too, decided to try using the classic Hmong storytelling form to provide specific safety information.

Impact:
In 2004, researchers hired a Hmong playwright to tell the story of Tou Joua, an orphan farmer boy. Woven into the saga of the orphan boy are benevolent spirits, wise old ladies, beautiful princesses in disguise, nasty relatives and precise instructions on using rototillers and knives, as well as guidelines for children working in markets. A dramatic reading of the story was piloted tested with a group of Hmong and received favorable response. Additional presentations were scheduled at four different venues in Minnesota early in 2005. A written version, illustrated by a Hmong artist, is being published as a bilingual book. Dramatic presentations were also scheduled for several Hmong communities in Wisconsin. Discussions following the presentations will determine if the safety messages have been received.

Genetic Research for the Functional Food Market

Description: Dairy cultures are essential for producing everyday foods and maintaining a healthy digestive tract. They add an extra health benefit to foods over and above nutrient content. In the food industry, foods in this category are generally referred to as functional foods. The functional, or probiotic, foods market is showing impressive annual worldwide growth. While the probiotic sector is vibrant in Asia, Europe and Australia, it is still quite small in the U.S., which accounts for more than one-third of the total functional foods market. This research project uses genomic technologies to answer key questions about Bifidobacterium longum, an important culture for maintaining health in the human large intestine. B. longum is able to break down many dietary carcinogens, thus potentially protecting against colon cancer. Researchers have isolated a strain of B. longum that was the most dominant in a young healthy adult. This strain, DJO10A, was found to inhibit many other bacteria by secreting an effective iron chelator that withheld the iron from its competitors. This iron-binding compound has been purified and its structure is being deciphered. As this strain appeared to have the characteristics necessary to compete and modulate the human large intestine, it was chosen as a model strain to try and understand this process. The complete genome sequence of this strain-- a single chromosome and two plasmids--was deciphered. In addition, a gene transfer system based on electroporation was developed for these bacteria. These tools will be important for functional analysis of the B. longum genome. Researchers have completed a thorough comparative analysis of our B. longum strain with the genome of another published strain. Surprisingly, it was found that there was very little colinearity between the strains, even though they showed > 98% sequence identity. This revealed that the genome of this prominent gastro intestinal tract microbe was quite fluid, being subject to both DNA acquisitions and rearrangements. Currently, the genome is being used to reveal important genes for stress protection in this bacterium as well as genes important for its colonization in the intestine using microarray technology. This information is crucial for the successful application of these probiotic cultures in the functional foods market.

Impact:
The inclusion of probiotic cultures in dairy products to improve people's overall health is perhaps the sector of the dairy foods business with the highest growth potential. To

maximize this potential it is imperative that the cultures used have scientifically validated probiotic attributes.

Source of funding: Hatch, Smith Lever 3b & c, state, county
Scope of impact: State Integrated

Key Theme: Agricultural Waste Management (Joint)

EXTENSION Plan of Work: Goal 4, Program 1
MAES Plan of Work: Goal 4, Program Program 6

Manure Management and Air Quality Management

Description: Animal agriculture plays an essential role in Minnesota's economy. Unfortunately, manure generated from animals can negatively impact the air and water quality of the state. Federal, state, and local regulations are designed to protect these natural resources; however, meeting these regulations requires innovations in technologies and management practices. Research and education programs come together to develop and disseminate economically feasible and environmentally sound manure handling systems. This program reaches private consultants and engineers who deal with manure and nutrient management, as well as public technical service providers, government regulators, custom manure applicators, livestock and poultry producers and crop farmers through educational materials, workshops and training sessions.

Impact
This integrated project collaborates with all Minnesota organizations working on this important issue, and draws on expertise from a variety of sources; therefore, credit for impacts must be shared. Extension and its collaborators are changing trends in manure management through extensive research and education.

Behavior changes:

- In one county alone, 17 producers came into compliance with feedlot laws, and four producers signed the state open lot agreement.
- 22 farmers wrote manure management plans or had them written.
- A post-season survey indicated that 61% of the responding participants had completed their nutrient management plans as the result of the workshops. If changes written into manure management plans are followed, the impacts will be a reduction of 132,000 lbs. of N and 176,000 lbs of P205.

Economic Impact:

- Thirty-four percent of participants in the workshop calculated that they would save at least $20 per acre in fertilizer costs if they utilized manure according to their nutrient management plan. 247 workshop participants were sent a follow up survey. 116 responded that they managed a total of 84,000 acres of cropland in

Minnesota. Therefore, quality manure management increased farm profits by approximately $1,680,000 while improving the quality of the environment.
- Non-compliance with feedlot laws could mean fines in excess of $20,000 for the group that came into compliance.

Aerial Pollutant Emissions from Animal Confinement Buildings

Description: The increasing sizes of poultry, swine and dairy operations in recent years have generated questions about adverse impacts of aerial pollutants from these operations on human and animal health and on the environment. Pollutants include odor, ammonia, hydrogen sulfide, carbon dioxide and particulates produced by the animals, their confinement materials and their manure. In an era of increased regulation, em9ission standards must be set. Those will depend on accurate assessment of emissions. Until now, no on-site, long-term emission studies have been done. Minnesota researchers joined scientists from five other states to determine baseline pollutant emission rates for six common types of animal confinement buildings from different sections of the U.S. over a 15-month period (winter, 2003 through spring of 2004). Researchers evaluated differences in emissions due to season, time of day, building design, growth cycle of the animals, and building management.

Impact:
Data gave a good picture of the cyclical nature of emissions. All emission rates fluctuated more in the summer than in the winter, probably due to more ventilation variability. While most daily emissions were well within allowable regulatory limits, spikes in the summer and fall may push the emissions level close to or beyond permissible levels. Research findings suggest the importance of having long-term data from which the Environmental Protection Agency can set allowable standards. The Minnesota study is going to be used as a template as the EPA partners with the livestock feeding industry to continue to collect long-term data.

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

Key Theme: Water Quality (Joint)

EXTENSION Plan of Work: Goal 4, Program 4
MAES Plan of Work: Goal 4, Program 4

Drainage Education and Water Management

Description: Artificial drainage systems have supported agriculture production in Minnesota for over a hundred years. Surface and subsurface (i.e., tile) drainage systems are an integral part of the landscape in the Minnesota River and Red River Basins and help ensure successful agricultural crop production in these regions. Since the inception of the Clean Water Act (1972) and Swampbuster provisions (1985), societal expectations toward wetlands and the environment have changed.

Artificial drainage on poorly drained agricultural soils can reduce soil erosion and compaction, phosphorous losses and unfavorable field conditions for farm equipment in the spring and fall. Water management on drained lands is vital to sustaining production and profitability of soils.

Basic and applied research is underway to improve our understanding of how artificial drainage impacts the environment and how drainage practices can change to reduce those impacts. Farmers, contractors, consultants, agency staff, local decision-makers and others understand how they can accomplish the dual objectives of agricultural production and minimized negative environmental effects. This program works to increase awareness of drainage needs, alternatives and impacts within the target audience through applied research, workshops, field days, seminars, conferences, a web site (http://d-outlet.coafes.umn.edu), publications and farm visits.

