

# 2009 University of Missouri Research Plan of Work

**Status: Accepted**  
**Date Accepted: 06/02/08**

## I. Plan Overview

### 1. Brief Summary about Plan Of Work

Agricultural research assumed new dimensions in the 21st century as a result of advances in science and technology, changes in the global economy and emergence of competing priorities that include heightened concern for the natural and social environments in which agricultural activity takes place.

Advancements in science and technology offer new opportunities to improve all aspects of food and fiber production. For instance, enhanced understanding of plant function at the cellular and molecular levels have allowed researchers to engineer desirable traits in plants such as drought tolerance, novel amino acid profiles and disease resistance. With marker assisted selection, plant breeders have significantly reduced the time it takes to identify and isolate novel traits. Advances in understanding have been made possible by significant innovation in the technologies needed to measure and analyze natural processes that regulate plant and animal functions.

Changes in the character of agricultural research have also been influenced by significant changes in the global economy. In prior decades, the U.S. went unchallenged as the world low cost producer of agricultural products. In today's globally competitive environment, major competitors such as Brazil have emerged as new, low cost, production centers. Our comparative advantage in the future economy relies on investments in basic and translational research that will result in new niches for a vibrant U.S. agricultural sector.

Agricultural research investments in plant and animal agriculture had been dominated by relatively narrow efforts to increase output and enhance efficiency. Today, societal needs are more complex and reflect competing priorities. Agricultural production is now evaluated in the context of environmental stewardship and the public's desire for sustainability. Research into social, economic and environmental implications of agricultural activity, from production through consumption, will continue to expand in the foreseeable future.

These changes in agricultural research are addressed in the portfolio of planned programs for the Missouri Agricultural Experiment Station. Programs in the areas of plant biology and biochemistry, animal biology and production, food systems and biological engineering, natural resources and agricultural policy and rural development represent a wider, integrated spectrum of research efforts than the more narrowly focused quest for increased output in previous times. The Missouri AES research plan of work addresses research efforts from plant and animal biology, through production systems and regional/national policy development. The plan of work integrates efforts from basic to translational research. The companion Missouri Extension plan of work identifies stakeholders and needs which are then communicated through program integration, thereby translating back to research priorities. Integration between the proposed research and extension efforts are shown below.

Research planned program

Goal

Extension planned program

Plant Biology and Biochemistry

Improve understanding of basic plant function and translate into improved plant technologies.

- Mo Crop Management Systems
- Plant Protection for the 21st Century
- Forage Production and Management

- Home Horticulture & Environment

#### Animal Biology and Production

Improve whole animal function & develop innovative animal husbandry practices.

- MO-PORK: Increasing Pork Production in Missouri
- Grass Based Dairy Systems
- Show-Me-Select

#### Natural Resources

Ensure that natural resources are conserved and managed for sustainable use.

- Missouri Master Wildlifer
- Missouri Woodland Steward
- Missouri Master Naturalist

#### Food Systems and Bioengineering

Improve the utilization & delivery of agricultural outputs as high-quality food and nonfood products

- Individual Wastewater Systems
- Watershed Management & Planning

#### Ag Policy and Rural Development

Provide meaningful public and private decision support

- Profit Focused Agriculture
- Facilitating Community Decision Making
- Creating Community Economic Viability
- Community Leadership Development
- Building Inclusive Communities

**Estimated Number of Professional FTEs/SYs total in the State.**

| Year | Extension |      | Research |      |
|------|-----------|------|----------|------|
|      | 1862      | 1890 | 1862     | 1890 |
| 2009 | 0.0       | 0.0  | 42.0     | 0.0  |
| 2010 | 0.0       | 0.0  | 42.0     | 0.0  |
| 2011 | 0.0       | 0.0  | 42.0     | 0.0  |
| 2012 | 0.0       | 0.0  | 42.0     | 0.0  |
| 2013 | 0.0       | 0.0  | 0.0      | 0.0  |

**II. Merit Review Process**

**1. The Merit Review Process that will be Employed during the 5-Year POW Cycle**

- Other (see below )

**2. Brief Explanation**

We will use annual faculty reporting instruments, including individual report of accomplishments and the CSREES progress reports to evaluate the program progress.

