PLAN OF WORK REPORT OF ACCOMPLISHMENT

University of Nebraska Agricultural Research Division
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

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Federal Fiscal Years
2000 to 2006

2006 Annual Report
PLAN OF WORK
University of Nebraska Agricultural Research Division

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Annual Report
University of Nebraska
Agricultural Research Division

I. INTRODUCTION:

The University of Nebraska Agricultural Research Division is a division of the University of Nebraska Institute of Agriculture and Natural Resources (IANR). Other divisions include the Cooperative Extension Division and the College of Agricultural Sciences and Natural Resources.

This annual report describes the Agricultural Research Division program impacts and accomplishments for fiscal year 2006 as required by the Agricultural Research, Extension, and Education Reform Act of 1998. It includes the elements identified in the USDA document, "Guidelines for Land Grant Institution - Annual Report." This federal annual report is based on the implementation of the current Strategic Plan of the Institute of Agriculture and Natural Resources and on emerging issues identified through stakeholder input in anticipation of beginning the next revision of the IANR Strategic Plan. This federal annual report is for the University of Nebraska Agricultural Research Division only, but was developed in conjunction with University of Nebraska Cooperative Extension Division's annual report.

In FY 2006, Agricultural Research Division expenditures in support of the programs described in this plan totaled $79,932,222. Of this amount, Federal Formula Funds provided $3,468,626 or 4.3% of the total funds expended.

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Gary Cunningham, Dean and Director
Agricultural Research Division

2006 Agricultural Research Division
Plan of Work
Annual Report

A. Planned Programs

Federal Goal I. To achieve an agricultural production system that is highly competitive in the global economy.

Overview - Research Results Related to Goal 1

Under this goal area, research programs relate to the production, marketing and processing of the major livestock species, traditional field crops, specialty crops such as dry edible beans and turf. The research also relates to new crops, increased instate production and processing and development of new products and services. There were a number of significant outputs from the research programs. Impact statements are enclosed at the end of this section providing more detail.

The varroa mite is a major pest of honeybees worldwide. Once varroa mites enter bee colonies, they build up to damaging levels causing bee hives to perish without human intervention. Control often is difficult because the two arthropods are so closely related – what kills the mites can kill the bees. A University of Nebraska-Lincoln scientist is developing protocols for using a natural product, oxalic acid, to reduce mite populations in bee colonies. Oxalic acid, a natural chemical found in plants such as rhubarb, turnips and broccoli, can deter mite populations from establishing in bee colonies and reduce mite populations. Oxalic acid, which makes vegetation in those plants nonpalatable to insects, will help struggling beekeepers keep their hives healthy and economically profitable. Of the 2.5 million bee colonies in the U.S., 1.4 million are needed to pollinate crops. The varroa mite has caused beekeepers to lose half or more of their colonies. An average beekeeper might have 1,500 colonies. With each colony worth about $120, the use of oxalic acid to control varroa mite populations could result in a $90,000 saving to a single beekeeper with a varroa mite infestation.

Economical wet byproducts from Nebraska's expanding ethanol and grain processing industry have become a major cattle feed, thanks largely to pioneering IANR research that is paying handsome dividends for Nebraska. UNL animal scientists proved the feasibility, benefits and economic advantages of feeding byproducts wet instead of drying and shipping them to dried feed markets. Feeding byproducts wet saves drying costs for processors and provides an economical cattle feed. More recent studies resulted in formulas for mixing several widely available dry forages with wet distillers grains – findings that could help feedlot managers and cow-calf producers purchase wet distillers grains during the summer when their plentiful supply can mean lower prices and safely store them for use later in the season, or for winter feeding. It's estimated that, from 1992 through 2006, the cumulative benefit to Nebraska from feeding byproducts wet instead of dry was nearly $500 million. Feeding wet byproducts saves cattle feeders $10 to $20 per head; selling byproducts wet instead of drying them reduces ethanol production costs about 5 percent. These findings were instrumental in encouraging some ethanol plants to locate in Nebraska. Ethanol production in the state has increased ten-fold since the early 1990s.

The Sorghum, Millet and Other Grains Collaborative Research Support Program (INTSORMIL), headquartered at the University of Nebraska–Lincoln, is funded by USAID, contributing universities, and host countries. Scientists from six U.S. land-grant universities – UNL, Kansas State University, Mississippi State University, Purdue University, Texas A&M University, and West Texas A&M University – and the U.S. Department of Agriculture's Agricultural Research Service have collaborated with scientists in the INTSORMIL host countries. Better marketing strategies in Niger are increasing farm income, while in the U.S. farmers have access to improved hybrids, including varieties that can withstand attack by greenbugs, a major sorghum pest. These are a few of the many agricultural improvements here and abroad made possible by INTSORMIL. For nearly 30 years, INTSORMIL has provided life-sustaining aid to some of the poorest nations in the world. At the same time, it has improved sorghum and millet hybrids for U.S. farmers and has brought more than $80 million to the University. Having access to sorghum and millet strains from Africa and other countries has helped U.S. plant breeders develop new sorghums and millets for this country. In addition, much of the U.S.'s sorghum research is funded through INTSORMIL. INTSORMIL works in Africa, Central America, Eurasia and the U.S.

University of Nebraska-Lincoln wheat breeders and geneticists are part of a national scientific team working to harness genetic technologies to improve U.S. wheat quality and disease resistance. The four-year project will put to use new molecular technologies, called Marker Assisted Selection. This research will identify markers associated with specific desirable genetic traits and verify those associations. Results will change how wheat breeding is done and ultimately help increase the U.S.'s competitiveness in the global wheat market. Involvement in this research also will enhance Nebraska's breeding program. Nebraska-developed hard red winter wheat varieties already have helped boost Nebraska's annual yields by 9.5 million bushels since the 1960s. These improved varieties are worth roughly $30 to $35 million annually to Nebraska producers based on increased yield alone.

How aphids, the world's most damaging crop pest, damage plants is poorly understood. Discoveries by UNL entomologists someday could lead to better controls for aphids. They discovered that aphids block energy from leaving the plant's chloroplasts. A buildup of molecules excited by this energy eventually chews up plant cells and causes visible damage. Now they're exploring genes they believe help protect resistant plants from aphid damage. If they pinpoint these protective genes and show they're more active in resistant plants during aphid infestations, the genes could be used to develop crops that survive aphid damage. Since this seems to hold true for most types of aphids, scientists eventually may be able to find a single solution to reduce losses across a variety of crops and aphid species.

Examples of accomplishments are included in the attached impact statements. These offer evidence of the impact that the Agricultural Research Division outputs are making towards the specific Nebraska ARD goals under Federal Goal I. The Nebraska goals are:

1. Enhance plant and animal production systems to be more profitable and sustainable.
2. Support agribusiness and economic development, including marketing and value-added processing of agricultural commodities.
3. Increase public/consumer understanding of food systems.

Goal I Resources

Source of Funds	Federal*	State	All Other	Total
FY 2006 Expenditures ($ x 1,000)	$1,863	17,813	23,248	$42,923

Faculty SYs in FY 2006 - 95.8

- Includes Hatch, Multistate, McIntire-Stennis and Animal Health funds

Impact Statements Related to Federal Goal I – Identified by Key Themes

Category: **Competitive Agricultural Systems in a Global Economy**
Key Theme: *Apiculture, Invasive Species*

Impact Statement: **Natural products control Varroa Mites, a major pest of honeybees.**
(Relates to Nebraska Subgoals 1&2, Output Indicators 1,4,&5, and Outcome Indicator 3)

Issue: The varroa mite is a major pest of honeybees worldwide, and its control often is difficult because the two arthropods are so closely related. Varroa mite has caused beekeepers to lose half or more of their colonies, affecting both honey production and crop pollination.

What has been done:
The use of bees to pollinate crops is a significant part of agriculture. However, because of the varroa mite, beekeepers have been unable to meet the bee colony demands on these farms. In the past, scientists have come up with some strategies to control varroa mite populations in bee colonies, but these are labor intensive and the mites have become resistant to many available chemical treatments. UNL entomologists are developing mite suppression strategies that use oxalic acid, a natural chemical found in plants such as rhubarb, turnips and broccoli, to deter mite populations from establishing in bee colonies and reduce mite populations. Oxalic acid, which makes vegetation in those plants nonpalatable to insects, will help struggling beekeepers keep their hives healthy and economically profitable. Once varroa mites enter bee colonies, they build up to damaging levels causing bee hives to perish without human intervention. Oxalic acid eventually will become a low-cost, effective and sustainable way to deal with the mite parasite.

Impact:
The Midwest is a prime honey producing area. However, most beekeepers' principle source of income is the use of their bee hives for crop pollination. Of the 2.5 million bee colonies in the U.S., 1.4 million are needed to pollinate crops. The varroa mite has caused beekeepers to lose half or more of their colonies. An average beekeeper might have 1,500 colonies. With each colony worth about $120, the use of oxalic acid to control varroa mite populations could result in a $90,000 savings to a single beekeeper with a varroa mite infestation.

Funding:
UNL Agricultural Research Division
Environmental Protection Agency

Scope of Impact: National

Summary:
The varroa mite is a major pest of honeybees worldwide, and its control often is difficult because the two arthropods are so closely related – what kills the mites can kill the bees. A University of Nebraska-Lincoln entomologist is developing protocols for using a natural product, oxalic acid, to reduce mite populations in bee colonies. Oxalic acid, a natural chemical found in plants such as rhubarb, turnips and broccoli, can deter mite populations from establishing in bee colonies and reduce mite populations. Oxalic acid, which makes vegetation in those plants nonpalatable to insects, will help struggling beekeepers keep their hives healthy and economically profitable.