Impact
Funding was acquired in 2003 to conduct an evaluation of the workshop through focus groups and written questionnaires from past program participants. The study is not complete, but early feedback suggests that participants think more analytically and holistically about water management alternatives. Others said that they factor environmental considerations when making water management decisions. Participants also show evidence of understanding the complexity of the soil-plant system they are managing. There is no question that workshop participants are better able to consider thoroughly consider difficult water management decisions that include both production and environment.

The web site has experienced over 10,000 visits since its development in 2001. There is evidence that the site is creating a ripple effect of education. Students and instructors at other institutions have downloaded materials for courses.

Small Community Wastewater Education Program

Description: The Small Community Wastewater Education Program supports the thousands of rural "unsewered" communities that need help finding viable solutions to healthy handling of wastewater. The program provides residents and community leaders with the tools they need to make viable solutions based on the solid environmental, financial and social needs of the community.

Impacts:
Community Processes Working for Health Compliance:
The program is reaching communities of the greatest need in Minnesota. In 2004, the program mobilized community decision-making processes with ten communities, including a lake association, a small town, two townships, and an Indian tribe. Impacts quantified in previous years would indicate that these ten communities will, as a result, they will find viable solutions that follow federal EPA and state MCPA guidelines.

Impacts include cleaner water, longer-lasting septic systems and more informed decision-making about public expenditures of public and private funds.

Shoreland Education Program

Description: The pressure on our water resources is demonstrated by data collected by the Minnesota Department of Natural Resources. Between 1967 and 1982, the number of homes on lakes outside the metro area grew by 74%. Seasonal homes increased 63%. Permanent homes increased by 99.5%. Many small cabins have been replaced by large homes and, as available lake and river frontage becomes scarce, more and more marginal lands are being developed.

Impacts:

Lake associations are working to improve the water quality of their lakes, and Extension provides them the education and funding connections they need to do the job and do it well. In 2004, four lake shore projects were connected to funding sources. These communities wrote quality proposals for shoreland restoration with the help of Extension's educational programs, and each of the proposals received funding in amounts ranging from $5,000 - $40,000. As a result of those projects, 500 linear feet of shoreland is or will be restored, and 20,000 square foot of shoreline were restored. In addition, these efforts mobilized owners to care for their shoreland property, resulting in future stewardship of the land and water.

Source of Funding: Hatch, Smith-Lever b&c, State

Scope of Impact: Multi-state integrated

The Karst Campaign for Clean Water, Productive Soil and Profitable Farms

Description: The overall goal of the Karst Campaign is to promote clean water, productive soil and profitable farms through a comprehensive educational strategy targeted at the karst region of southeastern Minnesota. The karst region is composed of porous limestone, which can allow contaminants to leach into the water supply. To help producers maintain successful farm businesses as well as safeguard their water supply, University of Minnesota researchers and Extension Educators have determined and disseminated the Best Management Practices (BMPs) for the region. In 2004, researchers used the FANMAP (Farm Nutrient Management Assessment Program) to determine to what extent these recommendations had been adopted.

Impact:
Results of the analysis of 30,000 acres were mixed, but showed that farmers had adopted some of the BMPs. Farmers with a corn/soybean rotation came within 15 pounds of the recommended fertilizer application limit. Encouragingly, only 150 acres were still under moldboard plow, which promotes erosion. No-till practices, which result in increased residue cover and thus controls erosion and sediment loss, were used in 6,000 acres. On

the down side, liquid manure—generally hog manure—was over-applied by more than 50 pounds per acre. Results also showed that beef operations were spreading less than 25 percent of manure. Researchers are advising farmers, particularly those with beef operations, to spread more manure to reduce runoff, which releases fecal coliform bacteria into streams and rivers. Farmers who plant corn after alfalfa need to apply less nitrogen. Information conveyed to producers through the Karst campaign may be of potential health benefit to those who live in the area. Bacteria from manure and septic systems in surface streams and rivers in the area are of special concern, as these bacteria create potential concerns for those using these waters for recreation. The ground water concerns are primarily with Nitrogen levels in aquifers that supply drinking water in private wells.

Watershed Studies for Nutrient Reductions in the Minnesota River Basin

Description: This project is a farmer-led and initiated effort to accelerate the voluntary adoption of Best Management Practices (BMPs) for nutrient management in the Minnesota River Basin. Farmers want to take an active role in identifying practices that improve water quality and agency personnel want to know which practices effectively improve water quality and maintain agricultural productivity. This project uses a coalition of producers, agency personnel, and researchers at the University of Minnesota to evaluate BMPs implemented at the watershed scale in two adjacent agricultural watersheds in Nicollet County, Minnesota. All are in the Minnesota River Basin. Researchers collected water quality samples at the mouth of each watershed for three years. Farmers operating within both the treatment and control watersheds were surveyed to establish farm management practices. After a one-year control monitoring period, farmers in the treatment watershed were visited to discuss the types of changes in management they would be willing to make to improve water quality.

Impact:
BMPs were implemented on about 42% and 48% of the treatment watershed for the 2003 and 2004 crop years respectively. Researchers found that farmers are willing to make changes in their management practices to improve water quality. The level of adoption depends on their age, farm size, and production characteristics. Survey findings showed a wide range of management practices in the watersheds, and point out the need for a correspondingly wide range in BMPs. Preliminary results using erosion and phosphorus models indicate that installation of BMPs in the treatment watershed have reduced erosion rates by 20% and phosphorus losses by 15%.

Drainage Design and Management

Description: Subsurface (tile) drainage systems, while providing a great benefit to agriculture, can also worsen certain environmental impacts, such as nitrate losses to surface waters. In 2004, to determine whether planting winter rye as a cover crop after corn and before soybeans would reduce the loss of nitrate-nitrogen to surface water, and subsequently to drainage systems, researchers developed a new computer model, called RyeGro, and did long term simulations of using this cover crop.

Impact:
RyeGro results, which compared very well to observed data, indicate that using winter rye as a cover crop is most effective when the rye is seeded by mid-September and desiccated in late May: long-term simulations indicate that nitrate-nitrogen losses may be reduced by up to 45% for a corn-soybean rotation. Reducing nitrogen loads to streams has a substantial benefit to coastal ecosystems, Data and information from this research is allowing producers, contractors and other decision-makers to better incorporate environmental and agronomic objectives into water management planning and management.

Using Aquatic Insects to Track Water Quality

Description: Since 2001 researchers have been sampling small and large streams in a five-county area around the Twin Cities- including those that feed into the Mississippi and St. Croix rivers--to document the species and numbers of non-biting midges (Chironomidae). The presence or absence of certain species indicates whether and to what degree the water is polluted. This quantitative field data may help authorities correct problems before they become widespread. One of the streams sampled – Minnehaha Creek – is a valued and popular recreational and aesthetic resource as it flows through parks and urban areas from Minnesota's Lake Minnetonka to the Mississippi River. As part of this research project, a study of 168 samples at 14 sites was carried out at the creek from April until November in 2003.