**III. Evaluation of Multis & Joint Activities**

**1. How will the planned programs address the critical issues of strategic importance, including those identified by the stakeholders?**

The MO AES research planned program will provide the background research and discovery needed to

- supply extension programs with sound science for applied programs
- add to the body of scientific knowledge through peer reviewed dissemination of results
- prepare graduate students to work in areas of strategic importance
- develop applied solutions for state and regional issues.

**2. How will the planned programs address the needs of under-served and under-represented populations of the State(s)?**

Extension programs (identified elsewhere) that seek to address the needs of under-served and under-represented populations will influence research priorities.

### 3. How will the planned programs describe the expected outcomes and impacts?

By the nature of research results, outcomes and impacts for the research planned programs will be described in qualitative causal affects, rather than quantitative measurements. Quantitative measures standard to research progress, such as peer reviewed publications, will be used to measure program outputs.

### 4. How will the planned programs result in improved program effectiveness and/or efficiency?

Improved efficiency will be gained by more explicitly integrating research and extension functions and facilitating program evaluation by arranging knowledge areas into functional groups.

## IV. Stakeholder Input

### 1. Actions taken to seek stakeholder input that encourages their participation

- Other (see MU Extension Plan of Work)

#### Brief explanation.

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

### 2(A). A brief statement of the process that will be 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 will be 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 will be considered

- Other (see MU Extension Plan of Work)

#### Brief explanation.

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

**V. Planned Program Table of Content**

| S. NO. | PROGRAM NAME                                 |
|--------|--|
| 1      | 1) Plant Biology and Biochemistry            |
| 2      | 2) Animal Biology and Production             |
| 3      | 3) Natural Resources                         |
| 4      | 4) Food Systems and Biological Engineering   |
| 5      | 5) Agricultural Policy and Rural Development |

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

### Program #1

#### 1. Name of the Planned Program

1) Plant Biology and Biochemistry

#### 2. Brief summary about Planned Program

The Missouri AES research portfolio combines basic and applied research to further the discipline of plant biology and to provide information for delivery by extension programs. Understanding the basic functions of plant biology and biochemistry is critical to advancing agricultural science as it relates to plant production and protection. Traditional areas of crop management and breeding are now augmented by basic research that enhances our understanding of plant function at the environmental, whole plant, cellular and gene levels. Research in these areas provides new information about physiological relationships within the plant that ultimately are translated into crop management technologies. Research areas under this planned program include basic plant biology and genomics, pests and diseases affecting plants, abiotic stresses, plant production management and integrated pest management.

3. Program existence : Mature (More than five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

## 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 (Situation and Scope)

#### 1. Situation and priorities

Plants form the basis for Missouri's agricultural and green industries, from the direct production of food for human or animal consumption to their use as factories for novel chemical compounds. Weather, pests, plant genetic background and environmental impacts are four primary aspects of production that influence agricultural production and profitability. AES scientists at MU conduct basic and applied research in these areas to improve plant production systems.

Basic research leads to crop improvement by enhancing the understanding of plant genetics and function. With model system research, investigators use well understood plants, such as Arabidopsis, to increase knowledge of plant function in important processes including resistance to diseases and interactions with the environment. For instance, research in plant response to abiotic stress, such as water deficit, can help lead to crops with improved drought tolerance. Research in cellular signaling pathways is leading to an understanding of plant interactions with both beneficial and harmful microorganisms and insects. Genetic modification of plants with genes to synthesize natural products (biopesticides) or to exhibit resistance to pesticides can lead to decreased dependence on pesticides and thereby reduce negative environmental impacts (eg on water quality).

Ultimately, knowledge gained through basic research gives rise to applied or translational research that improves performance in plant production systems.

