

# 2007 University of Missouri Research Annual Report

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## I. Report Overview

### 1. Executive Summary

For the agricultural sector, 2007 stands out as a record breaking year. High petroleum prices and biofuel incentive policies significantly increased the demand for corn (ethanol) and the demand for soybeans (biodiesel). Furthermore, the weakening dollar increased export demand for U.S. commodities. The resulting high commodity prices have led to record crop and livestock production and dramatically increased net farm income, forecasted at \$87.5 billion, up 51% from the 10 year average.

The economic value of the agricultural sector, and the ability to respond to changing demand conditions, underscores the importance of basic and applied research needed to support advances in science, technology and the understanding of social and economic conditions related to agriculture. In 2007, research efforts in the Missouri Agricultural Experiment Station yielded significant accomplishments in plant and animal sciences, as well as food systems and public policy analysis. Leveraged funding from externally sponsored programs exceeded \$33M, leading the campus insponsored programs.

Typically, a change in condition, such as an increase in the knowledge base, is subtly observed as incremental progress in the scientific knowledge area. Milestones are best recognized after the fact – looking back at accomplishments that went on to generate significant impacts on future research. The same can be said for the research documented in the planned programs of this report. Outcome narratives reflect incremental progress in science under the planned programs. Quantitative outputs, such as peer reviewed publications, are helpful indicators of the increase in knowledge base, which ultimately further basic as well as applied research. The successful engineering of the cystic fibrosis defect into pigs to provide a model for human disease research provides an example of a benchmark in progress.

The science years and quantitative outputs in this report significantly exceed targets established in the 2007 plan of work. This shift in magnitude arises because initial estimates were based on a fewer number of active station projects than existed prior to the new plan of work. At that time, station projects were more broadly defined across knowledge areas and collaborating investigators. The process of developing the plan of work in 2006, predicated on identifying critical issues and priorities, resulted in a restructuring of how station projects were organized. Specifically, individual station projects are now more narrowly focused, resulting in an overall greater number of station projects. For evaluation purposes, this granular approach allows better tracking of inputs and outputs to the appropriate planned program. Targets in future plans of work will be updated to reflect the new organizational structure.

The reporting methodology designed during the initial plan of work allows a systematic approach to associate inputs, outputs and outcomes with the appropriate planned program. Accomplishments are based on quantifiable outputs, such as publications, and descriptive narratives that are linked back to knowledge areas. Some examples of significant accomplishments made by station researchers against the goals of the plan of work follow.

As part of a nine state collaboration, researchers at MU are making significant strides in evaluating soybean cyst nematode resistance. Data are being combined with other data from the region for inclusion on the Plant Health Initiative (NSCRP) web site used by growers in making germplasm selection for yearly production. Test results have also contributed to a greater understanding of the extent of evolution in *P. sojae* populations, and therefore have assisted breeders in focusing on appropriate combinations of specific resistance genes or quantitative genes to be used for development of new germplasm.

In animal research, scientists at MU have successfully engineered pigs to produce omega 3 fatty acids, a beneficial compound which is known to improve cardiovascular fitness and reduce the risks of heart disease. Regarding human consumption, FDA approval of transgenic animals may not be economically viable, but hog producers could benefit because the pigs themselves would also be healthier, so sows could remain in the breeding herd longer. In the near future, modified pigs could benefit researchers studying the impacts of omega 3 fatty acids on cardiovascular, immune and reproductive health.

In natural resources, researchers at MU are working for a possible solution to the "flying" Asian carp. This invasive species of fish is competing with native fish in Missouri rivers. Scientists are conducting nutritional analysis on the fish as a possible food for zoo animals, such as penguins, pelicans and sea lions.

MU scientists have developed a new diagnostic tool for early stage detection of melanoma. A method called photoacoustic detection combines laser and ultrasound techniques to accurately monitor for cancer by "listening" for it in a simple blood sample. By speeding diagnosis, photoacoustic detection will allow doctors to treat and remove melanoma at its earliest stages, preventing the spread to other parts of the body.

Researchers in applied social sciences held an Agriculture and Rural Development workshop to study entrepreneurship in food, agriculture, natural resources and rural development. Researchers and practitioners work to improve the understanding of nature, causes, and consequences of entrepreneurial activity for food and agricultural production and the development of rural communities.

**Total Actual Amount of professional FTEs/SYs for this State**

Year:2007	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	42.0	0.0
<b>Actual</b>	0.0	0.0	76.0	0.0

**II. Merit Review Process****1. The Merit Review Process that was Employed for this year**

- Other (see below )

**2. Brief Explanation**

Annual faculty reporting instruments, including individual report of accomplishments and the CSREES progress reports were used to evaluate the program progress. In addition, information in news releases and web publications was used to identify milestone events reported in 2007.

**III. Stakeholder Input****1. Actions taken to seek stakeholder input that encouraged their participation**

- Other (see below)

**Brief Explanation**

Stakeholder input is addressed in the MU Extension Plan of Work.