Impact:
Researchers found that Minnehaha Creek showed unexpectedly high biodiversity for an urban stream, indicating high water quality and very good habitat conditions at several sites. Most sampled sites had at least 60 species, one site alone had more than 90 species, and a total of 124 species were documented. Study results will be given to the Minnehaha Creek Watershed District, and researchers will work with the watershed district to ensure that the creek's water quality and in-stream habitat are preserved. In addition, on the basis of findings from all streams, including the St.Croix tributaries, researchers have prepared a guidance document that enables private citizens and working professionals to use aquatic insects to monitor and evaluate water quality. It is available in digital form on-line. Eventually, sampling for certain Chironomidae species may assure the public that the water they use for swimming, fishing and boating is of high quality. In Minnesota and other states where water-based recreational pursuits are an important part of many residents' lives, results of this research may increase the enjoyment of life. Websites for more information on this project are:
http://www.entomology.umn.edu/midge/minnehaha_creek.htm
http://www.entomology.umn.edu/midge.GuidePage.htm

Biogeochemistry and Ecological Risk Management of Trace Chemical Constituents

Description: Mercury and its more toxic form, methyl mercury, are present in most fish caught and/or eaten in Minnesota. Cooking or cleaning methods cannot reduce the

mercury levels in fish. Mercury poses a health risk to humans, especially to children, breast-fed babies and developing fetuses, and may cause brain damage and learning disabilities. For three years, researchers have been studying the net methylation of atmospherically derived mercury in pristine upland bogs in northern Minnesota. Application to the bog of sulfates, which also combine with Mercury to produce methyl mercury, was part of the procedure. General results of the research suggest that atmospheric deposits of sulfates from power plants and other sources burning fossil fuels may cause a net increase in methyl mercury, and hence, in mercury levels in fish. In addition to continuing this project, researchers are beginning a new study investigating the effects of forest fires on net methylation and fish bioaccumulation in paired lake systems in the Boundary Waters Canoe Wilderness Area.

Impact:
The study showed that the methyl mercury concentrations present in many surface waters (which appear to be about 10 times pre-industrial levels) may be the result not only of enhanced atmospheric deposition of mercury (currently 2.5 to 3 times pre-industrial levels) but also enhanced atmospheric deposition of sulfate. This coupled biogeochemical cycling of sulfate and mercury/methyl mercury provides an opportunity to reduce the impacts of mercury deposition on aquatic ecosystems both directly (through decreases in mercury deposition) and indirectly (through reduction in sulfate deposition). In light of the current high numbers of lakes and rivers in Minnesota and the world impaired by high concentrations of methyl mercury, this research may have impacts far beyond the region of the study.

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

Key Theme: Forest Crops (Research)

MAES Plan of Work: Goal 4, Program 3

Development of Chemicals and Materials for Paper Applications

Description: Laboratory and pilot –scale work on thermoplastic pressure sensitive adhesives was completed in 2004. The new technology resulting from this research includes designs for thermoplastic pressure sensitve adhesive label systems that in hibit the fragmentation of the adhesive during recycling operations. This allows for the removal of the adhesive film very early in the recycling process eliminating the negative impact these materials currently have on paper production and product quality.

Impact:
The results of the research have been made avalable to all manufacturers through presentations at national meetings, invited talks to industrial representatives and journal publications. The information allows for the formulation of thermoplastic pressure sensitive adhesives that are removed from the recycling process with existing process

designs and cleaning equipment with a majority of the removal occurring during the early screening operations. Label facestock recipes have also been developed that significantly improve pressure sensitive removal efficiencies. An important aspect of this project is that the mathematical models and materials derived from the research have direct application to the label market in that they allow manufacturers to design benign pressure sensitive adhesive products without raising manufacturing costs or requiring capital investment. The new design ideas have been demonstrated at the pilot scale using the U.S. Postal Service Stamp Protocol developed by the Forest Products Laboratory. They are also found in a new environmentally benign, PSA label product line that was developed through a joint venture, initiated by the University of Minnesota, between H.B. Fuller Company and Avery Dennison Corporation.

Deterioration in Historic and Archaeological Wood

Description: The University of Minnesota's past research on microbial and enzymatic degradation of wood and wood components has been useful in helping to protect and conserve historic and archaeological wood from a variety of National Parks and Monuments and World Heritage Sites, including those in Southwestern U.S., ancient Egypt, King Midas' tomb and the huts of Antarctic explorers. Investigations of the biological and non-biological degradation processes in wooden structures has been or is being carried out in cooperation with The Getty Conservation Institute, The Metropolitan Museum of Art, The American Museum of Natural History, the U. S. National Park Service, and The Institute for Nautical Archaeology, as well as many archaeologists and conservators working to preserve wooden cultural properties around the world. Different abiotic and biotic forms of deterioration result in distinct changes within wood cells. These chemical and morphological degradation patterns can be used to determine the type of decay and the causal agent. Understanding the mechanisms of deterioration as well as the condition of the artifact at the ultrastructural level makes it possible to tailor treatment, physical supports, and environmental conditions most appropriate for the long-term preservation of
archaeological woods.

Impact:
University of Minnesota research is being used to better understand deterioration processes that affect ancient woods and to help preserve these national and international heritage sites long into the future. This research is also providing important new information on the biology and ecology of these little known microorganisms that attack ancient wooden objects and other organic materials. This past year work was done to protect and conserve Cliff Dwellings at Tonto National Monument, Arizona; Scotty's Castle, Death Valley National Park, California; historic huts built by Scott and Shackleton (explorers to the South Pole) and structures built in the Arctic by Greely, Peary and several early English explores. More details of the research findings can be found at: http://forestpathology.coafes.umn.edu/ In one of the projects undertaken in 2004 researchers studied wood used in the construction of the great houses in Chaco Culture National Historic Park and also the ruins at Aztec Ruins National Monument, both located in New Mexico. The Chaco great houses, which are about 1000 years old

were excavated in the early 1900's. The houses are primarily made of mud and brick, but also contain a great deal of wood. University researchers assessed the type and extent of deterioration in the houses, finding that deterioration was due largely to brown and soft rot fungi. Their recommendations are being used to conserve the structures and careful monitoring is being done to prevent further deterioration and to preserve these national treasures. The dollar impact of saving historical wood structures for future generations is incalculable.

*Biology, Control, and Biotechnological Uses of Forest Microbe*s

Description: Research on tree diseases and wood microbiology is vital in order to develop effective control strategies for Minnesota's forest and shade tree diseases. Tree diseases and wood deterioration processes result in large economic losses in Minnesota and the nation. Research results on the biology and ecology of these organisms provide important information on tree disease agents and effective methods of control. New exotic diseases continue to threaten trees throughout the United States. The recent introduction of sudden oak death into California is of special concern. The highly valued and ecologically important oak population in urban landscapes and forests of Minnesota is at great risk from the introduction of Sudden Oak Death and researchers are continuing efforts to look for this disease on woody plants brought into the state and to do everything possible to prevent it from getting established. Diseases of woody ornamentals are increasing and new investigations have been initiated to determine the causal agent of cankers, root rots and diebacks that occur in these plants. Each year, woody ornamental nurseries and home owners throughout the upper Midwestern United States lose countless numbers of shrubs and trees to unknown diseases. One group causing serious losses is the fungus-like organism called Phytophthora (the name is derived from the Greek meaning plant-destroyer and this is the same group causing Sudden Oak Death). University investigations to monitor for Sudden Oak Death have provided important new information on the Phytophthora species that are problematic in Minnesota nurseries.