Once varroa mites enter bee colonies, they build up to damaging levels causing bee hives to perish without human intervention. Most beekeepers' principle source of income is the use of their bees for crop pollination. Of the 2.5 million bee colonies in the U.S., 1.4 million are needed to pollinate crops. The varroa mite has caused beekeepers to lose half or more of their colonies. An average beekeeper might have 1,500 colonies. With each colony worth about $120, the use of oxalic acid to control varroa mite populations could result in a $90,000 saving to a single beekeeper with a varroa mite infestation.

Category: Competitive Agricultural Systems in a Global Economy
Key Theme: Adding Value to New and Old Agricultural Products, Animal Production Efficiency.

Impact Statement: Wet byproducts from ethanol and corn processing have become a major source of cattle feed in Nebraska, a leading cattle feeding state.
(Relates to Nebraska Subgoals 1&2, Output Indicators 1,4,&5, and Outcome Indicators 3,4,&5)

Issue:
Nebraska is one the nation's largest ethanol producer and the largest ethanol producing state west of the Mississippi. Turning grain into fuel is big business for the Cornhusker state and making the best use of byproducts from this production is critical to the industry's success.

What has been done:
University of Nebraska-Lincoln animal scientists pioneered research on how to feed cattle wet byproducts from ethanol and corn processing. Their research in the 1990s proved the feasibility, benefits and economic advantages of feeding wet gluten feed, wet distillers grains and steep liquor to cattle directly instead of drying and shipping them to dried feed markets. They found that drying actually reduces byproducts' nutritional value. Feeding byproducts wet saves drying costs for processors and provides an economical feed for cattle producers. More recent studies resulted in formulas for mixing several widely available dry forages with wet distillers grains – findings that could help feedlot managers and cow-calf producers purchase wet distillers grains during the summer when their plentiful supply can mean lower prices and safely store them for use later in the season, or for winter feeding.

Impact:
Thanks largely to this research, wet byproducts from ethanol and corn processing have become a major source of cattle feed in Nebraska, a leading cattle feeding state. Use of wet feeds provides major and ongoing economic benefits. It's estimated that, from 1992 through 2006, the cumulative benefit to Nebraska from feeding byproducts wet instead of dry was nearly $500 million. Feeding wet byproducts saves cattle feeders $10 to $20 per head; selling byproducts wet instead of drying them reduces ethanol production costs about 5 percent. UNL research has been instrumental in encouraging some ethanol plants to locate in Nebraska; the state’s ethanol production has increased nearly ten-fold since the early 1990s.

Funding:
Nebraska Corn Board
Nebraska Ethanol Board
UNL Agricultural Research Division
Hatch Act

Scope of Impact: Regional

Summary:
Economical wet byproducts from Nebraska's expanding ethanol and grain processing industry have become a major cattle feed, thanks largely to pioneering IANR research that is paying handsome dividends for Nebraska. UNL animal scientists proved the feasibility, benefits and economic advantages of feeding byproducts wet instead of drying and shipping them to dried feed markets. Feeding byproducts wet saves drying costs for processors and provides an economical cattle feed. More recent studies resulted in formulas for mixing several widely available dry forages with wet distillers grains – findings that could help feedlot managers and cow-calf producers purchase wet distillers grains during the summer when their plentiful supply can mean lower prices and safely store them for use later in the season, or for winter feeding. It's estimated that, from 1992 through 2006, the cumulative benefit to Nebraska from feeding byproducts wet instead of dry was nearly $500 million. Feeding wet byproducts saves cattle feeders $10 to $20 per head; selling byproducts wet instead of drying them reduces ethanol production costs about 5 percent. These findings were instrumental in encouraging some ethanol plants to locate in Nebraska; ethanol production in the state has increased ten-fold since the early 1990s.

Category: Competitive Agricultural Systems in a Global Economy
Key Themes: Agricultural Profitability, Plant Production Efficiency,

Impact Statement: Sorghum, millet research connects UNL with U.S., global researchers
(Relates to Nebraska Subgoals 1,2,&3, Output Indicators 1,2,3,&5, and Outcome Indicators 1&3)

Issue:
Better marketing strategies in Niger are increasing farm income, while in the U.S. farmers have access to improved hybrids, including varieties that can withstand attack by pest.

What has been done:
The International sorghum and Millet Collaborative Research support Program (INTSORMIL) has provided sorghum and millet management, breeding, and production knowledge to U.S. and International clientele for over 30 years. Thanks to a $9 million, five-year cooperative agreement from the U.S. Agency for International Development, its work will continue and will continue to be based at UNL. Scientists from six U.S. land-grant universities – UNL, Kansas State University, Mississippi State University, Purdue University, Texas A&M University, and West Texas A&M University – and the U.S. Department of Agriculture's Agricultural Research Service have collaborated with scientists in the INTSORMIL host countries. INTSORMIL works in Africa, Central America, Eurasia and the U.S. Because of INTSORMIL involvement, Mali, Africa, has one of the strongest sorghum research programs in the world today. The center of origin for sorghum and pearl millet is in Africa so breeders are able to bring back germplasm from native types and from improved types with desirable characteristics and enter them into their breeding programs back in the U.S. Sorghum and pearl millet are important food staples, especially in semiarid regions, because of their drought-tolerant characteristics. In the U.S., sorghum is used mainly as livestock feed. Nebraska ranks third in sorghum production.

Impact:
Better marketing strategies in Niger are increasing farm income, while in the U.S. farmers have access to improved hybrids, including varieties that can withstand attack by greenbugs, a major sorghum pest. These are a few of the many agricultural improvements here and abroad made possible by the International Sorghum and Millet Collaborative Research Support Program, or INTSORMIL, headquartered at the University of Nebraska–Lincoln. For nearly 30 years, INTSORMIL has provided life-sustaining aid to some of the poorest nations in the world. At the same time, it has improved sorghum and millet hybrids for U.S. farmers and has brought more than $80 million to the University. Having access to sorghum and millet strains from Africa and other countries has helped U.S. plant breeders develop new sorghums and millets for this country, as well as for host countries. In addition, much of the U.S.'s sorghum research is funded through INTSORMIL.

Funding:
USAID
Hatch
USDA's Cooperative State Research, Education and Extension Service
National Research Initiative
UNL Agricultural Research Division

Scope of Impact: International

Summary:
The Sorghum, Millet and Other Grains Collaborative Research Support Program (INTSORMIL), headquartered at the University of Nebraska–Lincoln, is funded by USAID, contributing Universities, and host countries. Scientists from six U.S. land-grant universities – UNL, Kansas State University, Mississippi State University, Purdue University, Texas A&M University, and West Texas A&M University – and the U.S. Department of Agriculture's Agricultural Research Service have collaborated with scientists in the INTSORMIL host countries. Better marketing strategies in Niger are increasing farm income, while in the U.S. farmers have access to improved hybrids, including varieties that can withstand attack by greenbugs, a major sorghum pest. These are a few of the many agricultural improvements here and abroad made possible by INTSORMIL. For nearly 30 years, INTSORMIL has provided life-sustaining aid to some of the poorest nations in the world. At the same time, it has improved sorghum and millet hybrids for U.S. farmers and has brought more than $80 million to the University. Having access to sorghum and millet strains from Africa and other countries has helped U.S. plant breeders develop new sorghums and millets for this country. In addition, much of the U.S.'s sorghum research is funded through INTSORMIL. INTSORMIL works in Africa, Central America, Eurasia and the U.S.

Category: Competitive Agricultural Systems in a Global Economy
Key Themes: Agricultural Profitability, Plant Genomics,

Impact Statement: UNL Wheat Breeders Part of National Team on Wheat Research to improve U.S. wheat quality.
(Relates to Nebraska Subgoals 1&2, Output Indicators 1,4,&5, and Outcome Indicator 3)

Issue:
Wheat growers need varieties that will stand up to various growing conditions whether they be for pest resistance or factors that influence yield.

What has been done:
University of Nebraska-Lincoln wheat breeders and geneticists are part of a national scientific team working to harness genetic technologies to improve U.S. wheat quality and disease resistance. UNL and government scientists in 17 states received a $5 million U.S. Department of Agriculture grant. UNL received $162,750 for its portion of the study. The four-year project will put to use new molecular technologies, called Marker Assisted Selection. Markers are genes or DNA segments that serve as molecular signposts, pinpointing a specific spot on wheat's genetic map. While there are many known molecular markers for wheat chromosomes, scientists often don't know whether they are associated with a useful gene. This research will identify markers associated with specific desirable genetic traits and verify those associations. Once that's done, wheat breeders can more quickly and precisely select wheat lines that contain specific characteristics. The UNL team will focus on environmentally sensitive genetic traits, such as grain yield, test weight and kernel size, as well as how drought influences certain traits.

Impact:
Results will change how wheat breeding is done and ultimately help increase the U.S.'s competitiveness in the global wheat market. Involvement in this research also will enhance Nebraska's breeding program. Nebraska-developed hard red winter wheat varieties already have helped boost Nebraska's annual yields by 9.5 million bushels since the 1960s. These improved varieties are worth roughly $30 to $35 million annually to Nebraska producers based on increased yield alone. Consumers benefit, too. Yield improvement in these varieties means Nebraska wheat growers can feed nearly 3.8 million more people a year than they did on the same acreage in the 1960s.

Funding:
Hatch
USDA's Cooperative State Research, Education and Extension Service
National Research Initiative
UNL Agricultural Research Division

Scope of Impact: National

Summary:
Wheat growers need varieties that will stand up to various growing conditions whether they be for pest resistance or factors that influence yield. University of Nebraska-Lincoln wheat breeders and geneticists are part of a national scientific team working to harness genetic technologies to improve U.S. wheat quality and disease resistance. The four-year project will put to use new molecular technologies, called Marker Assisted Selection. Markers are genes or DNA segments that serve as molecular signposts, pinpointing a specific spot on wheat's genetic map. This research will identify markers associated with specific desirable genetic traits and verify those associations. Once that's done, wheat breeders can more quickly and precisely select wheat lines that contain specific characteristics. Results will change how wheat breeding is done and ultimately help increase the U.S.'s competitiveness in the global wheat market. Involvement in

this research also will enhance Nebraska's breeding program. Nebraska-developed hard red winter wheat varieties already have helped boost Nebraska's annual yields by 9.5 million bushels since the 1960s. These improved varieties are worth roughly $30 to $35 million annually to Nebraska producers based on increased yield alone.