**2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them****1. Method to identify individuals and groups**

- Use Advisory Committees

**Brief Explanation**

The following committees meet regularly to get stakeholder input:

- Farms and Centers Advisory Committee
- Research Center Advisory Committee
- Ag commodity group advisory boards
- Vice Chancellor's Leadership Council, College of Agriculture, Food and Natural Resources

**2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them****1. Methods for collecting Stakeholder Input**

- Other (see MU Extension Plan of Work)

**Brief Explanation**

see MU Extension Plan of Work

**3. A statement of how the input was considered**

- Other (see MU Extension Plan of Work)

**Brief Explanation**

Stakeholder input is addressed in the MU Extension Plan of Work.

**Brief Explanation of what you learned from your Stakeholders**

Stakeholder input is addressed in the MU Extension Plan of Work.

**IV. Expenditure Summary**

<b>1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)</b>			
<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	8452918	0

<b>2. Totaled Actual dollars from Planned Programs Inputs</b>				
<b>Extension</b>			<b>Research</b>	
	<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
<b>Actual Formula</b>	0	0	8452918	0
<b>Actual Matching</b>	0	0	8452918	0
<b>Actual All Other</b>	0	0	45155947	0
<b>Total Actual Expended</b>	0	0	62061783	0

<b>3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous years</b>				
<b>Carryover</b>	0	0	0	0

**V. Planned Program Table of Content**

<b>S. NO.</b>	<b>PROGRAM NAME</b>
1	Plant Biology and Biochemistry
2	Animal Biology and Production
3	Natural Resources
4	Food Systems and Biological Engineering
5	Agricultural Policy and Rural Development

**Program #1****V(A). Planned Program (Summary)****1. Name of the Planned Program**

Plant Biology and Biochemistry

**V(B). Program Knowledge Area(s)****1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			6%	
201	Plant Genome, Genetics, and Genetic Mechanisms			14%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			11%	
204	Plant Product Quality and Utility (Preharvest)			5%	
205	Plant Management Systems			10%	
206	Basic Plant Biology			26%	
211	Insects, Mites, and Other Arthropods Affecting Plants			4%	
212	Pathogens and Nematodes Affecting Plants			17%	
213	Weeds Affecting Plants			3%	
216	Integrated Pest Management Systems			4%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	15.0	0.0
<b>Actual</b>	0.0	0.0	25.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	2535875	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	2535875	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	13546694	0

**V(D). Planned Program (Activity)****1. Brief description of the Activity**

Basic and translational research will be conducted and the results disseminated via scientific publications, scientific meetings, workshops, conferences, etc.

**2. Brief description of the target audience**

researchers, scientists, extension specialists, field operation managers, agricultural producers

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

	<b>Direct Contacts Adults</b>	<b>Indirect Contacts Adults</b>	<b>Direct Contacts Youth</b>	<b>Indirect Contacts Youth</b>
<b>Year</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>Plan</b>	0	0	0	0
2007	0	0	0	0

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

**Year Target**

**Plan: 0**

2007 : 2

**Patents listed**

Zhang Z, Nguyen H, Su J, Chen X. A high-frequency Agrobacterium-mediated transformation system for soybean [Glycine max (Merr.) L.] (U.S. provisional patent).

Wan J, Zhang Z, Stacey MG, Stacey G. LysM-receptor-like kinases to improve plant defense response against fungal pathogens. US Patent Application #60/836,084;

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Plan</b>			
2007	0	345	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	70	138

**Output #2**

**Output Measure**

- Number of other peer reviewed publications (book chapters, proceedings, abstracts, etc.)

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	9	206

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	2	55

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	7	17

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

<b>O No.</b>	<b>OUTCOME NAME</b>
1	Enhanced understanding of basic aspects of plant physiology and biochemistry.
2	Development of plant varieties with improved yield, disease and insect resistance and drought tolerance.
3	Development of new plant varieties with value added traits, such as oil and protein content.
4	Translation of basic knowledge gained in model systems for the improvement of cropping systems management.

**Outcome #1****1. Outcome Measures**

Enhanced understanding of basic aspects of plant physiology and biochemistry.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Plant hormones play important roles in nearly all growth and developmental processes in the life cycle of plants. One of these hormones, auxin, elicits a highly diverse range of growth and developmental responses. The molecular mechanisms involved in auxin action, including signal transduction pathways involved in auxin-regulated gene expression, are still largely unsolved.

**What has been done**

Researchers work to unravel at least a part of the network involved in auxin-regulated gene expression. Investigators have developed new techniques to analyze transgene and endogenous gene expression and discovered a domain in Aux/IAA proteins that functions as a transferable repression domain that is dominant over activation domains.

**Results**

Results have provided new insight into mechanisms involved in auxin-responsive gene expression. The novel transcription factors provide new tools to modify plant growth and development in response to auxin or some other chemical.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

**Outcome #2****1. Outcome Measures**

Development of plant varieties with improved yield, disease and insect resistance and drought tolerance.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement**



**Issue (Who cares and Why)**

Plants are exposed to a wide variety of pathogens including viruses, bacteria, fungi, nematodes and protozoa but have evolved multiple defense mechanisms to restrict pathogen growth. Researchers at MU focus on characterizing resistant genes and manipulating plant disease resistance signaling pathways in order to engineer durable pathogen resistance in crop plants.