Impact:
Tree diseases and microbes that attack wood cause many billions of dollars in damage each year. One goal of this research is finding trees with resistance to disease and finding new environmentally friendly biological control methods to control disease. During 2004, researchers were successful in selecting families of eastern white pine that have good resistance to white pine blister rust. Studies determined that there are significant differences in protein expression between resistant and susceptible seedlings. These defense proteins are being characterized and genes responsible identified. University research is helping nurseries provide fine quality, disease free plants and protecting Minnesota from the introduction of devastating new diseases. Diseases such as Phytophthora are difficult to identify and control. Researchers are developing rapid methods to detect Phytophthora diseases affecting woody plants. For details on these research projects, visit: http://forestpathology.coafes.umn.edu/

Source of Funding: Hatch, State
Scope of Impact: State. Multi-State

Key Theme: Natural Resource Management (Research)

MAES Plan of Work: Goal 4, Program 1

Using Pheromones to Control Invasive Species of Fish

Description: By determining the identify and function of pheromones (potent chemical signals that pass between organisms of the same species) they can be used to control nuisance/invasive species of fish. Pheromones have great promise for use in invasive fish control because they exert powerful effects on fish behavior, are easy and inexpensive to apply, and are environmentally safe. Studies of pheromones in the sea lamprey, common carp and Asian carps have made significant progress. The sea lamprey migratory pheromone has now been isolated, structurally elucidated, and found to be comprised of three unique disulfated steroids. This is the first migratory pheromone to be identified in a vertebrate. Initial field trials of this pheromone in Michigan have been very successful. A patent application has been filed for the use of this pheromone to control lampreys. Other research has demonstrated that common carp release a species-specific aggregation pheromone that has potential for use in control. Also this research has discovered evidence that carp use alarm pheromones that might be used as repellants in invasive fish control.

Impact
The greatest single threat to the fisheries and waterfowl found in the lakes and large rivers of the Upper Midwest are exotic species. While the common carp may comprise over half the biomass of many shallow lakes where it seriously disrupts food chains through its habit of scavenging in the bottom, the parasitic sea lamprey kills as many fish as fisherman catch in many areas of the Great Lakes. At present, the only option for controlling these exotic invaders is to poison entire watersheds, an extremely expensive, damaging, and inefficient technique. This project is making good progress towards developing pheromones as a new tool for use as attractants in their management. It has lead to the formation of state, national, an international network to promote and use the approaches it advocates.

Source of Funding: Hatch, State
Scope of Impact: State

Key Theme: Housing (Research)

MAES Plan of Work: Goal 5

Defining Family-Appropriate Rental Housing and Neighborhoods in Minnesota

Description: An evaluation of the RentWise program began the basis for a report to the Minnesota Housing Finance Agency. Comparative analysis of the data from RentWise participants and a control suggested that participants learned new skills and behaviors. For, example, participants were more likely to use a spending plan with affordable rent, complete a neat, written rental application, request screening criteria when applying for rental housing, and practice good communication skills with landlords and neighbors. They were more likely to be in permanent housing, report improvement in their housing, positively evaluate their current neighborhood, and be satisfied with their current housing as well as the cost of their current housing. Furthermore they were more likely to feel positive about their life as a whole and to expect their standard of living to improve within the next three years. One of the most dramatic findings was a different in perception of how they were treated in the rental market. Participants were less likely to feel they experience discrimination in their search for housing. Two additional indicators suggested that the RentWise program helped participants stabilize their housing. Participants in the program are less likely to rely on shelters or change schools for their children.

Impact:
Researchers are discovering what is successful and what needs additional attention in the RentWise program. The findings are increasing the understanding of homeless and precariously housed households in the Twin Cities area for funders as well as shelter and service providers. The report to the housing finance agency is helping them lobby for funds to provide housing and housing support programs such as education that will prevent homelessness. The RentWise program is included in the state's plan to end homelessness. A pool of responsible, stable tenants is also a tangible benefit to landlords in the business of affordable housing.

Source of Funding: Hatch, State
Scope of Impact: State

Key Theme: Parenting (Research)

MAES Plan of Work: Goal 5

Strengthening Fatherhood

Description: This year researchers completed the central analyses for the Strengthening Fatherhood project. They found that intervention was effective in increasing fathers' skills with their infants and fathers' time involvement with their infants during workdays.

They also found significant relationships between fathers' family of origin relationships and their attitudes towards fathering.

Impact:
As a result of this research, a successful intervention curriculum for the transition to fatherhood has been developed and is ready for adoption by family life educators and health care systems.

Relationships in Adoptive Families

Description: Researchers have developed and published a theoretical model of communication about adoption within the family based on research results to date. And intensive qualitative analysis identified the increasing role that adolescents take on in terms of communication and contact with birthparents. Both adoptive parents and birthparents expected that adolescents would be taking on more independence in initiating contact. The maintenance of open adoptions requires ongoing negotiation of needs and roles of the members over time. There is no uniform pattern for open adoption—kinship networks have contact by different means, among different people, at varying rates, and with varying degrees of interest. Successful relationships in such complex family situations hinge on participants' flexibility, communication skills, interest, perception of importance, and commitment to the relationships.

Impact:
With the continuation of longitudinal analyses, the policy implications of this project are becoming more clear, and researchers are communicating them more broadly to decision-makers. Study findings argue for a strength-based approach to adoption, rather than one that is deficit-based, and for the need for flexibility in decision-making about contact over time. The key results have been presented to national and international audiences.

Source of Funding: Hatch, State
Scope of Impact: State

Key Theme: Youth Development (Research)

MAES Plan of Work: Goal 5

Youth Civic Engagement

Description: Work on youth civic engagement is being used to stimulate local policy and program development in a variety of youth programs.

Impact:
Researcher convened and led international Northern Ireland conference on research on youthwork in contested spaces/societies for nine countries which have begun for the first time local field research on youth civic work, leading to policy and program development. Models of nonviolent, democratic youth engagement have provided actual

alternatives for young people to local violent paramilitaries, violent revolutions, criminal gangs or social withdrawal. Also, emerging networks of local action provide support to civic youth workers and young people in difficult circumstances.

Source of Funding: Hatch, State
Scope of Impact: State

Key Theme: Conflict Management (Research)

MAES Plan of Work: Goal 5

Impact of Restorative Justice

Description: As the field of restorative justice continues to expand in nearly every state and as the use of victim offender mediation and dialogue in crimes of severe violence is now developing in approximately 15 states, including Minnesota, the findings from this research provide helpful and much need implications for policy development and practice in this emerging field. Individual case studies of the use of victim offender mediation and dialogue in Northern Ireland and in Israel are providing preliminary data on how this mediation/dialogue intervention is beginning to be used in healing the wounds of political violence in two of the most entrenched conflicts.

Impact:
This research represents the only on-going and multi-site assessment of mediation and dialogue in crimes of severed violence, a practice that is receiving broader policy support both within Minnesota and many other states. The research has documented the only known cases of applying dialogue in the context of such highly volatile places as Northern Ireland and Israel/Palestine.