Missouri investigators conduct applied research to improve the economic performance of plant production systems and mitigate adverse environmental consequences associated with system inputs. Research in areas such as integrated crop management and plant breeding is transferred by means of extension programs such as the Missouri Crop Management Systems program that uses multiple delivery methods to reach a broad range of learners. The Forage Production and Management extension program is used to educate forage producers on best practices in systems such as management-intensive grazing and pasture-based dairying.

While a variety of crops are grown in Missouri, the major economic drivers in Missouri crop production are soybean and forages. This economic importance is reflected in research priorities at MU. In addition, Missouri ranks 6th in rice production in the US and research efforts to improve plant production management are increasing in importance. Basic research underlying applied plant research continues to be a priority as significant advances in the understanding of plant structure and function leads to improvements in crop production and disease resistance.

Soybean production in Missouri is reduced by biotic and abiotic stresses. Soybean cyst nematode accounts for approximately 50 dollars in yield losses annually. Researchers work in the areas of plant breeding, genomics and plant-microbe interactions to improve disease and nematode resistance, nitrogen fixation and the development of value added soybeans through manipulation of protein and oil content and the amino acid profile.

## 2. Scope of the Program

- Multistate Integrated Research and Extension
- Integrated Research and Extension
- Multistate Research
- In-State Research

## V(D). Planned Program (Assumptions and Goals)

### 1. Assumptions made for the Program

#### Interdisciplinary work -

People will continue to work together –

- 1) across disciplines, divisions and colleges
- 2) with extension personnel so that research results can translated into practical applications.

MU has a rich history and culture of collaborative work. In the plant sciences, researchers from the Division of Plant Sciences, Division of Natural Resources, Division of Biochemistry and the Division of Biological Sciences work together to advance questions related to plant biology. Researchers in crop production and protection have worked closely with the extension faculty in crop and forage programs.

### 2. Ultimate goal(s) of this Program

#### Basic research

- improve understanding of basic plant function
- improve understanding of plant interaction with the biotic and abiotic environment
- manipulate plant genomics to create added value for producers

#### Translational research

- improve drought tolerance in crops
- increase disease and nematode resistance
- develop improved pest management



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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

| Year | Extension |      | Research |      |
|------|-----------|------|----------|------|
|      | 1862      | 1890 | 1862     | 1890 |
| 2009 | 0.0       | 0.0  | 23.0     | 0.0  |
| 2010 | 0.0       | 0.0  | 23.0     | 0.0  |
| 2011 | 0.0       | 0.0  | 23.0     | 0.0  |
| 2012 | 0.0       | 0.0  | 23.0     | 0.0  |
| 2013 | 0.0       | 0.0  | 23.0     | 0.0  |

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

**1. Activity for the Program**

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

**2. Type(s) of methods to be used to reach direct and indirect contacts**

| Extension   |   |
|---|---|
| Direct Methods  | Indirect Methods  |
| <ul style="list-style-type: none"> <li>Other 1 (see MU Extension Plan of Work)</li> </ul> | <ul style="list-style-type: none"> <li>Other 1 (see MU Extension Plan of Work)</li> </ul> |

**3. Description of targeted audience**

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

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

**1. Standard output measures**

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

| Year | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|------|------------------------|--------------------------|-----------------------|-------------------------|
|      | Target                 | Target                   | Target                | Target                  |
| 2009 | 0                      | 0                        | 0                     | 0                       |
| 2010 | 0                      | 0                        | 0                     | 0                       |
| 2011 | 0                      | 0                        | 0                     | 0                       |
| 2012 | 0                      | 0                        | 0                     | 0                       |
| 2013 | 0                      | 0                        | 0                     | 0                       |

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

**Expected Patent Applications**

2009 :0                      2010 :0                      2011 :0                      2012 :0                      2013 :0

**3. Expected Peer Review Publications**

| Year | Research Target | Extension Target | Total |
|------|-----------------|------------------|-------|
| 2009 | 75              | 0                | 0     |
| 2010 | 75              | 0                | 0     |
| 2011 | 75              | 0                | 0     |
| 2012 | 75              | 0                | 0     |
| 2013 | 0               | 0                | 0     |