**What has been done**

Gene-for-gene disease resistance is a highly specific plant defense mechanism in which a particular plant resistance gene governs the resistance response against only those pathogen strains expressing a corresponding avirulence gene. Scientists use an Arabidopsis resistance gene called RPS4 to understand the protein action and identify additional proteins that trigger a plant defense response. Researchers have ascertained the biological relevance of splice variants of RPS4 encoding truncated RPS4 proteins and identified a second resistance gene related to RPS4.

**Results**

Understanding the way plant resistance proteins work can be used to improve engineering of durable innate pathogen resistance in crop plants, with significant benefits to sustainable agricultural production and the environment.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
206	Basic Plant Biology
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
201	Plant Genome, Genetics, and Genetic Mechanisms

**Outcome #3****1. Outcome Measures**

Development of new plant varieties with value added traits, such as oil and protein content.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Plant seeds are important renewable sources of biosynthetic polymers including protein, starch, oil and fiber. The amount of these natural products in seed varies among plants, from negligible amounts in some plants, to a majority of the seeds total mass in other plants. In order to ultimately improve plant characteristics, researchers work to understand the development of oilseeds during the period when various storage compounds accumulate. They use advanced proteomic approaches and instrumentation to investigate global protein and phosphoprotein expression networks during seed-filling in crop oilseeds.

**What has been done**

Two-dimensional gel based separation methods are currently being used to anonymously profile protein expression trends in developing seed of Arabidopsis, canola, soybean and castor. This technique allows scientists to rapidly and reproducibly profile a 1000 of the most abundant proteins in any developing seed. These comparative studies will allow the researchers to develop models for carbon flow and protein accumulation that can then be tested using Arabidopsis as a molecular genetic model plant for oilseeds.

**Results**

A better understanding of the protein expression networks operating during this phase of development may reveal the differences between high and low oil accumulating plants for future crop improvement.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
204	Plant Product Quality and Utility (Preharvest)

#### Outcome #4

##### 1. Outcome Measures

Translation of basic knowledge gained in model systems for the improvement of cropping systems management.

##### 2. Associated Institution Types

•1862 Research

##### 3a. Outcome Type:

Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

##### 3c. Qualitative Outcome or Impact Statement

###### Issue (Who cares and Why)

Competition in cotton on the world market is becoming increasingly more competitive. Domestic cotton milling is decreasing dramatically and foreign mills require a higher quality cotton than domestic mills. The effective transfer of scientific technical information about cotton production is essential for the Missouri cotton producer to remain competitive in a global market.

###### What has been done

Production techniques are being evaluated under the unique growing conditions found in Missouri. Variety evaluation is an important part of cotton production because the short growing season in Missouri does not allow many of the longer maturing varieties to be produced profitably. Control of vegetative growth and good defoliation in a low temperature regime are necessary in the short season environment. Variety trials were conducted in six locations. Yield stability of varieties is being studied and irrigation timing on clay is also being investigated.

###### Results

Results of these trials provide the technical information that producers need to remain competitive in the highly competitive cotton market.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
204	Plant Product Quality and Utility (Preharvest)

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Competing Public priorities

##### Brief Explanation

**V(I). Planned Program (Evaluation Studies and Data Collection)**

**1. Evaluation Studies Planned**

- During (during program)

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**Program #2**

**V(A). Planned Program (Summary)**

**1. Name of the Planned Program**

Animal Biology and Production

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals			33%	
302	Nutrient Utilization in Animals			10%	
303	Genetic Improvement of Animals			6%	
304	Animal Genome			12%	
305	Animal Physiological Processes			9%	
306	Environmental Stress in Animals			8%	
307	Animal Management Systems			2%	
308	Improved Animal Products (Before Harvest)			6%	
311	Animal Diseases			12%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			2%	
<b>Total</b>				100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	10.0	0.0
<b>Actual</b>	0.0	0.0	17.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	1859642	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1859642	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	9934543	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

Basic and translational research will be conducted and the results disseminated via scientific publications, scientific meetings, workshops, conferences, etc.

**2. Brief description of the target audience**

researchers, scientists, extension specialists, livestock producers

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

	<b>Direct Contacts Adults</b>	<b>Indirect Contacts Adults</b>	<b>Direct Contacts Youth</b>	<b>Indirect Contacts Youth</b>
<b>Year</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>Plan</b>	0	0	0	0
2007	0	0	0	0

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

<b>Year</b>	<b>Target</b>
<b>Plan:</b>	1
2007 :	4

**Patents listed**

PT 32 Sperm protein, Sperm c-Yes, Oocyte Cytoplasmic c-Yes, and Uses Thereof. P. Sutovsky, R. Oko, Inventors, U.S. US Patent No 6,995,252 granted

'Early Pregnancy Diagnosis Using PAGS (pregnancy-associated glycoproteins) Mexican Patent 233668

Categorically ranking animals for feed efficiency

Amino acid oligomer dietary supplement

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Plan</b>			
2007	0	306	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1****Output Measure**

- Number of peer reviewed journal articles

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	80	157

**Output #2****Output Measure**

- Number of other peer reviewed publications (book chapters, proceedings, abstracts, etc.)