Source of Funding: Hatch, State
Scope of Impact: State

Key Theme: Aging (Research)

MAES Plan of Work: Goal 5

Promoting Life Strengths Among Elders

Description: Vital Involvement Practice (VIP) is a practice modality for promoting diverse strengths in elders, across diverse living circumstances and level of physical well-being. Researchers have revised and refined a basic, standardized VIP modality and associated tools, as well as training procedures.

Impact:
VIP constructs have been integrated into the life-planning work of the Minnesota Vital Aging Network, and into the foundation of the community group ElderZest. VIP presentations have been well-received at the University, local, state, national, and international levels. The researcher's work on VIP is credited with having inspired and guided the development of South Australia's Better Practices Project, now honored as a model for community-based gerontological practice in Australia.

Source of Funding: Hatch, State
Scope of Impact: State

Report on Stakeholder Input Process

A. 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. All of the five colleges that receive MAES funding: The Colleges of Agricultural, Food and Environmental Sciences (COAFES), Human Ecology (CHE), Natural Resources (CNR), Biological Sciences (CBS), and Veterinary Medicine (CVM) have processes in place to provide stakeholder input into research direction, selection and review.

Here are some specific examples:

In COAFES a process begun in April of 2000 to set priorities for the college in research teaching and outreach engaged alumni, citizens, and organizations across Minnesota to establish six priorities: 1) promoting safe and healthy food, 1) Improving environmental quality 2) Enhancing agricultural systems 4) Revitalizing Minnesota's rural communities and 5) Serving urban communities, and 6) Emphasizing exemplary education.

Advisory committees for each of MAES's Research and Outreach Centers connect research to the specific needs of the region.

In CHE, departmental faculty, graduate and undergraduate students, staff, Extension educators, advisory boards, and external constituents predicated in semi-structured dialogues asking, among other questions, how do we achieve broader community outreach/engagements. The yearlong process culminated in the 20004 Scholarship Dialogue that brought together community partners to hear results and give feedback on directions for the future.

In the College of Natural Resources, a program and budget review workshop is held each spring. The College of Human Ecology Advisory Council meets twice a year and different members are engaged in different ways that transcend all areas of the college.

The Department of Food Science (jointly administered in the College of Human Ecology and COAFES has an Advisory Council that meets annually, This Council met recently to focus on critical issues and listen to responses of relevance and prioritizations of those issues.

The School of Social Work has a Gamble-Skogmo Child Welfare Advisory Board that meets twice a year for planning policy makers and social service Agencies. The Center for Advanced Studies in Child Welfare Advisory Board meets twice each year with representatives from the legislature and policy makers. The Institute on Domestic Violence in the African-American Community has an eight member all African American board.

The University of Minnesota Center for Animal Health and Food Safety stresses collaboration on issues of animal health and food safety across academic, government, industry and other concerned organizations, and serves as a facilitator for stakeholders interested in animal health and food safety.

B. 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, mailing lists for Experiment Station and college publications, mailing lists for under-represented/underserved populations, departmental and faculty contact lists, web site contacts.

C. 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 each month to identify research priorities, set research policies, plan programs, and discuss stakeholder input for inclusion in the policy and planning decisions.

D. 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. Here are two recent examples: CBS was heavily involved in Governor Pawlenty's Bioscience Council, helping to develop a state-wide strategy to strengthen Minnesota's bioscience industry. COAFES responded to input from the Governor's Livestock Task Force seeking ways to revitalize Minnesota's livestock industry by assembling an inter-disciplinary team of researchers and Extension educators. They developed a plan that included both research and education strategies to help both livestock producers and local government officials manage both technology and policy issues related to the livestock industry.

Another good example of how stakeholder input is used to refocus priorities or identify emerging issues is through the use of 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.

Update on Program Review Processes

The review process for Hatch supported projects has not changed since the original Plan of Work was written. The processes for developing a program review as a basis of our next Plan of Work will begin this spring and summer.

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

Success of multi-state, multi-instutiional and multidisciplinary activies

Faculty in the Minnesota Agricultural experiment Station participated in 143 multi-state projects and committees this reporting year, a slight increase over last year. CRIS progress reports have been filed to document Minnesota's participation in the projects.

A few specific examples of multi-state, multi-disciplinary efforts:

The St. Paul campus, as a home to diverse genomics research projects in plants, microbes and animals, provides a collaborative atmosphere for developing bioinformatics. COAFES, DVM and CBS are collaborating in animal genomics work fostered by the Center for Microbial and Plant Genomics.

Family Social Science faculty are pursuing an exchange arrangement with the Centro De Investigation Familiar in Monterrey, Mexico to conduct collaborative research and better understand how to assist Latino/a populations in the U.S. and Mexico through the development of effective preventive interventions.

A major accomplishment for the College of Biological Sciences was the Minnesota State Legislature's award of 20 million dollars over 5 years to support research on energy and the environment. CBS has worked closely with COAFES, IT and the HHH Institute to develop the Initiative on Renewable Energy and the Environment.

Multi-state collaborative research efforts on ongoing and emerging agronomic problems including potato aphid and soybean rust, are documented in this report.

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. One hundred and forty highly 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.

Other examples of progress in integrating research and Extension activities are described in the joint themes described in this report.

Reporting requirement for integrated research and extension activities

In this accomplishment report, we reported on joint themes with the University of Minnesota Extension Service. The Hatch and MRF dollars expended for these themes totaled $214,520.

The actual dollars expended in 2004 for all Hatch projects integrated with Extension (including MRF) are documented on the CREES—REPT (2/00) form.

As stated in the original Plan of Work, the University of Minnesota has an extensive list of faculty with joint appointments, including both research and extension components, which is attached. This listing provides further evidence of the integrated efforts of federal funding for research and extension.

AREERA
Fiscal Year 2003/2004 DETAIL OF EXPENDITURES

Goal / Theme	Hatch	MRF	McIntire Stennis	Animal Health	State Funds	Other Federal	Other Non-Fed	Total Funds
Goal 1								
Agricultural Competitiveness	89,716	2,046	0	0	460,248	277,264	500,113	1,329,387
Agricultural Profitability	68,218	0	0	0	420,012	413,896	800,101	1,702,227
Animal Health	25,000	24,007	0	0	506,771	0	53,109	608,887
Ornamental/Green Agriculture	29,141	0	0	0	138,059	0	78,642	245,842
Plant Health	17,550	17,038	0	0	133,533	232,744	297,632	698,497
Goal 1 Total	**229,625**	**43,091**	**0**	**0**	**1,658,623**	**923,904**	**1,729,597**	**4,584,840**
Goal 2								
Food Safety	0	781	0	0	311,826	0	73,309	385,916
Goal 2 Total	**0**	**781**	**0**	**0**	**311,826**	**0**	**73,309**	**385,916**
Goal 3								
Human Health	47,450	797	0	0	121,887	81,146	45,327	296,607
Goal 3 Total	**47,450**	**797**	**0**	**0**	**121,887**	**81,146**	**45,327**	**296,607**
Goal 4								
Forest Crops	57,562	0	0	0	159,332	68,605	57,638	343,137
Natural Resources Management	0	0	0	0	60,534	94,149	0	154,683
Water Quality	6,002	0	0	0	650,390	374,574	184,457	1,215,423
Goal 4 Total	**63,564**	**0**	**0**	**0**	**870,256**	**537,328**	**242,095**	**1,713,243**
Goal 5								
Aging	7,538	0	0	0	23,579	0	0	31,117
Conflict Management	0	0	0	0	21,309	0	0	21,309
Housing	7,637	0	0	0	75,128	0	184	82,949
Parenting	0	0	0	0	103,588	90,599	0	194,187
Youth Development	0	0	0	0	35,136	0	0	35,136
Goal 5 Total	**15,175**	**0**	**0**	**0**	**258,740**	**90,599**	**184**	**364,698**
Grand Total	**355,814**	**44,669**	**0**	**0**	**3,221,332**	**1,632,977**	**2,090,512**	**7,345,304**