Category: Competitive Agricultural Systems in a Global Economy
Key Themes: Agricultural Profitability, Plant Health,Integrated Pest Management

Impact Statement: Understanding how aphids harm plants could lead to better control of the world's most damaging crop pest.
(Relates to Nebraska Subgoal 1, Output Indicators 1,&5, and Outcome Indicator 3)

Issue:
Aphids are the world's most damaging crop pest but exactly how aphids harm plants is unclear. University of Nebraska-Lincoln entomologists are finding answers that could lead to better control.

What has been done:
Scientists long thought aphids produced a toxin that damaged plant chloroplasts, where photosynthesis happens. But no toxin has been found. UNL entomologists are exploring how aphids damage plants at the molecular level. They discovered aphids block energy from leaving the plant's chloroplasts. It is a buildup of molecules excited by this energy – not a toxin – that eventually chews up the cells and causes visible damage. They're now exploring genes they think have key roles in protecting resistant plants from aphid damage. If they pinpoint these protective genes and show they are more active in resistant plants during aphid infestations, the genes could be used to develop crops that survive aphid damage.

Impact:
This basic research is a key first step toward controlling this costly pest using fewer chemicals. This discovery seems to hold true for most types of aphids so scientists may be able to find a single solution to reduce losses across a variety of crops and aphid species. Creating plants that withstand aphids is better than killing the insects, which can develop resistance to chemical controls.

Funding:
UNL Agricultural Research Division
USDA North Central regional research funds
Hatch Act

Scope of Impact: National

Summary:
Discoveries by UNL entomologists someday could lead to better controls for aphids, the world's most damaging crop pest. Just exactly how aphids harm plants is unclear. IANR entomologists now think they've found key clues. They discovered that aphids block energy from leaving the plant's chloroplasts. A buildup of molecules excited by this energy eventually chews up plant cells and causes visible damage. Now they're exploring genes they believe help protect resistant

plants from aphid damage. If they pinpoint these protective genes and show they're more active in resistant plants during aphid infestations, the genes could be used to develop crops that survive aphid damage. Since this seems to hold true for most types of aphids, scientists eventually may be able to find a single solution to reduce losses across a variety of crops and aphid species.

Federal Goal II. A Safe, Secure Food and Fiber System

Food animal production and food processing are major components of the Nebraska economy. The Nebraska Agricultural Research Division maintains a significant food safety research effort. Research faculty work closely with the food industry and regulatory agencies to focus research efforts of pre-harvest food safety areas, in particular, working with livestock producers. There have been a number of significant outputs from the research programs. An impact statement is enclosed at the end of this section providing more detail.

Five years of intensive University of Nebraska-Lincoln research on controlling *E. coli* O157:H7 in feedlots have demonstrated the effectiveness of a new vaccine and a beneficial bacterial feed additive to reduce *E. coli* in the manure of feedlot cattle. UNL research has determined methods to best use the vaccine in feedlot cattle. A Canadian company, Bioniche, has been granted conditional licensing for the vaccine and limited use by Canadian veterinarians. Bioniche and UNL researchers continue to work on the data so the vaccine can be fully on the market in both Canada and the U.S. The vaccine is the world's first and is a step toward the first effective intervention to lessen the *E. coli* problem among animals in feedlots, reducing the probability for cattle to shed the organism in their feces by 60 to 70 percent. This will be an important factor in helping reduce the prevalence of this toxic bacterium in meat and produce contamination.

The Nebraska goals under this federal goal are:

1. Animal and plant production systems and food processing and production systems to be enhanced to improve food safety and quality.
2. Research based information will increase awareness of consumers, producers, food processors, food handlers and extension personnel on food safety issues and technologies.

Goal II Resources

Source of Funds	Federal*	State	All Other	Total
FY 2006 Expenditures ($ x 1,000)	$156	$1,487	$1,941	3,584

Faculty SYs in FY 2006 - 8.0

Includes Hatch, Multistate, McIntire-Stennis and Animal Health funds

Impact Statement Related to Federal Goal II - Identified by Key Themes

Category: A Safe, Secure Food and Fiber System
Key Theme: Food Safety

Impact Statement: *E. coli* vaccine shows promise in controlling the bacteria in cattle before slaughter, a critical step in reducing chances it will reach consumers.
(Relates to Nebraska Subgoal 1 , Output Indicators 1, and Outcome Indicator 1& 2)

Issue: Control of *E. coli* bacteria in cattle before slaughter is a critical step in reducing chances it will reach consumers.

What has been done?
Five years of intensive University of Nebraska-Lincoln research on controlling *E. coli* O157:H7 in feedlots have demonstrated the effectiveness of a new vaccine and a beneficial bacterial feed additive to reduce *E. coli* in the manure of feedlot cattle. UNL research has determined methods to best use the vaccine in feedlot cattle. A Canadian company, Bioniche, has been granted conditional licensing for the vaccine and its limited use by Canadian veterinarians. If the vaccine's potential holds, it means reducing the possibility of consumers eating meat or produce contaminated with *E. coli*. The University of Saskatchewan and the University of British Columbia were among other partners responsible for developing the drug, now approved by the Canadian Food Inspection Agency. In order to reach full licensing, Bioniche must produce more data which should be completed this year. The UNL team also continues its studies so the vaccine can be fully on the market in both Canada and the U.S.

Impact:
The beef industry is eager for tools to control *E. coli*. The vaccine is the world's first. It is a step toward the first effective intervention to lessen the *E. coli* problem among animals in feedlots, reducing the probability cattle shed the organism in their feces by 60 to 70 percent. This will be an important factor in helping reduce the prevalence of this toxic bacterium in meat and produce contamination.

Funding:
Nebraska Beef Council
USDA
UNL Agricultural Research Division
Hatch Act
Bioniche Life Sciences Inc.
Nutrition Physiology Corp.

Scope of Impact: National

Summary:
Consumers and cattle producers share concerns about *E. coli* O157:H7, a dangerous bacteria that causes foodborne illness outbreaks. Finding ways to control the bacteria in cattle before slaughter is a critical step in reducing chances it will reach consumers. Five years of intensive University of Nebraska-Lincoln research on controlling *E. coli* O157:H7 in feedlots have demonstrated the effectiveness of a new vaccine and a beneficial bacterial feed additive to reduce *E. coli* in the

manure of feedlot cattle. UNL research has determined methods to best use the vaccine in feedlot cattle. A Canadian company, Bioniche, has been granted conditional licensing for the vaccine and limited use by Canadian veterinarians. Bioniche and UNL researchers continue to work on the data so the vaccine can be fully on the market in both Canada and the U.S. The vaccine is the world's first and is a step toward the first effective intervention to lessen the *E. coli* program among animals in feedlots, reducing the probability for cattle to shed the organism in their feces by 60 to 70 percent. This will be an important factor in helping reduce the prevalence of this toxic bacterium in meat and produce contamination.

Federal Goal III. A Healthy Well-Nourished Population

Enhancing the quality of life of individuals and families through healthy lifestyles including better nutrition and reduction of high risk activity is the Nebraska goal in this area. Particular areas of research emphasis include lipid metabolism, bioavailability of nutrients, eating behaviors and disorders, biochemistry of cardiac illnesses and functions of health care and family support systems. In addition to being incorporated in Cooperative Extension programs, research results are also used by a broad range of health care professionals, educators, and marketers and consumers of all ages.

IANR nutrition scientists combined stearic acid from beef tallow with plant sterols from soybeans to create a potent cholesterol-lowering compound that could be used as a dietary supplement or a food ingredient. It outperformed commercially available plant-based food additives in animal studies. Preliminary research also suggests it works at least as well as widely prescribed cholesterol-lowering statin drugs. This is an outgrowth of earlier research by this College of Education and Human Sciences and Institute of Agriculture and Natural Resources scientist who found that stearic acid, a saturated fat in beef tallow, actually lowers cholesterol. This technology could provide a powerful new tool for managing cholesterol. More than 140 million Americans' cholesterol levels put them at risk for heart disease, according to the American Heart Association.

The above example and the impact statement to follow identify the types of contributions being made by the Agricultural Research Division activities to Federal Goal III.

Goal III Resources

Source of Funds	Federal*	State	All Other	Total
FY 2006 Expenditures ($ x 1,000)	$187	$1,785	$2,330	$4,301
Faculty SYs in FY 2006 - 9.6				

* Includes Hatch, Multistate, McIntire-Stennis and Animal Health funds

Impact Statements Related to Federal Goal III - Identified by Key Themes

Category: Healthy, Well-Nourished Population
Key Theme: Human Health

Impact Statement: New cholesterol-fighting compound made from soybeans and beef tallow provide powerful new cholesterol management tool.
(Relates to Nebraska Subgoal 1, and Output Indicator 3, and Outcome Indicator 2 & 3)

Issue:
Animal fats are widely considered dietary pariahs but University of Nebraska research shows certain saturated fats actually can lower cholesterol. Harnessing that cholesterol-fighting power could benefit the more than 140 million Americans whose blood cholesterol levels put them at risk for heart disease.