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	70	148

**Output #3****Output Measure**

- Number of invited papers and invited presentations

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	12	56

**Output #4****Output Measure**

- Number of graduate degrees awarded

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	15	20

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

<b>O No.</b>	<b>OUTCOME NAME</b>
1	1) Pigs will be genetically modified to provide new biomedical models of human and animal diseases.
2	2) Improved and more economical protocols for fixed-time artificial insemination of cattle will be developed.
3	3) New information on measuring feed efficiency in cattle will be developed and recommendations on the incorporation of byproducts feeds into swine, poultry, and cattle rations will be determined.
4	4) Management procedures will be developed for reducing negative environmental impacts in swine, poultry, and beef confinement.
5	5) New selection tools for the genetic improvement of livestock species will be developed.

**Outcome #1****1. Outcome Measures**

1) Pigs will be genetically modified to provide new biomedical models of human and animal diseases.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Cystic fibrosis is the most common genetic disease in Caucasians. The median lifespan for those with the disease is 36 years and lung disease is the major cause of mortality. For years, scientists have studied cystic fibrosis using mice in which the cystic fibrosis gene was altered. However, mice do not develop lung disease like humans with cystic fibrosis.

**What has been done**

Researchers at the University of Missouri, collaborating with scientists at the University of Iowa, have taken the first step in developing a cystic fibrosis model with pigs. Compared to mice, pigs may be a good model for human genetic diseases because their anatomy, biochemistry, physiology, size and genetics are more similar to those of humans. To create the genetic defect in pigs, pig cells were genetically modified. Researchers then generated the genetically modified pigs from those cells using a method called nuclear transfer.

**Results**

The production of these pigs could provide researchers with opportunities to conduct studies investigating treatments and therapies for cystic fibrosis that were not previously possible. Furthermore, this discovery could lead to additional uses of the pig when studying other diseases.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
304	Animal Genome
305	Animal Physiological Processes
303	Genetic Improvement of Animals

**Outcome #2****1. Outcome Measures**

2) Improved and more economical protocols for fixed-time artificial insemination of cattle will be developed.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement**



**Issue (Who cares and Why)**

Profitability in beef production is highly dependent on reproduction rates.

**What has been done**

Studies at MU are designed to develop and evaluate practices that improve reproductive management on farming and ranching operations involved with beef cow-calf production. Research is focused on the use of progestins in combination with prostaglandin F2a (PG) and gonadotropin releasing hormone (GnRH) to synchronize or induce estrus in yearling beef heifers and postpartum suckled beef cows. Research conducted at the University of Missouri Thompson Farm characterized more accurately the timing of estrus among cows whose estrous cycles are synchronized with a protocol developed at MU called MGA Select. An intensive ultrasound study was conducted to characterize changes in patterns of dominant follicle development among cows assigned to the MGA Select or 7-11 Synch protocols.

**Results**

These studies will lead to highly effective and economical protocol(s) to synchronize estrus in postpartum beef cows and replacement beef heifers which will result in excellent pregnancy rates following artificial insemination (AI) at a fixed time.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes
307	Animal Management Systems

**Outcome #3****1. Outcome Measures**

3) New information on measuring feed efficiency in cattle will be developed and recommendations on the incorporation of byproducts feeds into swine, poultry, and cattle rations will be determined.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Using a byproduct of ethanol production to improve feed efficiency in cattle.

**What has been done**

Distiller dried grain supplement (DDGS) is a byproduct of ethanol production and a protein feed supplement that can be substituted for soybean meal in cattle diets. DDGS is a common additive in dairy rations and research was conducted to evaluate its economical potential in beef heifer and steer production. Studies were conducted to evaluate DDGS in corn / corn silage diet. In addition, a grazing study was performed to determine optimal levels of DDGS for growing heifers grazing tall fescue.

**Results**

DDGS was found to be a more economical protein source than soybean meal in terms of gain and cost per pound of gain. Utilizing this byproduct of ethanol production has the potential to reduce cattle producers costs while maintaining the rate of gain.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
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302	Nutrient Utilization in Animals
307	Animal Management Systems

**Outcome #4****1. Outcome Measures**

4) Management procedures will be developed for reducing negative environmental impacts in swine, poultry, and beef confinement.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Evaluating low-phytic acid grains fed to swine.

**What has been done**

Investigators conduct experiments on weanling swine to evaluate the efficacy of a new phytase feed enzyme derived from e-coli for the purpose of reducing phosphorus supplementation in low-phosphorus diets, thereby reducing the excretion of phosphorus in swine manure. Performance criteria for evaluation included animal growth performance, bone breaking strength, and mineral balance for phosphorus, calcium, magnesium, iron, copper, and zinc.

**Results**

Results indicate that the new phytase enzyme derived from e-coli was highly efficacious in significantly improving animal growth, bone and mineral balance. In addition, phosphorus excretion in manure was significantly reduced, thereby reducing the quantity of potential pollutants in animal waste.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
307	Animal Management Systems
302	Nutrient Utilization in Animals

**Outcome #5****1. Outcome Measures**

5) New selection tools for the genetic improvement of livestock species will be developed.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Genetic improvement is an important factor for enhancing the economic viability in beef cattle production.