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

**1. Output Target**

- Number of peer reviewed journal articles

2009 :70                      2010 :70                      2011 :70                      2012 :70                      2013 :0

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

2009 :9                      2010 :9                      2011 :9                      2012 :9                      2013 :0

- Number of invited papers and invited presentations

2009 :2                      2010 :2                      2011 :2                      2012 :2                      2013 :0

- Number of graduate degrees awarded

2009 :7                      2010 :7                      2011 :7                      2012 :7                      2013 :0

**V(I). State Defined Outcome**

| <b>O. No</b> | <b>Outcome Name</b>  |
|--------------|--|
| 1            | Research efforts will result in enhanced understanding of basic aspects of plant physiology and biochemistry. This knowledge will facilitate the development of better cropping management systems and improved plant varieties that have stronger disease or drought resistance, or value added traits. |

**Outcome #1****1. Outcome Target**

Research efforts will result in enhanced understanding of basic aspects of plant physiology and biochemistry. This knowledge will facilitate the development of better cropping management systems and improved plant varieties that have stronger disease or drought resistance, or value added traits.

**2. Outcome Type :** Change in Knowledge Outcome Measure

2009 0

2010 :0

2011 :0

2012 0

2013 :0

**3. Associated Institute Type(s)**

- 1862 Research

**4. Associated Knowledge Area(s)**

- 102 - Soil, Plant, Water, Nutrient Relationships
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 216 - Integrated Pest Management Systems

**V(J). Planned Program (External Factors)****1. External Factors which may affect Outcomes**

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

**Description**

{NO DATA ENTERED}

**V(K). Planned Program (Evaluation Studies and Data Collection)****1. Evaluation Studies Planned**

- During (during program)

**Description**

We will use annual faculty reporting instruments, including individual report of accomplishments and the CSREES progress reports to evaluate the program progress.

**2. Data Collection Methods**

- {NO DATA ENTERED}

**Description**

{NO DATA ENTERED}

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

**Program #2**

**1. Name of the Planned Program**

2) Animal Biology and Production

**2. Brief summary about Planned Program**

The Animal Biology and Production Research Program will encompass both basic and translational research, extending beyond the traditional areas of agriculture to include such disciplines as molecular and cellular biology, immunology, and molecular genetics. The research effort will be diverse and focus on the following objectives: 1) Elucidation of molecular, cellular, and metabolic mechanisms that impact growth, lactation, muscle biology, reproductive efficiency, and well being of livestock species; 2) Production of genetically modified rodent and livestock animals that will benefit human medicine, veterinary medicine, and animal agriculture; 3) Utilization of basic research discoveries to improve whole animal function and to develop innovative animal husbandry practices that will promote food and fiber production.; and 4) Examination of the economic impact of new production practices in commercial livestock and poultry enterprises. Each of the preceding objectives is central to the life sciences research effort in Missouri and has the potential to directly impact the economy of Missouri.

**3. Program existence :** Mature (More than five years)

**4. Program duration :** Long-Term (More than five years)

**5. Expending formula funds or state-matching funds :** Yes

**6. Expending other than formula funds or state-matching funds :** Yes

**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 Production 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 (Situation and Scope)

#### 1. Situation and priorities

Animal agriculture is a very important resource to Missouri. The state has a high inventory (top 10 ranking among states) in the major livestock species. Sales of livestock, poultry and their products contribute \$2 billion annually to the State's income, accounting for over 50% of the total agricultural cash income. One in six jobs in Missouri involves livestock production, processing, transportation or sales. Animal products serve human needs by supplying approximately 3/4 of the protein, 1/3 of the energy and a substantial amount of essential vitamins and minerals in the American diet as well as fiber to be used in the production of clothing. The challenge of providing food and fiber for the ever expanding human population is before us. A thriving and efficient animal agriculture is essential to aid in meeting these challenges of the 21st century.

The research effort will focus on both basic and translational approaches. Research in animal reproduction, forage utilization, ruminant nutrition and swine nutrition/production will be transferred to end users through the following extension programs: Show-Me Select Heifer Program, Forage Production Management, Pasture Based Dairy, and Mo-Pork (Increasing pork production in Missouri).