What has been done:
A University of Nebraska nutrition scientist has developed a promising new cholesterol-fighting compound using homegrown ingredients. He developed a way to combine stearic acid from beef tallow with plant sterols from soybeans. The result is a potent cholesterol-lowering compound that could be used as a dietary supplement or a food ingredient. Animal studies showed this new compound packs far more cholesterol-lowering power than commercially available plant-based food additives. Preliminary research also suggests it works at least as well as widely prescribed cholesterol-lowering statin drugs. The new compound is an outgrowth of Nebraska research on fats' role in heart disease which revealed that stearic acid, a saturated fat in beef tallow, actually lowers cholesterol. The university is patenting this technology and the team is further testing its effectiveness and exploring how best to commercialize it for consumers' benefit. Human clinical trials now are under way, with results expected early in 2007.

Impact:
Medical experts agree that controlling blood cholesterol is critical to reducing major health problems, including stroke and heart attack. This Nebraska-developed compound should provide a powerful new tool for managing cholesterol. In animal studies, it lowered LDL, or bad cholesterol, by about 70 percent, compared with 10 percent for commercially available plant-based food additives.

Funding:
University of Nebraska Agricultural Research Division
Hatch Act

Scope of Impact: National

Summary:
Beef tallow is a key ingredient in a promising new cholesterol-fighting compound. An IANR nutrition scientist combined stearic acid from beef tallow with plant sterols from soybeans to create a potent cholesterol-lowering compound that could be used as a dietary supplement or a food ingredient. It outperformed commercially available plant-based food additives in animal studies. Preliminary research also suggests it works at least as well as widely prescribed cholesterol-lowering statin drugs. This is an outgrowth of earlier research by this College of

Education and Human Sciences and Institute of Agriculture and Natural Resources scientist who found that stearic acid, a saturated fat in beef tallow, actually lowers cholesterol. The university is patenting this technology, which could provide a powerful new tool for managing cholesterol. That's a national health concern because more than 140 million Americans' cholesterol levels put them at risk for heart disease, according to the American Heart Association.

Federal Goal IV. To Achieve Greater Harmony (Balance) Between Agriculture and the Environment

Improvement of natural resources and environmental quality while maintaining a productive and profitable agricultural industry is one of three major themes in the Nebraska Agricultural Research Division Strategic Plan. Research activities in support of federal goal area IV have increased in recent years. The Nebraska goals are:

1. Improved environmental quality by conserving and enhancing air, soil and water resources.
2. Improved ecosystem management for sustained productivity and enhanced biodiversity.
3. Increased information and expertise on natural resources and environmental issues for facilitating policy development and successful implementation programs.

UNL water researchers are teaming with the USDA's Risk Management Agency to provide current groundwater levels across Nebraska via the Internet. Through the new partnership, satellite uplink and computer equipment is being installed in 52 of the 5,800 wells monitored statewide to compile groundwater data. This will allow information about current levels to be shared immediately via the Web. Recent drought coupled with recent water policy and legal decisions have increased the need for more timely groundwater information. The new rapid monitoring program, which will be available on the Internet by spring 2008, will provide a real-time snapshot of groundwater status.

Expanded use of the Water Optimizer, a decision-support computer program developed by IANR researchers, is helping irrigators facing water shortages make difficult and complex choices about how best to use their limited water supplies. By running "what if" scenarios, growers can see the best options for farming with limited water whether it be growing different crops, irrigating fewer acres, applying less water to existing crops or going to dryland farming. A recent $885,000 grant is helping refine and improve the Water Optimizer to address more critical risk-management issues surrounding limited water.

IANR scientists are studying how different grasses perform under varying levels of shade from different trees to identify the best combinations of grasses for grazing and trees with market value. Combining trees and livestock grazing, called silvopasturing, can diversify and improve economic potential. This research is providing some of the first information on which grass and tree combinations work best in Nebraska. Results should help producers make more informed management choices to combine trees and grazing to maximize profits.

Goal IV Resources

Source of Funds	Federal*	State	All Other	Total
FY 2006 Expenditures ($ x 1,000)	$1,089	$10,412	$13,590	$25,091

Faculty SYs in FY 2006 - 56.0

* Includes Hath, Multistate, McIntire-Stennis and Animal Health funds

Impact Statements Related to Federal Goal IV—Identified by Key themes

Category: **Greater harmony Between Agriculture and the Environment**
Key Theme: *Natural Resource Management*

Impact Statement: Groundwater level monitoring provides essential information to assess and manage this valuable resource.
(Relates to Nebraska Subgoal 1 & 3, Output Indicators 6 & 7, and Outcome Indicator 1 & 3)

Issue:
Nebraska has some of the world's most abundant groundwater supplies, but groundwater levels have dropped in many areas in recent years. Natural resources managers, irrigators and policymakers need current information to better assess and manage this valuable resource.

What has been done:
For more than 75 years, the University of Nebraska's groundwater monitoring program has annually recorded and published Nebraska groundwater level rises and declines. Today, the program uses early spring readings from more than,5800 irrigation, domestic, observation and monitoring wells. Yearly changes and cumulative changes since irrigation development began are published as colored maps and are available online. In 2005, the program published a map depicting widespread groundwater level declines from 2000 to 2005, the period of the current drought. Through a partnership with USDA's Risk Management Agency, the program is placing satellite uplinks and associated technology on 52 rapid response wells. This new technology, which will be available on the Internet by spring 2008, will provide current well level readings online to anyone with a computer.

Impact:
Annual and longer-term groundwater level information have long been used by decision makers and resource managers to set policies related to groundwater pumping and to make key decisions about how to use this resource. Recent drought coupled with recent water policy and legal decisions have increased the need for current groundwater information. The new rapid monitoring program will provide immediate snapshots of groundwater conditions across the state to aid growers and policymakers.

Funding:
UNL Agricultural Research Division
USDA Risk Management Agency
Hatch Act
UNL Water Resources Research Initiative

Scope of Impact: Regional

Summary:
UNL water researchers are teaming with the USDA's Risk Management Agency to provide current groundwater levels across Nebraska via the Internet. For more than 75 years, the university has recorded levels in groundwater wells statewide and reported findings annually in publications to aid decisions about groundwater use, management and policy. Those color maps also are available online. Through the new partnership, satellite uplink and computer equipment

is being installed in 52 of the 5,800 wells monitored statewide to compile groundwater data. This will allow information about current levels to be shared immediately via the Web. Recent drought coupled with recent water policy and legal decisions have increased the need for more timely groundwater information. The new rapid monitoring program, which will be available on the Internet by spring 2008, will provide a real-time snapshot of groundwater status.

Category: Greater harmony Between Agriculture and the Environment
Key Theme: Natural Resource Management

Impact Statement: Expanded water optimizer use helps regional irrigators make decision about wise water use.
(Relates to Nebraska Subgoal 1 & 3, Output Indicators 4, 6 & 7, and Outcome Indicator 5)

Issue:
Nebraska irrigators facing limited water supplies must make difficult and complex decisions about how best to use limited water.

What has been done:
The University of Nebraska-Lincoln's Water Optimizer became available in 2005 to help farmers make better-informed cropping choices with limited water. Growers load information into the program, and in return it enables them to evaluate what crops to grow, how many acres to irrigate or how much water to apply. A recent $885,000 grant will help a multidisciplinary IANR team refine and improve the Water Optimizer to address more critical risk-management issues surrounding limited water. It will take into account crops grown in the semiarid High Plains, expand to additional counties in Nebraska and irrigated areas in Colorado and Kansas, develop capability to evaluate at a "whole-farm" basis or field by field, develop capabilities to deal with multi-year water allocations and evaluate how irrigation system improvements affect decisions. The Water Optimizer is available on the Web at http://extension-water.unl.edu/ or on a DVD/CD set and was promoted at dozens of UNL Extension meetings.

Impact:
This Institute of Agriculture and Natural Resources-developed tool is helping Nebraska farmers make more informed choices that conserve water and producer profits. Over 1200 clients have downloaded or purchased the tool.

Funding:
University of Nebraska-Lincoln Extension
University of Nebraska-Lincoln Agricultural Research Division
USDA Risk Management Agency
Hatch Act
Multi-state research funds
Smith-Lever 3(b) & (c)

Scope of Impact: National

Summary:
Nebraska irrigators facing water shortages have a new tool to help them make difficult and

complex choices about how best to use their limited water supplies. The Water Optimizer, a decision-support computer program developed by IANR researchers, became available in 2005 to help farmers make more informed choices that conserve water and producer profits. Over 1200 clients have downloaded or purchased the tool. It lets users enter individualized information and calculate what crops will be most profitable with the given costs and available water. By running "what if" scenarios, growers can see the best options for farming with limited water whether it be growing different crops, irrigating fewer acres, applying less water to existing crops or going to dryland farming. A recent $885,000 grant is helping refine and improve the Water Optimizer to address more critical risk-management issues surrounding limited water.

Category: **Greater Harmony Between Agriculture and the Environment**
Key Themes: *Forest Resource Management, Natural Resources Management*

Impact Statement: Silvopasturing, grazing livestock amid trees that have market value, diversifies and improve economic potential.
(Relates to Nebraska Subgoal 2 & 3, Output Indicators 5, 6 & 7, and Outcome Indicator 3)

Issue:
Grazing livestock amid trees that have market value, called silvopasturing, can diversify and improve economic potential. To successfully integrate trees and grazing, agricultural producers need to know which combination of trees and grasses work best under local conditions.

What has been done:
University of Nebraska-Lincoln range and plant scientists are studying different combinations of forage grasses and trees in test plots to identify the best-performing combinations under different climate, soil and moisture conditions. This study compares yields and forage quality of big bluestem and smooth bromegrass in low, medium and high shade from mature green ash and scotch pine trees. Bluestem out yields bromegrass in full sun but yields are comparable in shade. Bluestem's higher water and nitrogen efficiency make it the better choice for drier situations. Findings show the best combination of forage grasses and trees varies according to local conditions and should be chosen based on specific management goals. The greatest challenge is finding shade trees that will grow in often harsh climates and that also have market value.