**What has been done**

Scientists at MU develop quantitative methods for genetic evaluation and selection schemes that would be useful in large commercial operations. A computer program has been developed to simulate an alternative Monte Carlo method for constructing a matrix used to create mixed model equations. These equations describe the relationship between sire and progeny.

**Results**

Results from this modeling can be used to develop better genetic selection schemes, thereby improving profitability in the beef cattle industry. Further improvements using these quantitative methods include modeling genetic selection aimed at improving product quality attributes (such as fat content in beef) or traits that improve production efficiency, such as reduced disease susceptibility or improved reproductive traits.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
303	Genetic Improvement of Animals
304	Animal Genome

**V(H). Planned Program (External Factors)****External factors which affected outcomes**

- Public Policy changes
- Government Regulations
- Competing Public priorities

**Brief Explanation****V(I). Planned Program (Evaluation Studies and Data Collection)****1. Evaluation Studies Planned**

- During (during program)

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**Program #3**

**V(A). Planned Program (Summary)**

**1. Name of the Planned Program**

Natural Resources

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			7%	
104	Protect Soil from Harmful Effects of Natural Elements			1%	
111	Conservation and Efficient Use of Water			2%	
112	Watershed Protection and Management			14%	
123	Management and Sustainability of Forest Resources			14%	
125	Agroforestry			10%	
131	Alternative Uses of Land			2%	
133	Pollution Prevention and Mitigation			12%	
135	Aquatic and Terrestrial Wildlife			30%	
605	Natural Resource and Environmental Economics			8%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	12.0	0.0
<b>Actual</b>	0.0	0.0	17.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	2535875	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	2535875	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	13546694	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

Basic and applied research will be conducted to address elucidate underlying principles related to natural resources and to assist in the implementation of efficient, effective management actions to conserve natural resources and ensure the sustainable use of those resources. Research finds will be disseminated via appropriate scientific publications, conferences, workshops, trainings, etc.

**2. Brief description of the target audience**

researchers, scientists, extension specialists, conservation managers, policy makers

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

	<b>Direct Contacts Adults</b>	<b>Indirect Contacts Adults</b>	<b>Direct Contacts Youth</b>	<b>Indirect Contacts Youth</b>
<b>Year</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>Plan</b>	0	0	0	0
2007	0	0	0	0

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

**Year Target**

Plan: 0

2007 : 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Plan</b>			
2007	0	382	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	50	215

**Output #2**

**Output Measure**

- Number of other peer reviewed publications (book chapters, proceedings, abstracts, etc).

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	30	166

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	3	43

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	15	26

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

<b>O No.</b>	<b>OUTCOME NAME</b>
1	Development of new, more efficient strategies to manage renewable natural resources.
2	Develop new economic opportunities related to the sustainable use of natural resources.
3	Develop new techniques for study of ecosystems and constituent communities and species.
4	Enhanced understanding of people's attitudes toward, perceptions of, and use of natural resources.
5	Develop direct solutions to problems related to the human-natural resource interactions.
6	Enhanced understanding of the basic functioning of ecosystems and their constituent communities and species.

**Outcome #1****1. Outcome Measures**

Development of new, more efficient strategies to manage renewable natural resources.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Chestnuts offer new opportunities as an alternative crop using agroforestry practices. Researchers are working to develop a viable chestnut industry in Missouri.

**What has been done**

Work includes cultivar testing and improvement, coupled with associated horticultural management practices. Work will expand to include harvest and processing technology, and marketing. Improvements were made on the replicated, 3 cultivar, research/demonstration orchard at a horticultural research farm. Electric fencing was installed to reduce deer predation and trickle irrigation was installed for use during stress periods and to maximize early growth and development. Chestnut production yield and nut descriptor data were collected on all producing cultivars during the fall. Data collection includes harvest dates, nut weight/size, crop load and yield.

**Results**

Research results, disseminated through the MU Center of Agroforestry website and publications, conferences, and meetings, provide producers with both horticultural and management information for establishing this crop alternative.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
131	Alternative Uses of Land
605	Natural Resource and Environmental Economics

**Outcome #2****1. Outcome Measures**

Develop new economic opportunities related to the sustainable use of natural resources.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

There is a need to tie or overlay human, socioeconomic factors on the natural landscape to get a comprehensive view of land use patterns. More specifically, place becomes its own dimension in characterizing the people and activities in a region, just as location names Bordeaux and Champagne invoke meaning to the regions they represent. Investigators are exploring the relationships between ecological characteristics of landscapes and the socioeconomic characteristics of people in those landscapes.

**What has been done**

Surveys were developed and administered in research study areas in northern and southeastern Missouri, and results were analyzed. With respect to spatial linkages of social and ecological variables, a range of demographic data were linked via GIS (geographic information system) techniques to ecological data for Missouri from the National Hierarchy of Ecological Units.