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

Institution University of Minnesota

State Minnesota

Check one

	Multistate Extension Activities
X	Integrated Activities (Hatch Act Funds)
	Integrated Activities (Smith-Lever Act Funds)

Title of Planned Program/Activity	**Actual Expenditures**				
	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Goal 1.	$1,509,210	$3,051,628	$2,109,359	$1,813,789	$1,246,175
Goal 2.	$ 291,982	$ 379,236	$ 137,018	$ 47 235	$ 35,774
Goal 3.	$ 88,621	$ 98,731	$ 52,469	$ 67,215	$ 99,544
Goal 4.	$ 508,025	$ 474,188	$ 340,191	$ 352,567	$ 265,959
Goal 5.	$ 189,992	$ 292,702	$ 180,558	$ 94,161	$ 116,874
Total	$2,587,830	$4,284,038	$2,819,595	$2 374 967	$1,764,326

Form CSREES-REPT (/O1)

Director **Date**

Fiscal Year 2003 / 2004 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	14-040	ECONOMIC ANALYSIS OF LIVESTOCK INDUSTRY MARKETING, PRICES, PRODUCTION AND	
	14-057	AN ECONOMIC ANALYSIS OF U.S. LIVESTOCK SECTOR FACING DEMAND AND SUPPLY STR	
	14-064	ENVIRONMENTAL AND TRADE COMPETITIVENESS ISSUES IN AGRICULTURE	
	14-160	THE ECONOMICS OF PLANT BIOTECHNOLOGY POLICIES AND PRACTICES: INTERNATIONA	
	17-062	REGULATION OF ECDYSIS-PRODUCING NEURONS IN INSECTS AND OTHER INVERTEBRAT	18,111
Beef Production	03-017	METHODS TO INCREASE REPRODUCTIVE EFFICIENCY IN CATTLE	987
	16-019	INTERPRETING CATTLE GENOMIC DATA: BIOLOGY, APPLICATION, OUTREACH	989
	16-044	FACTORS AFFECTING BIOLOGICAL AND ECONOMIC EFFICIENCY OF THE BEEF CATTLE EN	
	17-056	SOURCES, DISPERSAL AND MANAGEMENT OF STABLE FLIES ON GRAZING BEEF AND DAI	265
	63-036	EVOLVING PATHOGENS, TARGETED SEQUENCES, AND STRATEGIES FOR CONTROL OF BO	31,433
	63-060	CONTROL OF ANIMAL PARASITES IN SUSTAINABLE AGRICULTURAL SYSTEMS	11,032
Climate and Weather Services	25-064	IMPACT CLIMATE AND SOILS ON CROP SELECTION AND MANAGEMENT	70,447
Commercial Vegetable and Fruit Production	21-028	CHANGES IN QUALITY OF HORTICULTURAL CROPS DURING GROWTH AND STORAGE	26,738
	21-049	INCREASING PRODUCTION EFFICIENCY AND LONG TERM HEALTH OF NURSERY GROWN	29,141
	21-060	IMPACT OF TEMPERATURE AND LIGHT ON FLOWERING	
Commodity Crop Production	12-040	INVESTIGATING DRAINAGE DESIGN AND MANAGEMENT ALTERNATIVES FOR MEETING B	16,848
	13-019	OAT BREEDING AND GENETICS	39,122
	13-020	CHARACTERIZING WEED POPULATION VARIABILITY FOR IMPROVED WEED MANAGEMEN	106,868
	13-022	MOLECULAR CYTOGENETICS IN PLANT IMPROVEMENT	39,970
	13-030	BARLEY BREEDING AND GENETICS	51,370
	13-033	LEGUMES IN CROPPING SYSTEMS	48,702
	13-067	DECISION MAKING FOR DIVERSIFIED CROPPING SYSTEMS	1,000
	17-032	ECOLOGY AND MANAGEMENT OF EUROPEAN CORN BORER AND OTHER STALK-BORING	42,138
	17-034	MANAGEMENT STRATEGIES FOR EUROPEAN CORN BORER, CORN ROOTWORMS, AND STA	18,043
	17-039	DYNAMIC SOYBEAN PEST MANAGEMENT FOR EVOLVING AGRICULTURAL TECHNOLOGIE	1,017
	17-042	POTATO INSECTS: BIOLOGICAL AND CULTURAL CONTROL	15,309
	17-049	MANAGEMENT OF INSECTS AND INSECT VECTORS OF PLANT PATHOGENS	14,595
	21-019	POTATO BREEDING AND GENETICS	43,265
	22-015	COMPARATIVE GENOMICS OF LEGUMES	18,940
	22-020	DISEASE RESISTANCE IN SMALL GRAIN CEREAL CROPS AND THEIR WILD RELATIVES	
	22-026	MANAGEMENT AND CONTROL OF DISEASES OF SOYBEANS	2,955
	22-029	SOYBEAN RUST: A NEW PEST OF SOYBEAN PRODUCTION	1,103
	22-059	RUST DISEASES OF CEREALS	
Dairy Modernization	05-015	MANAGEMENT SYSTEMS TO IMPROVE THE ECONOMICS AND ENVIRONMENTAL SUSTAIN	1,728
	16-020	GENETIC SELECTION AND CROSSBREEDING TO ENHANCE REPRODUCTION AND SURVIVA	73,588