Impact:
This research is providing some of the first specific information about the best grass and tree combinations for Nebraska climate and soil conditions. Results should help producers make more informed management choices to combine trees and grazing to maximize profits.

Funding:
UNL Agricultural Research Division
USDA National Agroforestry Center
Hatch Act
McIntire-Stennis Cooperative Forestry

Scope of Impact: National

Summary:
IANR scientists are studying how different grasses perform under varying levels of shade from different trees to identify the best combinations of grasses for grazing and trees with market value. Combining trees and livestock grazing, called silvopasturing, can diversify and improve economic potential. However, producers need to know which combination of trees and grasses work best in their situation. Results show the best combinations of forage grasses and trees vary according to local conditions and should be chosen based on specific management goals of the producer. This research is providing some of the first information on which grass and tree combinations work best in Nebraska. Results should help producers make more informed management choices to combine

Federal Goal V. To Enhance Economic Opportunities and the Quality of Life Among Families and Communities

Nebraska's population has steadily shifted. Rural areas see declining populations relative to regional trade centers and metropolitan areas. These changes are leading to a decline in the number of young people in rural Nebraska. The impacts of these shifts on main street businesses and communities are dramatic in many cases. Over the next 30 years, Nebraska's 65-and-older population is expected to nearly double. In addition to the aging population, other demographic changes include the increase in minority populations in Nebraska. Nutrition, health and wellness, including obesity, are critically important to Nebraskans. ARD research programs deal with policy issues as well as research to assist educational programs in these areas. The research programs are closely linked to Cooperative Extension educational programs. The specific Nebraska goals related to this area are:

1. Enhance basic life skills for Nebraska's children, youth and adults.
2. To enhance business and livable employment opportunities.

Turning agricultural waste products into fabrics not only can add value to agricultural products, but make the fiber industry more sustainable and reduce the use of petroleum-based synthetic fabrics. Several years after developing a patented process that efficiently and inexpensively converts cellulose in cornhusks into textile fibers that can be made into fabric, the scientist also has found a use for the millions of tons of chicken feathers and rice straw available worldwide. Corn is Nebraska's largest crop and the U.S. produces about 20 million tons of cornhusks annually. If all of that were used to produce textiles, it could make at least 2 million tons of fibers worth about $4 billion annually. With the about 560 million tons of rice straw available worldwide, more than 80 million tons of fibers can be produced from rice straw every year. Using 50 percent of the rice straw available in the U.S. could produce about 2 billion pounds of fiber with a potential sales of about $2 billion. About 4 billion pounds of feathers are produced by the U.S. poultry industry each year. Assuming 50 percent of those feathers were used to produce fibers, sales of $16 billion could be achieved each year. This could result in $400 million in profits per year for farmers growing rice, while using chicken feathers could result in $6 billion in additional profits for farmers per year.

Goal V Resources

Source of Funds	Federal*	State	All Other	Total
FY 2006 Expenditures ($ x 1,000)	$175	$1,673	$2,184	$4,032

Faculty SYs in FY 2006 - 9.0

* Includes Hatch, Multistate, McIntire-Stennis and Animal Health funds

Impact Statements Related to Federal Goal V—Identified by Key Themes

Category: Enhance Economic Opportunities and Quality of Life Among Families and Communities

Key Theme: Jobs/Employment,

Impact Statement: New uses for waste products hold promise of new jobs and income for rural America.

(Relates to Nebraska Subgoal 2 , Output Indicators 5, and Outcome Indicator 2)

Issue:

Turning agricultural waste products into fabric not only can add value to agricultural products, but make the fiber industry more sustainable and reduce the use of petroleum-based synthetic fabrics.

What has been done:

A University of Nebraska-Lincoln textiles scientist has found a way to turn rice straw, chicken feathers and cornhusks into fabrics. Several years after developing a patented process that efficiently and inexpensively converts cellulose in cornhusks into textile fibers that can be made into fabric, the scientist also has found a use for the millions of tons of chicken feathers and rice straw available worldwide. Rice fabrics, composed mostly of cellulose, are capable of being spun into fabrics similar to linen using common textile machinery. Chicken feathers, composed mostly of keratin, offer the potential for developing fabrics that are lightweight and offer better shock absorption and superior insulation. It has similar applications as wool fibers. The fibers also are biodegradable. Using these resources could more than keep up with the current world's consumption of 67 million tons of natural and synthetic fibers. However, keeping up with this demand may be a challenge due to limited availability of cultivable land, increasing price and decreasing petroleum.

Impact:

Using agricultural resources already available makes for an abundant, cheap and renewable alternative to petroleum-based synthetic fibers. Corn is Nebraska's largest crop and the U.S. produces about 20 million tons of cornhusks annually. If all of that were used to produce textiles, it could make at least 2 million tons of fibers worth about $4 billion annually. With about 560 million tons of rice straw available worldwide, more than 80 million tons of fibers can be produced from rice straw every year. Using 50 percent of the rice straw available in the U.S. could produce about 2 billion pounds of fiber with potential sales of about $2 billion. About 4 billion pounds of feathers are produced by the U.S. poultry industry each year. Assuming 50 percent of those feathers were used to produce fibers, sales of $16 billion could be achieved each year. This could result in $400 million in profits per year for farmers growing rice, while using chicken feathers could result in $6 billion in additional profits for farmers per year.

Funding:

University of Nebraska-Lincoln Agricultural Research Division
University of Nebraska-Lincoln College of Education and Human Sciences
Hatch Act
Multi-State Research
Consortium for Plant Biotechnology Research

Nebraska Research Initiative

Scope of Impact: National

Summary:
Turning agricultural waste products into fabrics not only can add value to agricultural products, but make the fiber industry more sustainable and reduce the use of petroleum-based synthetic fabrics. Several years after developing a patented process that efficiently and inexpensively converts cellulose in cornhusks into textile fibers that can be made into fabric, the scientist also has found a use for the millions of tons of chicken feathers and rice straw available worldwide. Corn is Nebraska's largest crop and the U.S. produces about 20 million tons of cornhusks annually. If all of that were used to produce textiles, it could make at least 2 million tons of fibers worth about $4 billion annually. With the about 560 million tons of rice straw available worldwide, more than 80 million tons of fibers can be produced from rice straw every year. Using 50 percent of the rice straw available in the U.S. could produce about 2 billion pounds of fiber with a potential sales of about $2 billion. About 4 billion pounds of feathers are produced by the U.S. poultry industry each year. Assuming 50 percent of those feathers were used to produce fibers, sales of $16 billion could be achieved each year. This could result in $400 million in profits per year for farmers growing rice, while using chicken feathers could result in $6 billion in additional profits for farmers per year.

B. Stakeholder Input Process

The processes used for stakeholder input for the Agricultural Research Division were described in detail in the initial ARD Plan of Work. Nebraska has had an extensive system of stakeholder input in place for many years. The Agricultural Research Division and the Cooperative Extension Division collaborate routinely in the planning and development of programs. These divisions, as part of the Institute of Agricultural and Natural Resources (IANR), have been partners in development of Strategic Plans for over 10 years.

a) **Actions Taken to Seek Stakeholder Input**

IANR conducted four formal listening sessions across Nebraska in 2006. While the sessions were open to the general public, special invitations were made to ensure representation by underserved groups. The participants included limited resource audiences, ethnic minorities, state and local agency representatives, volunteer organization representatives, school officials, in-state clientele and out-of state stakeholders. The findings from the listening sessions were consistent with previous years, with water quality/quantity and rural economic development continuing to be the highest priorities.

Most IANR departments, research and extension centers, interdisciplinary centers and program areas have external advisory groups representing stakeholders and users. These groups meet at least annually and provide input on current and future programs of the units. The Agronomy and Horticulture Department Advisory Board has 25 members who meet twice annually. They provided information on strategic issues related to Agronomy and Horticulture teaching, research and extension. An Animal Science Department Advisory Committee was established in 2001 and has met several times. It has 27 members from various segments of the livestock, meat, and feed industry. In 2006, a water science advisory committee was organized to provide clientele input into water related research, outreach, and policy issues. The panel includes representatives from state government, environmental organizations, agricultural groups and irrigation providers.

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The Northeast Nebraska Experimental Farm Association serves as the stakeholder input group for the Northeast Research and Extension Center and Haskell Agricultural Laboratory. This group consists of representatives from each of the counties in the northeast district and meets annually to provide input on program needs at NEREC. Other research centers with advisory committees which meet annually include the High Plains Agricultural Lab and the Gudmundsen Sandhills Lab. Examples of programs which have advisory committee meetings which meet at least annually include the Republican River Basin Irrigation Management Demonstration Project and the *E. coli* 0157:H7 Food Safety Research Program.

b) **Brief Statement of the Process Used by the Recipient Institution to Identify Individuals in Groups Who are Stakeholders and to Elicit Input from Them**

The Animal Science Advisory Committee began by familiarizing members with the department's research, extension, and teaching programs. Currently, the Committee is providing input on future needs.

The Department of Nutrition and Health Science (formerly Nutritional Science and Dietetics) meets twice per year with its Community Nutrition Partnership Council. This Council helps to coordinate nutrition education for limited resource audiences. The members of the Council represent a broad group of state and local agencies, volunteer organizations, school officials, and others. They provide valuable input both on extension needs for Cooperative Extension and research needs for these types of programs.

The Department of Agricultural Economics advisory council consists of stakeholders who help to provide perspectives on research and education needs at state, regional and national levels.

The Department of Agricultural Leadership, Education, and Communication's Advisory Council meets twice annually and consists of representatives from clientele groups throughout the state.