**Results**

Results improve the understanding between possible associations between demographic groups and certain ecological landscapes in terms of how people and places are related to ecological settings that characterize such places. Results may also help in analysis of data at different levels of geographic scale.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

**Outcome #3****1. Outcome Measures**

Develop new techniques for study of ecosystems and constituent communities and species.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Forestry ecology research is used to determine the influence of factors such as herbivores, fragmentation and fires on natural communities of plants, mammal and insect populations.

**What has been done**

Concerning herbivores, researchers evaluated an 8-year data set of American ginseng to establish the overall effect of deer on this forest species. Both deer browsing and harvesting are problematic, particularly if harvesting is indiscriminate and if deer populations are great. Projections from our data indicate that it may take 15 years for a seedling to produce enough seeds to replace itself.

**Results**

Results of studies yield both basic ecological information and applied management recommendations. Data from our findings have contributed to the USDA Eastern Forest Region conservation assessment and USDI FWS CITES export permit applications policy.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources



**Outcome #4****1. Outcome Measures**

Enhanced understanding of people's attitudes toward, perceptions of, and use of natural resources.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Research on urban ecosystems has gained importance with the increased interest in creating and maintaining cities and metropolitan regions that are ecologically sustainable. Urban wildlife conservation is central to a new emphasis in ecology on the study of urban ecosystems. Ecologists recognize cities and the agricultural and forested areas that surround them as unique ecological places. Furthermore, urban greenspaces within 1 km of home are part of the day-to-day experience of most urban residents. Research on urban ecology involves collaborative efforts by ecologists, physical and social scientists.

**What has been done**

Researchers analyze the relationship between habitat patch size and landscape setting on small mammal species composition and abundance. The effects of management and restoration projects on breeding bird species composition and abundance are evaluated.

**Results**

A better understanding of urban ecology, combined with a better understanding of the social values attached to habitat patches will help in developing a more participatory and inclusionary approach to conservation.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

**Outcome #5****1. Outcome Measures**

Develop direct solutions to problems related to the human-natural resource interactions.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Scientists investigate new alternatives for capturing benefits from woody plant production systems. Work is underway to evaluate the potential for using short-rotation poplars as a source of biomass and as a method of sequestering carbon on floodplain sites in the lower Midwest.

#### What has been done

A project was designed to measure carbon balance and eco-physiology. An eddy covariance flux tower will be installed for measuring ecosystem-level mass and energy exchange. The tower measures net carbon dioxide fluxes over a large area. Independent measures of biomass accumulation through traditional growth monitoring and soil respiration measurements are also being conducted.

#### Results

Results will be useful for policy makers involved in greenhouse gas emission decision-making and for producers searching for alternative crops.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
123	Management and Sustainability of Forest Resources
131	Alternative Uses of Land

#### Outcome #6

##### 1. Outcome Measures

Enhanced understanding of the basic functioning of ecosystems and their constituent communities and species.

##### 2. Associated Institution Types

•1862 Research

##### 3a. Outcome Type:

Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

##### 3c. Qualitative Outcome or Impact Statement

###### Issue (Who cares and Why)

The Great Plains population of piping plovers (*Charadrius melodus*) is listed as threatened or endangered and continues to decline. Research is needed to assess wildlife management in the context of this threatened ecosystem.

###### What has been done

A research team has developed population models that assess the likelihood of the species surviving under the current conditions compared to recently initiated management to exclude predators. Investigators estimated fledging success rates and revised a stochastic simulation model of plover demography to simulate population growth scenarios, with and without predator exclusion.

###### Results

The results suggest that active management of piping plovers nesting areas can be effective in slowing the decline of the population in the Great Plains and even reversing the trend. This feasibility of success should encourage management agencies and managers to proceed with management to exclude nest predators at piping plover breeding sites.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Public Policy changes
- Competing Public priorities

**Brief Explanation**

{No Data Entered}

**V(I). Planned Program (Evaluation Studies and Data Collection)**

**1. Evaluation Studies Planned**

- During (during program)

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**Program #4**

**V(A). Planned Program (Summary)**

**1. Name of the Planned Program**

Food Systems and Biological Engineering

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment			5%	
404	Instrumentation and Control Systems			12%	
405	Drainage and Irrigation Systems and Facilities			3%	
501	New and Improved Food Processing Technologies			34%	
502	New and Improved Food Products			11%	
511	New and Improved Non-Food Products and Processes			6%	
702	Requirements and Function of Nutrients and Other Food Components			14%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			2%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			13%	
<b>Total</b>				100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	2.0	0.0
<b>Actual</b>	0.0	0.0	8.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	253588	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	253588	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1354669	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

Basic and applied research will be conducted and the results disseminated via scientific publications, scientific meetings, workshops, conferences, etc.