**2. Scope of the Program**

- Integrated Research and Extension
- Multistate Research
- Multistate Integrated Research and Extension
- In-State Research

**V(D). Planned Program (Assumptions and Goals)**

**1. Assumptions made for the Program**

Animal agriculture will continue to be a major industry in Missouri.

The need for continued development of efficient, sustainable, and economical animal production practices will continue to be a high priority.

Research opportunities for new uses of livestock species, e.g., xenotransplantation of pig organs to humans, will continue.

The Animal Biology and Production Research Program will continue to be a scientifically diverse program with the ability to address research problems from the molecular to whole animal level.

**2. Ultimate goal(s) of this Program**

To continue utilizing basic research discoveries to improve whole animal function and to develop innovative animal husbandry practices that will promote food and fiber production.

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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

| Year | Extension |      | Research |      |
|------|-----------|------|----------|------|
|      | 1862      | 1890 | 1862     | 1890 |
| 2009 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2010 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2011 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2012 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2013 | 0.0       | 0.0  | 15.0     | 0.0  |

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

**1. Activity for the Program**

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

**2. Type(s) of methods to be used to reach direct and indirect contacts**

| Extension   |   |
|---|---|
| Direct Methods  | Indirect Methods  |
| <ul style="list-style-type: none"> <li>● Other 1 (see MU Extension Plan of Work)</li> </ul> | <ul style="list-style-type: none"> <li>● Other 1 (see MU Extension Plan of Work)</li> </ul> |

**3. Description of targeted audience**

researchers, scientists, extension specialists, livestock producers

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

**1. Standard output measures**

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

|      | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|------|------------------------|--------------------------|-----------------------|-------------------------|
| Year | Target                 | Target                   | Target                | Target                  |
| 2009 | 0                      | 0                        | 0                     | 0                       |
| 2010 | 0                      | 0                        | 0                     | 0                       |
| 2011 | 0                      | 0                        | 0                     | 0                       |
| 2012 | 0                      | 0                        | 0                     | 0                       |
| 2013 | 0                      | 0                        | 0                     | 0                       |

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

**Expected Patent Applications**

**2009 :1                      2010 :1                      2011 :1                      2012 :0                      2013 :0**

**3. Expected Peer Review Publications**

| Year | Research Target | Extension Target | Total |
|------|-----------------|------------------|-------|
| 2009 | 150             | 0                | 0     |
| 2010 | 150             | 0                | 0     |
| 2011 | 150             | 0                | 0     |
| 2012 | 150             | 0                | 0     |
| 2013 | 0               | 0                | 0     |

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

**1. Output Target**

- Number of peer reviewed journal articles

**2009 :80                      2010 :80                      2011 :80                      2012 :80                      2013 :0**

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

**2009 :70                      2010 :70                      2011 :70                      2012 :70                      2013 :0**

- Number of invited papers and invited presentations

**2009 :12                      2010 :12                      2011 :12                      2012 :12                      2013 :0**

- Number of graduate degrees awarded

**2009 :15                      2010 :15                      2011 :15                      2012 :15                      2013 :0**



**V(I). State Defined Outcome**

| <b>O. No</b> | <b>Outcome Name</b>   |
|--------------|---|
| 1            | The research efforts will result in new knowledge that will improve our understanding of animal physiology, genetics, reproduction, nutrition, growth, and animal well being. This knowledge will be translated to better animal production practices. In addition, students will be trained for positions in animal production, industry, government, and research/teaching. |

**Outcome #1****1. Outcome Target**

The research efforts will result in new knowledge that will improve our understanding of animal physiology, genetics, reproduction, nutrition, growth, and animal well being. This knowledge will be translated to better animal production practices. In addition, students will be trained for positions in animal production, industry, government, and research/teaching.