The above examples are only a part of the on-going stakeholder process. While the types of membership for these advisory groups vary, in all cases the intent is to have a membership selection process which allows for good representation from all clientele groups and rotation of membership to provide different views.

c) A Statement of How Collected Input was Considered

Minutes of meetings and reports are maintained and revisited periodically to see if programs have been adjusted in response to the recommendations. It is essential for effective advisory group functioning that the membership be able to review and reflect upon the impact of earlier recommendations. Stakeholder input has been valuable to units in making decisions on which programs to emphasize or initiate as well as which programs to de-emphasize. Stakeholder input is often critical in helping units and administrators make decisions on which areas are highest priorities for filling faculty positions. Since the filling of faculty positions is a critical element in refocusing programs, reaffirming priorities, or identifying emerging issues to address, the stakeholder input is very valuable in helping units and the Agricultural Research Division in making these decisions. The current five-year IANR Strategic Plan is based on the results of the listening sessions, reactions and input from the faculty and consideration of federal priorities.

C. Program Review Process

Nebraska has made no significant changes in program review processes since the 5-Year Plan of Work was submitted. The scientific peer review process used the by Agricultural Research Division as described in the 5-Year Plan of Work remains the same.

D. Evaluation of the Success of Multi and Joint Activities

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

Critical issues of strategic importance identified by stakeholders are directly reflected in the IANR Strategic Plan. The Strategic Plan serves as a fundamental document which guides decision-making on program emphasis and staffing. ARD faculty currently participate in multi-state projects which are provided research funding support through the multistate research component of the federal formula funds. These projects are selected and approved by regional Director Associations because they are high priority needs identified for multistate activity. A list of current ARD participation in multistate committees and the related federal goals is attached as Appendix 1.

2) Did the planned programs address the needs of under-served and under-represented populations of the state?

ARD research programs related to human nutrition and healthy lifestyles were highlighted under the federal goals and key themes. The results of this research feed science-based information directly into Cooperative Extension programs which target under-served and under-represented populations. Nutritional sciences research includes the project on evaluating the nutritional characteristics of meat from American bison. This is important because the growth, production and use of American bison as a healthy meat source is increasing and the fact that bison herds have been started on Nebraska's Native American reservations. A research project on assessing managerial and work force development in food service management is providing information useful for effective training of low income and minority populations working in the food service area.

3) Did the planned programs describe the expected outcomes and impacts?

Output and outcome indicators were described in the 5-Year Plan of Work submitted in 2000. The impacts of the example projects described in the accomplishments and results section relate directly to these output and outcome indicators.

4) Did the planned programs result in improved program effectiveness and/or efficiency?

Effective documentation of research programs, joint program output and outcomes, and ultimately impacts is an important part of our program activity. Individual faculty members are expected to identify outcomes and impacts in their annual faculty reports. The impact reports that are included in the accomplishment section of this report are developed for use by stakeholders and originate with the impacts identified by individual faculty annually. Having to

document individual impacts, as well as interdisciplinary and joint program impacts keeps faculty focused on the need for productive programs.

The joint planning of multistate project activity results in less duplication and more cooperative program efforts. Many University of Nebraska IANR faculty have joint Agricultural Research Division and Cooperative Extension Division appointments. Therefore, joint planning is assured and this results in research programs that are directly related to Cooperative Extension's education needs. This arrangement definitely improved program effectiveness and/or efficiency.

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

Select One: □ **Interim** X **Final**
Institution: **University of Nebraska-Lincoln Extension and Ag Experiment Station**
State: **Nebraska**

	Integrated Activities (Hatch)		**Multistate Extension Activities (Smith-Lever)**		**Integrated Activities (Smith-Lever)**	
Established Target %	25	%	25	%	25	%
This FY Allocation (from 1088)	**$3,132,095**		**$4,898,516**		**$4,898,516**	
This FY Target Amount	**$783,024**		**$1,224,629**		**$1,224,629**	
Title of Planned Program Activity						
Goal 1: Integrated Crop Management Integrated Livestock Systems Management Sustainable Agricultural Production Systems	$517,486		$495,872		$601,096	
Goal 2: Food Processing and Food Service Management Food Safety	$69,325		$22,928		$77,360	
Goal 3: Human Nutrition, Health and Safety	$8,577		$49,394		$21,118	
Goal 4: Natural Resource Management and Protection Environmental Protection Environmental and Natural Resources Policy	$253,299		$495,188		$401,694	
Goal 5: Family Strengths	$20,474		$177,140		$132,712	
Total	$869,161		$1,240,522		$1,233,980	
Carryover						

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

Dr. Elbert C. Dickey — May 15, 2007
Director of University of Nebraska-Lincoln Extension — **Date**

Dr. Gary L. Cunningham — May 15, 2007
Director of University of Nebraska-Lincoln Ag Experiment Station — **Date**

F. INTEGRATED RESEARCH AND EXTENSION ACTIVITIES

Below are a few examples of integrated Research and Extension activities.

Goal 1

Activity: Integrated Crop Management

Topic: Organic Farming Project

Issue: Organic farming is one of the fastest growing segments of U.S. agriculture. In Nebraska, certified organic crop and pasture acreage nearly doubled from 1997 to 2003, according to the U.S. Department of Agriculture. To capitalize on this expanding market, the state's farmers need practical, science-based information about growing food organically under Nebraska conditions.

What has been done: The University of Nebraska-Lincoln in 2005 initiated a project to expand organic farming research and education, enhance collaborations with growers and develop science-based information for organic food production. As part of a $750,000 grant, Institute of Agriculture and Natural Resources researchers are establishing the university's first certified organic research plots at four research farms around the state where scientists are studying locally important organic production issues. Scientists are working closely with organic farmers. Advisory committees of organic producers are helping to guide research and scientists are conducting studies on cooperating certified organic farms. Education is a key part of this project. A UNL Extension educator is coordinating the project and is sharing research results and organic concepts with farmers and students. The overall aim is to incorporate organic farming concepts into IANR's extension, research and teaching.

Impact: This research and education effort is laying the foundation to help the university meet the increasing need for practical, science-based information about organic farming in Nebraska. Establishing certified organic test plots will take three years but will make possible long-term research on organic systems and allow researchers to provide localized information for producers. Initial educational activities are reaching a new Extension audience.

Funding:
UNL Agricultural Research Division
UNL Extension
USDA Cooperative State Research, Education and Extension Service

Activity: Integrated Livestock Systems Management

Topic: Ethanol Wet Co-product Feed Payoffs

Issue: Nebraska is the nation’s third largest ethanol producer and the largest ethanol producing state west of the Mississippi. Turning grain into fuel is big business for the Cornhusker state and making the best use of co-products from this production is critical to the industry’s success.

What has been done: University of Nebraska-Lincoln animal scientists pioneered research on how to feed cattle wet co-products from ethanol and corn processing. Their research in the 1990s proved the feasibility, benefits and economic advantages of feeding wet gluten feed, wet distillers grains and steep liquor to cattle directly instead of drying and shippin them to dried feed

markets. They found that drying actually reduces co-products' nutritional value. Feeding co-products wet saves drying costs for processors and provides an economical feed for cattle producers. Nebraska scientists, who are leaders in co-product feeds research, continue studies that have helped the cattle industry make the best use of these co-products. Their findings have been instrumental in encouraging some ethanol plants to locate in Nebraska. Extension faculty have conducted numerous educational programs for cattle feeders and cow-calf producers that have addressed co-product use. The 2006 Husker Nutrition Conference specifically addressed feeding of co-products to ruminants.

Impact: Thanks largely to this research, wet co-products from ethanol and corn processing have become a major source of cattle feed in Nebraska, a leading cattle feeding state. Use of wet feeds provides major and ongoing economic benefits. It's estimated that, from 1992 through 2004, the cumulative benefit to Nebraska from feeding co-products wet instead of dry was $400 million. Feeding wet co-products saves cattle feeders $10 to $20 per head; selling co-products wet instead of drying them reduces ethanol production costs about 5 percent. The 2006 Husker Nutrition Conference attracted 132 individuals, who influences a total of 3.6 million cattle and 900 livestock operations. Specifically, 15 participants noted a willingness to increase feeding rates of milling co-products from levels currently being used. Participants responding to a conference survey indicated that knowledge gained at the conference had the potential for increasing profitablility by $7.38 per head (average of all respondents); thus, a total estimated impact of up to $26.6 million.

Funding:
Nebraska Corn Board
Nebraska Ethanol Board
UNL Agricultural Research Division
UNL Extension

Activity: Sustainable Agricultural Production Systems

Topic: Alternative Crops for the Nebraska's Panhandle's Arid High Plains Climate

Issue: Alternative, higher value crops can broaden crop options for farmers and bolster regional economies, but new crops also are risky. Farmers need information about producing unfamiliar crops under local conditions as well as their market protential.

What has been done: University of Nebraska–Lincoln agricultural scientists and UNL Extension staff have identified and are educating producers about promising alternative crops for the Nebraska Panhandle's arid high plains climate. The effort focuses on alternatives with higher value potential for growers and the region's economy. Studies have revealed how best to plant, manage and harvest several new crops. Scientists identify existing varieties best suited to local growing conditions or breed new varieties for the region and explore a new crop's market potential. New crops being grown in the Panhandle as a result of these efforts include: proso and foxtail millet and sunflowers for birdseed; chickpeas for human food; turf and forage grass seed, and chicory. Brown mustard and canola for environmentally friendly biodiesel production are among the latest crops being studied.

Impact: New crops have expanded farmers' production options and added millions of dollars to the region's economy. Birdseed crops now grow on 250,000 Panhandle acres and birdseed

production is a $20 million a year industry, including several processing plants that extension staff helped attract to the region. Panhandle growers produce about 1,500 acres of grass seed valued at $1 million annually. The region's 900 acres of chicory, valued at $1 million annually, are processed at the nation's only chicory processing plant in Scottsbluff, which opened in 2001. The Panhandle now produces 10,000 acres of chickpeas and with 80 percent of U.S. chickpeas imported, there's room to grow.