**2. Brief description of the target audience**

researchers, scientists, extension specialists, food industry scientists

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

	<b>Direct Contacts Adults</b>	<b>Indirect Contacts Adults</b>	<b>Direct Contacts Youth</b>	<b>Indirect Contacts Youth</b>
<b>Year</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>Plan</b>	0	0	0	0
2007	0	0	0	0

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

<b>Year</b>	<b>Target</b>
<b>Plan:</b>	0
2007 :	2

**Patents listed**

Suppes, G.; Hsieh, F.; Tu, Y.; Kiatsimkul, P. Soy-based polyols. UM Disclosure No. 07UMC029. U.S. Provisional Patent Applications Serial No. 60/857,438 filed 11/07/06.  
 US Patent Application submitted to MU on 'Intracellular Glucose Sensor.' S.A. Grant, M. Milanick, D. Lichlyter, M. Dweik, and K. Arnett. Filing Date: May 2006. #06UMC088

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Plan</b>			
2007	0	96	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1****Output Measure**

- Number of peer reviewed journal articles

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	10	54

**Output #2****Output Measure**

- Number of other peer reviewed publications (book chapters, proceedings, abstracts, etc.)

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	12	41

**Output #3****Output Measure**

- Number of invited papers and invited presentations

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	3	35

**Output #4****Output Measure**

- Number of graduate degrees awarded

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	4	9

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

<b>O No.</b>	<b>OUTCOME NAME</b>
1	Develop new uses and products from biomass - food and nonfood (fuels, plastics, acids, etc).
2	Improve efficiency in conversion processes.
3	Food and water quality – develop sensing tools and assurance systems.
4	Food safety and health – develop biosensing and microbiological technologies.

**Outcome #1****1. Outcome Measures**

Develop new uses and products from biomass - food and nonfood (fuels, plastics, acids, etc).

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Flavor analysis is used to develop new food and improve existing food products.

**What has been done**

Research at MU is directed at characterizing food components with important functional properties, such as flavorful compounds. In particular, flavor and other attributes are being analyzed for reduced fat ice cream, including appearance, flavor (aroma and taste), mouthfeel and aftertaste. Research is focused on developing a scientific approach to analyzing flavor in lower fat ice creams by determining the release of flavor volatiles from ice creams with different fat levels. Sensory thresholds and vapor liquid partition coefficients have been determined. The instrumental and sensory flavor profile of ice creams have also been determined.

**Results**

Results provide information that can be used to reformulate lower fat ice cream that is better tasting and establish a more economical way of determining the changes required in flavorings when fat levels are reduced. Inferences from this work has broader application to other food products as well.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
502	New and Improved Food Products
501	New and Improved Food Processing Technologies

**Outcome #2****1. Outcome Measures**

Improve efficiency in conversion processes.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**



Soybean is a potential source for fulfilling the protein requirements of a growing world population. However, it contains antinutritional factors that must be inactivated before its protein content can be safely and efficiently utilized.

#### What has been done

Researchers at MU study the effect of extrusion conditions on trypsin inhibitor activity (TIA) and nitrogen solubility index (NSI). A laboratory size single screw extruder was used for extrusion cooking of the soybean implementing a 4x4x4 full factorial design. TIA and NSI of the soybean were found to be 47.0 TIU per mg and 78% respectively. Trypsin inhibitor inactivation ranged from 90% of that of raw soybean at lower screw speeds and higher temperatures to 50% for higher screw speeds and lower temperatures.

#### Results

Results indicate that reduction in TIA occurred mainly in the compression and metering sections of the extruder and confirm the efficiency of extrusion cooking for trypsin inhibitor inactivation. This model can be used to optimize extrusion conditions for food and feed purposes, thereby adding value to raw soybeans.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
501	New and Improved Food Processing Technologies
402	Engineering Systems and Equipment

#### Outcome #3

##### 1. Outcome Measures

Food and water quality – develop sensing tools and assurance systems.

##### 2. Associated Institution Types

•1862 Research

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2007	0	0

##### 3c. Qualitative Outcome or Impact Statement

###### Issue (Who cares and Why)

New sensing and imaging techniques have a broad range of medical and biological application.

###### What has been done

Research is directed towards imaging and classification techniques can be developed to use for biological tissue differentiation. Work is also being done on imaging technologies that include green fluorescent protein-based (GFP) biosensing techniques and visual system modeling.

###### Results

The work on imaging and classification methods will lead to new imaging technologies for applications in medicine, agriculture, food and other areas. The GFP-based sensing work will result in new sensing techniques for medical imaging, bioprocessing control and food pathogen detection. The biosystem modeling work will provide a better understanding of the feedback phenomena in biological systems.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems

#### Outcome #4

**1. Outcome Measures**

Food safety and health – develop biosensing and microbiological technologies.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

In the area of food science, probiotics is a growing field that employs new ways to utilize beneficial microbes to improve food nutrition and safety.

**What has been done**

Scientists work to optimize the survival of beneficial organisms in fermented and unfermented dairy and soy products and during passage through the gastrointestinal tract. In the area of food safety, researchers investigate the efficacy of feeding beef cattle microencapsulated probiotic bacteria to analyze the effect on fecal shedding of E. coli O157:7. In vivo studies using mice have been completed to investigate the effects of probiotic-fortified soymilk on specific health aspects, including reducing undesirable microbes in the GI tract, reducing cholesterol and specific fecal enzymes.