EXTENSION PROGRAM	RESEARCH PROJECT		HATCH $
Dairy Modernization	16-027	METABOLIC RELATIONSHIPS IN SUPPLY OF NUTRIENTS FOR LACTATING COWS	103,407
	16-032	STATISTICAL PROCESS CONTROL USE FOR MANAGEMENT DECISION MAKING TO IMPROV	
Farm Business Management	14-022	ENHANCING THE FINANCIAL VIABILITY OF MINNESOTA FAMILY FARMS	
	14-035	MANAGEMENT INFORMATION SYSTEMS FOR FIRMS IN THE FOOD SYSTEM	21
Landscape Design	21-055	BREEDING, EVALUATION & SELECTION OF HARDY LANDSCAPE PLANTS	94,620
Master Gardener	21-050	BREEDING AND GENETICS OF FLORICULTURAL CROPS: OLD, NEW CROP DEVELOPMENT,	35,468
	21-064	MOLECULAR ANALYSIS OF FLORAL GENE EXPRESSION	23,998
Nursery and Plant Health	21-082	PLANT AND ROOT RESPONSE TO ENVIRONMENTAL STRESS	23,910
Optimizing Forage Management and Use	17-067	DEVELOPMENT OF PEST MANAGEMENT STRATEGIES FOR FORAGE ALFALFA PERSISTENC	14,918
Poultry Production and Health	16-018	BIOPHYSICAL MODELS FOR POULTRY PRODUCTION SYSTEMS	649
	16-033	WATER QUALITY ISSUES IN POULTRY PRODUCTION AND PROCESSING	
	16-034	IMPROVING TURKEY PRODUCTION PERFORMANCE THROUGH NUTRITION AND MANAGE	130,658
	16-087	REPRODUCTIVE PERFORMANCE OF TURKEYS	
	63-032	AVIAN RESPIRATORY DISEASES: PATHOGENESIS, SURVEILLANCE, DIAGNOSIS AND CONT	1,362
	63-058	CONTROL OF EMERGING AND RE-EMERGING POULTRY RESPIRATORY DISEASES IN THE U	
Precision Agriculture	12-028	DEVELOPMENT AND TESTING OF DRY FERTILIZER SENSORS AND MACHINERY FOR PRECI	8,659
Swine Production Technology	16-025	GENETIC AND FUNCTIONAL GENOMIC APPROACHES TO IMPROVE PRODUCTION AND QU	2,604
	16-064	THE USE OF DISTILLER'S DRIED GRAINS WITH SOLUBLES AND PHYTASE IN MANURE PHO	23,015
	60-015	PORCINE REPRODUCTIVE AND RESPIRATORY DISEASE: METHODS FOR THE INTEGRATED	47,645
Turf Management	21-054	THE BIOLOGY AND UTILIZATION OF TURFGRASSES	9,537
	Total Hatch Dollars - Goal 1.		**$ 1,246,175**

Goal 2. A Safe and Secure Food and

Food Safety	12-020	MANAGEMENT OF GRAIN QUALITY AND SECURITY FOR WORLD MARKETS	14,201
	18-023	FUNCTIONAL FOODS: FIBER-AND ANTIOXIDANT-ENRICHED FOODS	
	18-037	CHARACTERIZATION AND CONTROL OF THE ACID RESISTANCE OF ENTEROHEMORRHAGI	19,047
	18-039	ENHANCING FOOD SAFETY THROUGH CONTROL OF FOOD-BORNE DISEASE AGENTS	781
	18-054	ELIMINATION OF ESCHERICHIA COLI AND SALMONELLAE FROM READY TO CONSUME AC	
	18-072	PROCESSING AND STORAGE EFFECTS ON STABILITY OF NUTRACEUTICALS	
	18-074	APPLICATION OF CHEMILUMINESCENT ANTIBIOTICS AS PLATFORM TECHNOLOGY FOR D	
	22-043	MYCOTOXINS IN CEREAL GRAINS	1,745
	Total Hatch Dollars - Goal 2.		**$ 35,774**

Goal 3. A Healthy, Well-Nourished Population

Health and Nutrition Education	12-027	INJURY PREVENTION AND HEALTH PROMOTION RESEARCH FOR PRODUCTION AGRICULT	18,111
	18-066	STRUCTURE/FUNCTION RELATIONSHIPS IN WHOLE GRAINS AND THEIR INFLUENCE ON P	13,913
	54-026	IDENTIFICATION OF FACTORS PREDICTING CONSUMPTION OF SELECTED DIETARY CONS	14,439
	54-028	PARENT AND HOUSEHOLD INFLUENCES ON CALCIUM INTAKE AMONG PREADOLESCENTS	797
	54-029	EXAMINATION OF NUTRITIONAL STATUS AND DIETARY BEHAVIOR FOR MINORITY POPU	2,729
	54-030	SYSTEMS ANALYSES OF THE RELATIONSHIPS OF AGRICULTURE AND FOOD SYSTEMS TO	845
	54-034	DIETARY REGULATION OF SEX HORMONE SYNTHESIS AND METABOLISM	15,306
	54-048	QUANTIFICATION OF FATTY ACID AND TRIGLYCERIDE FLUX IN FASTED AND FED HUMA	18,504
	54-059	IMPROVING FOOD AND HEALTH THROUGH CROSS-CULTURAL ENGAGEMENT	

EXTENSION PROGRAM	RESEARCH PROJECT		HATCH $
Health and Nutrition Education	54-064	DEFINING A DESIRABLE DIETARY FIBER INTAKE	14,900
	Total Hatch Dollars - Goal 3.		**$ 99,544**

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

Environmental Safety and Management	14-073	U.S. AGRICULTURAL AND ENVIRONMENTAL POLICY	30,469
	14-089	EXAMINING POLICIES AND INSTITUTIONS FOR LAND AND WATER RESOURCE PROTECTIO	17,502
	41-033	EVOLUTIONARY GAMES AND MODELING CONSERVATION: CONSEQUENCES OF SPACE AN	
	41-074	TROPHIC RELATIONS IN FRESHWATER SYSTEMS	
Natural Resources Management and Utilization	12-076	ENVIRONMENTAL AND AIR QUALITY ASSESSMENT AND CONTROL OF LIVESTOCK FACILI	
	12-084	ANIMAL MANURE AND WASTE UTILIZATION, TREATMENT AND NUISANCE AVOIDANCE F	66,023
	22-069	BIOLOGY, CONTROL, AND BIOTECHNOLOGICAL USES OF FOREST MICROBES	57,562
	25-019	REDUCING THE POTENTIAL FOR ENVIRONMENTAL CONTAMINATION BY PESTICIDES AND	7,997
	43-054	ASSESSMENT OF CHANGING RAW MATERIAL NEEDS AND LIFE CYCLE ENVIRONMENTAL I	
	43-068	LIGNIN BIOSYNTHESIS, BIODEGRADATION AND DERIVATIVE PLASTICS	25,585
	53-065	THE STATE OF RESEARCH-BASED DESIGN PRACTICE	4,695
Water Resources Management Policy	14-029	EFFICIENT TECHNOLOGY AND RESOURCE MANAGEMENT CONSIDERING RISK AND THE E	6,723
	25-020	SOIL RESOURCE ASSESSMENT AND INTERPRETATIONS FOR MINNESOTA LANDSCAPES	2,095
	25-022	ASSESSING NITROGEN MINERALIZATION AND OTHER DIAGNOSTIC CRITERIA TO REFINE	956
	25-034	TILLAGE AND NUTRIENT SOURCE INTERACTIONS ON NON-POINT SOURCE POLLUTION FR	2,000
	25-083	BIOGEOCHEMISTRY AND ECOLOGICAL RISK MANAGEMENT OF TRACE CHEMICAL CONST	4,002
	25-084	IMPROVING PLANT NUTRIENT USE EFFICIENCY	2,380
	42-037	REMOTE SENSING OF LAND, VEGETATION, AND WATER RESOURCES	37,970
	Total Hatch Dollars - Goal 4.		**$ 265,959**