Funding:
UNL Agricultural Research Division
UNL Extension

Goal 2

Activity: Food Processing and Food Service Management of Food Safety

Topic: Listeria Monocytogenes Controls in Ready-to-Eat Meat Products

Issue: Small and very small rural businesses are challenged by a lack of education in the application of ingredients for L. monocytogenes control and a lack of published, validated research on products they produce. This project was designed to reduce the risk of Listeria monocytogenes in HACCP systems and to implement product formulation changes for ready to eat meat (RTE) products produced by small and very small meat and food processors in the Great Plains.

What has been done: The goal of this effort has been to increase the knowledge and skills of processors who operate small and very small business in rural locations by validating their processes for ready-to-eat (RTE) meat and poultry products to control L. monocytogenes through the use of antimicrobial ingredients; by providing training and information on product reformulation for Listeria control; by assuring that safe ready-to-eat products are acceptable to rural clientele; and by incorporating new Listeria knowledge into a national workshop training model. Extension professionals and researchers in the Great Plains states have worked cooperatively to conduct L. monocytogenes validation experiments in RTE meat and poultry products. Information obtained from these experiments has been incorporated into hands-on workshops provided to processors operating in rural Great Plains regions. Processors are taught how to incorporate antimicrobial ingredients into formulations to produce products having similar quality characteristics of existing products. Educational programs and training opportunities to integrate new Listeria knowledge into pre-requisite programs and HACCP plans have been provided through meetings, educational material, and one-on-one technical assistance. From these workshops and meetings, a national workshop model will be developed that can be used by Extension professionals to assist meat and poultry processors nationwide.

The four states (Nebraska, Kansas, Missouri, and South Dakota) have designed studies to better understand the use of the antimicrobial ingredients sodium lactate plus sodium diacetate; and buffered sodium citrate and sodium diacetate. The studies are designed to determine the effect of these antimicrobials on the outgrowth of Listeria monocytogenes during refrigerated storage and the changes in product quality of ready to eat meats. Each state selected a product commonly produced by small business processors, including boneless ham, course ground hot dogs,

bologna, and snack sticks. Each state is currently implementing the studies and collecting data. In addition, the four states have conducted workshops targeted at small business meat processors addressing the control of Listeria monocytogenes in ready to eat meats and the USDA regulations concerning ready to eat meat and poultry.

Impact: The work on this project is continuing. The majority of small business meat and poultry processors produce ready to eat meat products including hot dogs and deli products that present a greater risk for foodborne illness from Listeria monocytogenes. These processors normally produce products without antimicrobial ingredients or other interventions for the control of Listeria monocytogenes. This work is expected to demonstrate to small businesses that they can include antimicrobial ingredients in their ready to eat meat products without affecting product quality. Including antimicrobial ingredients in ready to eat meat products would provide the easiest method for small meat and poultry processors to reduce the risk of listerosis for their products. In addition, this work should make it easier for very small meat processors to comply with USDA regulations for Listeria monocytogenes control in ready to eat meat products.

Funding:
UNL Agricultural Research Division
UNL Extension
USDA CSREES

Goal 3

Activity: Human Nutrition, Health and Safety

Topic: Food Labeling Decisions

Issue: For most people, food labels provide helpful nutritional information. For people with food allergies, accurate labels can be a matter of life and death.

What has been done: An international study by University of Nebraska-Lincoln food scientists found that highly refined soybean oil does not trigger reactions in soy-sensitive people. Refined soy oil is commonly used in foods worldwide. Findings don't apply to cold-pressed soy oil, which has higher levels of protein, or allergens, that may present a risk to soy-allergic consumers and should be labeled. These UNL Food Allergy Research and Resource Program scientists shared their findings internationally with policymakers, congressional staffers, industry, farmers and consumers.

Impact: The UNL findings provided scientific evidence for European Union food allergen labeling decisions in 2005 and the U.S. Food Allergen Labeling and Consumer Protection Act of 2004. The EU temporarily exempted highly refined soy oil from food allergen labeling regulations. Earlier, U.S. regulators exempted highly refined vegetable oils derived from known allergens, such as soybeans or peanuts, from the federal food allergen labeling law that took effect this year. These decisions helped preserve farmers' widest possible access to world markets and expanded the types of foods soy-allergic people know they can safely consume.

Funding:
UNL Agricultural Research Division
UNL Extension
United Soybean board
Private food companies

Goal 4

Activity: Natural Resources Management and Protection

Topic: Water Optimizer

Issue: Continuing drought, interstate water compacts, and new state legislation have led to limitations on available irrigation water supplies. Nebraska irrigators facing water shortages must make difficult and complex choices about how best to use limited water.

What has been done: An agricultural economist and a biological systems engineer at the University of Nebraska-Lincoln developed the Water Optimizer. This decision-support computer program became available in late 2005 to help farmers make better-informed cropping choices such as determining whether it would be most profitable to grow different crops, irrigate fewer acres, apply less water to existing crops or go to dryland farming. Growers load information about their operation such as the amount of water available, soil type, irrigation system type and fuel type for irrigation. They also enter production costs, irrigation costs, crop prices and crop type. The Water Optimizer is available on the Web at http://extension-water.unl.edu/ or on a DVD/CD set and was promoted at dozens of UNL Extension meetings in 2005 and 2006.

Impact: This Institute of Agriculture and Natural Resources-developed tool is helping Nebraska farmers make more informed choices that conserve water and help maintain producer profits. Over 700 users have downloaded or purchased the tool. By running "what if" scenarios, growers can see the best options for farming with limited water whether it be growing different crops, irrigating fewer acres, applying less water to existing crops or going to dryland farming.

Funding:
UNL Agricultural Research Division
UNL Extension

Activity: Environmental Protection

Topic: Manure and Antibiotics

Issue: Applying manure to cropland enriches soil and puts waste to good use. Today's manure may contain traces of antibiotics used in livestock production and there's growing interest in knowing what happens to antibiotics in the environment.

What has been done: UNL IANR agricultural scientists teamed with a USDA Agricultural Research Service researcher at UNL to study the fate of antibiotics. Manure from confined cattle fed the recommended dose of oxytetracycline, an antibiotic commonly used in beef cattle rations, was applied to irrigated corn plots at UNL recommended or twice the recommended rates. Soil was sampled at different depths and water from the bottom of 8-foot deep sealed columns of soil was tested. Traces of oxytetracycline were detected in topsoil for 17 months after manure application. Levels decreased over time and the antibiotic was undetectable after 18 months. Two years of testing found no oxytetracycline in water collected 8 feet under the test plots. This information has been used in providing education to state regulators and livestock feeders. It will ultimately be valuable input to the development of Comprehensive Nutrient Management Plans.

Impact: The research provided one of the first overviews of what happens to antibiotics in manure that is applied to irrigated cropland. It provides the foundation for further studies to better understand potential health and environmental implications. The information has been key to helping both regulators and producers understand the potential issues relative to antibiotics in manure.

Funding:
UNL Agricultural Research Service
UNL Extension
USDA ARS
US EPA

Goal 5

Activity: Family Strengths

Topic: Rural Immigrants
Issue: Rural immigrants furthering their education while working face many challenges.

What has been done: University of Nebraska–Lincoln Research and Extension faculty hope to improve the chances of success by identifying what helps or hinders rural immigrants' educational pursuits. This study of bilingual Latinos in Northeast Nebraska pursuing online classes at UNL showed significant family or community support and access to child care are keys to success.

Impact: Participants with more support and those who were integrated into their communities reported less stress and depression. These results and further research should help provide better services for rural immigrants and women seeking an education.

Funding:
UNL Agricultural Research Division
UNL Extension
UNL College of Education and Human Sciences

Appendix 1

Multi-State Research Committees with Current Agricultural Research Division Faculty Participation

No.	Title	Participating Unit *	Federal Goal
NRSP-1	Research planning using the Current Research Information System (CRIS)	Administration	N/A
NRSP-3	The National Atmospheric Deposition Program (NADP) - A long-term monitoring program in support of research effects of atmospheric deposition	SNRS	4
NRSP-4	High Speciality Crop Pest Management	Entomology	1
NRSP-8	National Animal Genome Research Project	Animal Science	1
NC-007	Conservation, Management, Enhancement and Utilization of Plant Genetic Resources	Agron/Hort PREC	1
NC-100	Regional Research Coordination, N C Region	Administration	NA
NC-107	Evolving Pathogens, Targeted Sequences, and Strategies for Control of Bovine	VBS	1
NC-170	Mediating Exposure to Environmental Hazards through Textile Systems	TCD	3
NC-205	Ecology and Management of European Corn Borer and other Stalk-boring Lepidoptera	NEREC Ent	1
NC-213	Marketing and Delivery of Quality Cereals and Oilseeds	FS&T Agron/Hort	1
NC-218	Assessing Nitrogen Mineralization and other Diagnostic Criteria to Refine Nitrogen Rates for Crops and Minimize Losses	Agron/Hort	1
NC-219	Using Stage Based Intervention to Increase Fruit and Vegetable Intake in Young Adults	Nutr	3
NC-229	Porcine Reproductive & Respiratory Syndrome (PRRS): Mechanisms of Disease and Methods for the Detection, Protection and Elimination of PRRS Virus	VBS	1
NC-1003	Impact Analysis and Decision Strategies for Agricultural Research	Ag Econ	1
NC-1004	Genetic and Functional Genomic Approaches to Improve Production Quality of Pork	An Sci	1