**Results**

Consumers are becoming more aware of the benefits of consuming functional foods containing beneficial bacteria. Research in this area will provide much needed information about the viability of probiotics, delivered in various foods, and the health benefits they provide. Regarding food safety, finding ways to decrease the prevalence of E. coli O157:H7 in cattle, prior to slaughter may provide a new tool for reducing the likelihood of bacterial contamination in raw beef.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
702	Requirements and Function of Nutrients and Other Food Components
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

**V(H). Planned Program (External Factors)****External factors which affected outcomes**

- Public Policy changes
- Government Regulations
- Competing Public priorities

**Brief Explanation****V(I). Planned Program (Evaluation Studies and Data Collection)****1. Evaluation Studies Planned**

- During (during program)

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**Program #5****V(A). Planned Program (Summary)****1. Name of the Planned Program**

Agricultural Policy and Rural Development

**V(B). Program Knowledge Area(s)****1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management			35%	
610	Domestic Policy Analysis			40%	
803	Sociological and Technological Change Affecting Individuals, Families and Communities			25%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

Year: 2007	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	3.0	0.0
<b>Actual</b>	0.0	0.0	9.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	1267938	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1267938	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	6773347	0

**V(D). Planned Program (Activity)****1. Brief description of the Activity**

Public policy analysis will be conducted and provided to public agencies at the regional, state and national levels.

Research will be conducted and the results disseminated via scientific publications, scientific meetings, workshops, conferences, etc.

**2. Brief description of the target audience**

researchers, policy makers, public policy analysts

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

**Target for the number of persons (contacts) reached through direct and indirect contact methods**

	<b>Direct Contacts Adults</b>	<b>Indirect Contacts Adults</b>	<b>Direct Contacts Youth</b>	<b>Indirect Contacts Youth</b>
<b>Year</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>Plan</b>	0	0	0	0
2007	0	0	0	0

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

<b>Year</b>	<b>Target</b>
<b>Plan:</b>	0
2007 :	0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Plan</b>			
2007	0	105	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	5	43

**Output #2**

**Output Measure**

- Number of other peer reviewed publications (book chapters, proceedings, abstracts, etc.)

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	4	61

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	1	16

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2007	2	4

**V(G). State Defined Outcomes****V. State Defined Outcomes Table of Content**

<b>O No.</b>	<b>OUTCOME NAME</b>
1	Improve the understanding of potential consequences of alternative policies under consideration.
2	Policy impacts that are more consistent with intended objectives.
3	Improved business structures or organizations.

**Outcome #1****1. Outcome Measures**

Improve the understanding of potential consequences of alternative policies under consideration.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Applied agricultural economics is needed to help decision-makers understand the effects of policies and the implications of recent developments on commodity markets and agricultural producer welfare.

**What has been done**

The Food and Agricultural Policy Research Institute (FAPRI) conducts computer simulation models of the U.S. agricultural economy. Analysts use forecasts on oil, interest rates and other macroeconomics from the private forecasting firm Global Insight for exogenous variables in the computer models. A 10 year baseline scenario is developed using a complex interactive modeling process of all of the major U.S. commodity groups. The baseline scenario can then be modified using alternative policy considerations and the potential impacts of the policies can be examined. Current tax policies that support biofuel production were incorporated into the simulation models. Outcomes on commodity prices varied significantly depending on whether the current policies supporting biofuels were continued beyond 2008 and 2010.

**Results**

Apart from the direct relevance to multi-billion dollar markets for agricultural commodities, the results are also helpful to input suppliers and consumers, domestic and foreign. By successfully communicating results to policy-makers, policy decisions will be better informed.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
610	Domestic Policy Analysis

**Outcome #2****1. Outcome Measures**

Policy impacts that are more consistent with intended objectives.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Policy can have unanticipated consequences. Analysis is needed to anticipate possible unforeseen or unintended outcomes of alternative policies under consideration.

**What has been done**

FAPRI (Food and Agricultural Policy Research Institute) has analyzed the impact of biofuel policy on commodity prices, exports, and agricultural land under production. In addition, biofuel policies have a significant impact on the choice of crops planted, as seen by the dramatic increase in corn acres brought on by increased demand for ethanol production.

**Results**

Policy makers can use the results of alternative policies scenarios, such as required ethanol blending in gasoline, to see the broader impact on prices, markets and consumption in the agricultural sector.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
610	Domestic Policy Analysis

**Outcome #3****1. Outcome Measures**

Improved business structures or organizations.

**2. Associated Institution Types**

•1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2007	0	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Analyzing alternative business structures can give insight into factors which promote or inhibit firm viability and growth in agricultural related fields.

**What has been done**

Researchers study the impact of 'second-generation' biotechnology innovation on the organization of the agricultural value chain and its effects on small producers. This work is directed towards identifying existing network and organizational characteristics that impede or facilitate Missouri and Illinois agricultural producers' adoption of second-generation biotechnology.

**Results**

Results can be used to identify ways that supply-chain participants (firms, trade associations, producer cooperatives) can create more effective network bridges that facilitate adoption of second-generation biotechnology.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families and Communities



**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Natural Disasters (drought,weather extremes,etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

**Brief Explanation**

{No Data Entered}

**V(I). Planned Program (Evaluation Studies and Data Collection)**

**1. Evaluation Studies Planned**

- Other ()

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}