Goal 5. Enhanced Economic Opportunity and Quality of Life

Community Economics	13-015	SUSTAINING LOCAL FOOD SYSTEMS IN A GLOBALIZING ENVIRONMENT, FORCES, RESPO	407
	14-082	RURAL COMMUNITIES, RURAL LABOR MARKETS, AND PUBLIC POLICY	62,220
	42-046	BENEFITS-BASED MANAGEMENT: ASSESSING AND MANAGING FOR PUBLIC, PRIVATE, AN	13,019
	52-077	SELF EMPLOYMENT AMONG THE UNITED STATES HISPANIC HOUSEHOLDERS POPULATIO	1,567
Family Resource Management	52-055	FAMILY ECONOMIC WELL-BEING: TRANSITIONS FOR FAMILIES	6,547
	52-080	ASSET ACCUMULATION FOR LOW-INCOME WORKING FAMILIES	3,616
	53-073	DEFINING FAMILY-APPROPRIATE RENTAL HOUSING AND NEIGHBORHOODS IN MINNESOT	6,070
Parent Education	52-040	FAMILY SYSTEMS AND FAMILY REALITIES	1,363
	52-049	FAMILY BOUNDARY AMBIGUITY IN ALZHEIMER'S DISEASE AND OTHER SITUATIONS OF U	799
	52-054	DECISION-MAKING INTEGRAL TO RELATIONSHIP TRANSITIONS IN FAMILIES	1,994
	52-066	INTERGENERATIONAL RELATIONSHIPS IN SOUTHEAST ASIAN REFUGEE FAMILIES	4,515
	55-035	VITAL INVOLVEMENT PRACTICE: PROMOTING LIFE STRENGTHS AMONG DIVERSE ELDER	7,538
	55-048	PATTERNS OF ADAPTATION AND ACCEPTANCE OF HISPANICS IN AMERICAN COMMUNITI	7,219
	Total Hatch Dollars - Goal 5.		**$ 116,874**
	Total Hatch Dollars - All Goals		**$1,764,326**

FY 2004 Faculty with Joint Appointments (Research/Extension)

COLLEGE/DEPARTMENT	Research	Extension	Teaching	Total
COAFES				
NWROC - CROOKSTON				
Hollingsworth,Charla R	70%	30%	0%	100%
Macrae,Ian Vance	51%	49%	0%	100%
Wiersma,Jochum Jan	52%	48%	0%	100%
WCROC - MORRIS				
Johnston,Lee Jay	80%	20%	0%	100%
Rudstrom,Margaretha V	67%	33%	0%	100%
NCROC - GRAND RAPIDS				
Lamb,Graham Clifford	77%	23%	0%	100%
SROC - WASECA				
Baidoo,Samuel Kofi	80%	20%	0%	100%
Fritz,Vincent A	70%	30%	0%	100%
Zhu,Jun	80%	20%	0%	100%
BIOSYSTEMS AND AGRICULTURAL ENGINEERING				
Jacobson,Larry Dean	25%	75%	0%	100%
Sands,Gary Robert	35%	65%	0%	100%
Shutske,John M	25%	75%	0%	100%
Wilcke,William F	50%	50%	0%	100%
AGRONOMY AND PLANT GENETICS				
Becker,Roger Lee	25%	75%	0%	100%
Gunsolus,Jeffrey L	30%	70%	0%	100%
Hicks,Dale Ray	8%	92%	0%	100%
Naeve,Seth L	25%	75%	0%	100%
Peterson,Paul Richard	25%	75%	0%	100%
APPLIED ECONOMICS				
Buhr,Brian L	50%	29%	21%	100%
Fruin,Jeremiah E	50%	50%	0%	100%
Hurley,Terrance Michae	40%	50%	10%	100%
Kalambokidis,Laura TJachim	32%	58%	10%	100%
Lazarus,William Frankl	35%	65%	0%	100%
Olson,Kent D	33%	25%	42%	100%
Parliament,Claudia	13%	50%	37%	100%
Stinson,Thomas F	46%	44%	10%	100%
Taff,Steven James	50%	50%	0%	100%
ANIMAL SCIENCE				
DiCostanzo,Alfredo	19%	71%	10%	100%
Endres,Marcia Ines	25%	75%	0%	100%
Linn,James Gary	15%	75%	10%	100%
Noll,Sally	15%	75%	10%	100%
Roeber,Deborah L.	50%	50%	0%	100%
Shurson,Gerald C	5%	30%	65%	100%

FY 2004 Faculty with Joint Appointments (Research/Extension)

COLLEGE/DEPARTMENT	Research	Extension	Teaching	Total
ENTOMOLOGY				
Cannon,Colleen Ann	40%	60%	0%	100%
Hutchison,William Dale	66%	34%	0%	100%
Krischik,Vera	35%	65%	0%	100%
Ostlie,Kenneth R	40%	60%	0%	100%
Ragsdale,David Willard	64%	10%	26%	100%
Spivak,Marla S	59%	13%	28%	100%
COAFES - FOOD SCIENCE AND NUTRITION				
Addis,Paul B	40%	15%	45%	100%
Feirtag,Joellen	3%	94%	3%	100%
Schafer III,Henry W	2%	95%	3%	100%
HORTICULTURAL SCIENCE				
Erwin,John E	70%	30%	0%	100%
Hoover,Emily Esther	17%	24%	59%	100%
Horgan,Brian P	40%	60%	0%	100%
Meyer,Mary H	15%	85%	0%	100%
Tong,Cindy Bow San	50%	50%	0%	100%
PLANT PATHOLOGY				
Jones,Roger Kent	20%	80%	0%	100%
SOIL, WATER, & CLIMATE				
Anderson,James L	1%	88%	11%	100%
Lamb,John Alexander	55%	20%	25%	100%
Moncrief,John F	40%	60%	0%	100%
Rehm,George W	18%	79%	3%	100%
Rosen,Carl Jay	30%	70%	0%	100%
Seeley,Mark W	21%	79%	0%	100%
CNR				
FISHERIES AND WILDLIFE				
Blair,Robert B.	20%	65%	15%	100%
Oberhauser,Karen S	35%	35%	30%	100%
FOREST RESOURCES				
Blinn,Charles Robert	25%	70%	5%	100%
CHE				
FAMILY SOCIAL SCIENCE				
Bauer,Jean W	35%	65%	0%	100%
Danes,Sharon M	40%	60%	0%	100%
Stum,Marlene Sue	30%	70%	0%	100%
DESIGN, HOUSING, & APPAREL				
Bruin,Marilyn J	40%	60%	0%	100%
Johnson, Kim Kp	30%	7%	63%	100%

FY 2004 Faculty with Joint Appointments (Research/Extension)

COLLEGE/DEPARTMENT	Research	Extension	Teaching	Total
CHE - FOOD SCIENCE AND NUTRITION				
Hassel,Craig Alan	26%	64%	10%	100%
Reicks,Marla M	23%	69%	8%	100%
SOCIAL WORK				
Quam,Jean Kathleen	10%	7%	83%	100%
CVM				
CLINICAL AND POPULATION SCIENCES				
Ames,Trevor R	27%	9%	64%	100%
Dee,Scott Allen	64%	27%	9%	100%
Fetrow,John P	32%	51%	17%	100%
Morrison, Robert B	4%	31%	65%	100%