No.	Title	Participating Unit *	Federal Goal
NC-1005	Landscape Ecology of White-tailed Deer in Agro-forest Ecosystems: a Cooperative approach to Support Management	SNRS	4
NC-1006	Methods to Increase Reproductive Efficiency in Cattle	An Sci	1
NC-1007	Enteric Diseases of Swine and Cattle Prevention Control and Food	VBS	1
NC-1010	Interpreting Cattle Genomic Data: Biology, Application and Outreach	An Sci	1
NC-1011	Rural low-income families: Tracking their well-being and function in an era of welfare reform	FCS	5
NC-1016	Economic assessment of changes in trade arrangements, bio-terrorism threats and renewable fuels requirements on the U S Grain and Oilseed sector	Ag Econ	2
NC-1018	Impact of climate and soil on crop selection and management	SNR	4
NC-1020	Beef cattle grazing systems that improve production and profitability while minimizing risk and environmental impacts	An Sci	1
NC-1021	Nitrogen cycling, loading and use efficiency in forage-based livestock production systems	Agron/Hort	4
NC-1022	The chemical and physical nature of particulate matter affecting air, water and soil quality	SNR	4
NC-1023	Improvement of Thermal and Alternative Processes for Foods	IAPC	2
NC-1025	Mycotoxins:Biosecurity and Food Safety	Plant Path	2
NC-1026	Characterize Weed Populations Dynamics for Improved Long-term Weed Management Decision Making	Agron/Hort	1
NC-1100	North Central Regional Center for Rural Development	Ag Econ	5
NC-1119	Management Systems to improve the economic and environmental sustainability of dairy enterprises	Ag Econ	1
NC-1131	Molecular Mechanisms Regulating Skeletal Muscle Growth and Differentiation	Food Sci	1
NC-1142	Regulation of Photosynthetic Processes	Biochem	1

No.	Title	Participating Unit *	Federal Goal
NC-1167	N–3 Polyunsaturated Fatty Acids and Human Health and Disease	Nutr	3
NCAC-1	Crop Soil Research	Agro/H	NA
NCAC-2	Animal Health Advisory Committee	VBS	NA
NCAC-4	Horticultural Crops	Agro/H	NA
NCAC-5	Human Sciences	Home Ec	NA
NCAC-6	Livestock Production	An Sci	NA
NCAC-10	Forestry and Forest Products	SNRS	NA
NCAC-12	Agricultural Economics	Ag Econ	NA
NCAC-14	Plant Pathology	Plant Path	NA
NCAC-15	Entomology and Economic Zoology	Ent	NA
NCAC-16	Agricultural Engineering	BSE	NA
NCAC-22	Food Science and Human Nutrition	FS&T, Nutr	NA
NCAC-23	Fisheries and Wildlife	SNRS	NA
NCAC-24	Agricultural Education Research	AgLEC	NA
NCCC-9	MWPS: Research and Extension Education Materials	Agron/Hort	5
NCCC-22	Small Fruit and Viticulture Research	Agron/Hort	1
NCCC-31	Ecophysiological Aspects of Forage Management	Agron/Hort	1
NCCC-42	Committee on Swine Nutrition	An Sci	1
NCCC-52	Family Economics	FCS	5
NCCC-65	Social Change in the Market Place: Consumer/Retail/Producer Interface	TCD	1
NCCC-84	Potato Breeding and Genetics Technical Committee	PREC	1

No.	Title	Participating Unit *	Federal Goal
NCCC-97	Regulation of Adipose Tissue Accretion in Meat-Producing Animals	An Sci	1
NCCC-170	Research Advances in Agricultural Statistics	Stat	1
NCCC-204	The Interface of Molecular and Quantitative Genetics in Plant and Animal Breeding	Agron/Hort	1
NCDC-201	Nanotechnology and Biosensors	IAPC	1
NCDC - 202	Soybean Rust	Plant Path	1
NCDC-204	Biological control of plant pathogens in the North Central Region	Agron/Hort	4
NCDC-206	Impact of changing management systems on soil nematode communities	Plant Path	4
NCDC-207	Research and Education Support for the Renewal of Agriculture and the Middle	Agron/Hort	5
NCERA-3	Soil Survey	Agron/Hort	4
NCERA-57	Swine Reproductive Physiology	An Sci	1
NCERA-59	Soil organic matter: Formation, function and management	Agron/Hort	4
NCERA-87	Beef-Cow-Calf Nutrition and Management Committee	An Sci	1
NCERA-89	Swine Management Research Committee	An Sci	1
NCERA-103	Specialized soil amendments and products, growth stimulants and soil fertility management programs	Agron/Hort	4
NCERA-125	Biological control of arthropods and weeds	Entom	4
NCERA-137	Soybean Diseases	Plant Path	1
NCERA-148	Migration and Dispersal of Agriculturally Important Biota	PREC	4
NCERA-180	Site-Specific Management	Agron/Hort	1

No.	Title	Participating Unit *	Federal Goal
NCERA-184	Management of Small Grain Diseases	Plant Path	1
NCERA-192	North Central Regional Turfgrass	Agron/Hort	1
NCERA-194	Improving the Management and Effectiveness of Cooperatively Owned Business Organizations	Ag Econ	1
NCERA-199	Implementation and Strategies for National Beef Cattle Evaluation	Statistics	1
NCERA-200	Management Strategies to Control Major Soybean Virus Diseases in the North Central Region	Plant Path	4
NCR-13	Soil Testing and Plant Analysis	Agro/H	1
NCR-46	Development, Optimization, and Delivery of Management Strategies for Corn Rootworms	Ent	1
NCR-131	Animal Behavior and Welfare	AnSci	1
NCR-167	Corn Breeding Research	Agro/H	1
NCR-173	Biochemistry and Genetics of Plant-Fungal Interactions	Plant Path	1
NCR-193	Plant Health: Managing Insect Pests and Diseases of Landscape Plants	SNRS	1
NCR-201	Integrated Pest Management	Agro/Hort Ent	1
NCR-202	Health and Survival of Honey Bee Colonies	Ent	1
NCR-206	Nutrition and Management of Feedlot Cattle to Optimize Performance, Carcass Value and Environmental Capability	An Sci	1
NE-1010	Breeding and Genetics of Forage Crops to Improve Productivity, Quality, and Industrial Uses	Agron/Hort	1
NE-1017	Developing and Integrating Components for Commercial Greenhouse Production System	BSE	4

No.	Title	Participating Unit *	Federal Goal
NE-1020	Multi-state Evaluation of Winegrape Cultivars and Clones	Agron/Hort	5
NE-1022	Poultry Production Systems: Optimization of Production and Welfare Using Physiological, Behavioral and Physical Assessments	An Sci	1
S-295	Enhancing Food Safety Through Control of Food-Borne Disease Agents	FS&T	2
S-1000	Animal Manure and Waste Utilization, Treatment and Nuisance Avoidance for a Sustainable Agriculture	BSE	4
S-1002	New Technologies for Utilization of Textile Materials	TC&D	3
S-1005	Sources, Dispersal and Management of Stable Flies on Grazing Beef and Dairy Cattle	Ent WCREC	1
S-1007	Science and Engineering for a Biobased Industry and Economy	BSE	1
S-1008	Genetic Selection and Crossbreeding to Enhance Reproduction and Survival of Dairy Cattle	An Sci	1
S-1010	Dynamic Soybean Pest Management for Evolving Agricultural Technologies and Cropping Systems	Ent	1
W-112	Reproductive Performance in Domestic Ruminants	An Sci	1
W-173	Stress Factors of Farm Animals and Their Effects on Performance	Stat	1
W-1002	Nutrient Bioavailability -Phytonutrients and Beyond	Nutr	3
W-1082	Evaluating the Physical and Biological Availability of Pesticides and Pharmaceuticals in Agricultural Contexts	Agron/Hort	4

No.	Title	Participating Unit *	Federal Goal
W-1150	Exotic Germplasm Conversion and Breeding Common Bean (Phaseolus vulgaris L.) For Resistance to Abiotic and Biotic Stresses and to Enhance Nutritional Value	Plant Path	1
W-1171	Germ Cell and Embryo Development and Manipulation for the Improvement of Livestock	An Sci	1
W-1177	Enhancing the Global Competitiveness of U S Red Meat	PREC An Sci	1
W-1186	Genetic Variability in the Cyst and Root-Knot Nematodes	Plant Path	1
W-1190	Interfacing Technological, Economic, and Institutional Principles for Managing Intersector Mobilization of Water	Ag Econ	4
WERA-11	Western Regional Turfgrass Research	Agron/Hort	1
WERA-55	Rangeland Resource Economics and Policy	Ag Econ	1
WERA-60	Science and Management of Pesticide Resistance	Ent	1
WERA-66	Integrated Management of Russian Wheat Aphid and Other Cereal Aphids	PREC Ent	1
WERA-72	Agribusiness Research Emphasizing Competitiveness	Ag Econ	5
WERA-77	Management Invasive Weeds in Wheat	PREC	1
WERA-95	Vertebrate Pests of Agriculture, Forestry and Public Lands	SNRS	4
WERA–97	Diseases of Cereals	Plant Path	1
WERA-202	Climatic Data Application in Irrigation Scheduling and Water Conservation	BSE	4

* Unit Abbreviations

Ag Econ	Agricultural Economics
AgLEC	Agricultural Leadership, Education and Communication
Agro/H	Agronomy and Horticulture
An Sci	Animal Science
Biochem	Biochemistry
BSE	Biological Systems Engineering
Biometry	Biometry
Ent	Entomology
FCS	Family and Consumer Science
FS&T	Food Science and Technology
IAPC	Industrial Ag Products Center
Nutr	Nutritional and Health Sciences
Plant Path	Plant Pathology
SNRS	School of Natural Resource Sciences
TCD	Textiles, Clothing and Design
VBS	Veterinary and Biomedical Sciences
NEREC	Northeast Research and Extension Center
PREC	Panhandle Research and Extension Center
SCREC	South Central Research and Extension Center
WCREC	West Central Research and Extension Center