**2. Outcome Type :** Change in Knowledge Outcome Measure

2009 0

2010 :0

2011 :0

2012 0

2013 :0

**3. Associated Institute Type(s)**

- 1862 Research

**4. Associated Knowledge Area(s)**

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 303 - Genetic Improvement of Animals
- 304 - Animal Genome
- 305 - Animal Physiological Processes
- 306 - Environmental Stress in Animals
- 307 - Animal Production Management Systems
- 308 - Improved Animal Products (Before Harvest)
- 311 - Animal Diseases
- 314 - Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

**V(J). Planned Program (External Factors)****1. External Factors which may affect Outcomes**

- Public Policy changes
- Competing Public priorities
- Government Regulations

**Description**

{NO DATA ENTERED}

**V(K). Planned Program (Evaluation Studies and Data Collection)****1. Evaluation Studies Planned**

- During (during program)

**Description**

We will use annual faculty reporting instruments, including individual report of accomplishments and the CSREES progress reports to evaluate the program progress.

**2. Data Collection Methods**

- {NO DATA ENTERED}

**Description**

{NO DATA ENTERED}

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

**Program #3**

**1. Name of the Planned Program**

3) Natural Resources

**2. Brief summary about Planned Program**

The Natural Resources research program plans basic and applied research efforts within and across disciplines to understand the underlying principles related natural resources and the sustainable management of those resources. This research will address vitally important issues related to the conservation and sustainable use of natural resources. Those resources are essential to the economic, psycho-social, health needs of people. Increasing human populations put greater demands and stress on natural resources. There are widespread needs to restore, conserve, and effectively manage natural resources. To do so requires basic understanding of those natural resources.

**3. Program existence :** Mature (More than five years)

**4. Program duration :** Long-Term (More than five years)

**5. Expending formula funds or state-matching funds :** Yes

**6. Expending other than formula funds or state-matching funds :** Yes

**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 (Situation and Scope)

#### 1. Situation and priorities

Human populations continue to grow and place increasing demands on natural resources for economic and social betterment. To maintain a sustainable supply of natural resources for economic and social purposes, there is a need to understand the basic functioning of ecosystems and their constituent communities and species. There also is need to develop effective, efficient management strategies to ensure the health and sustainable use of those natural ecosystems and constituent parts.

#### 2. Scope of the Program

- In-State Research
- Integrated Research and Extension
- Multistate Integrated Research and Extension
- Multistate Research

**V(D). Planned Program (Assumptions and Goals)**

**1. Assumptions made for the Program**

- The conservation and sustainable use of natural resources will be a high priority for the State of Missouri and the nation.
- The human population will continue to increase, putting increased pressure on natural resources. •Problems related to natural resource use can be positively addressed by the scientific method.

**2. Ultimate goal(s) of this Program**

To protect the integrity of natural systems so as to ensure that natural resources are conserved and managed for sustainable use for the economic and social benefits of people.

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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

| Year | Extension |      | Research |      |
|------|-----------|------|----------|------|
|      | 1862      | 1890 | 1862     | 1890 |
| 2009 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2010 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2011 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2012 | 0.0       | 0.0  | 15.0     | 0.0  |
| 2013 | 0.0       | 0.0  | 15.0     | 0.0  |

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

**1. Activity for the Program**

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. Type(s) of methods to be used to reach direct and indirect contacts**

| Extension   |   |
|---|---|
| Direct Methods  | Indirect Methods  |
| <ul style="list-style-type: none"> <li>● Other 1 (see MU Extension Plan of Work)</li> </ul> | <ul style="list-style-type: none"> <li>● Other 1 (see MU Extension Plan of Work)</li> </ul> |

**3. Description of targeted audience**

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

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

**1. Standard output measures**

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

|      | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|------|------------------------|--------------------------|-----------------------|-------------------------|
| Year | Target                 | Target                   | Target                | Target                  |
| 2009 | 0                      | 0                        | 0                     | 0                       |
| 2010 | 0                      | 0                        | 0                     | 0                       |
| 2011 | 0                      | 0                        | 0                     | 0                       |
| 2012 | 0                      | 0                        | 0                     | 0                       |
| 2013 | 0                      | 0                        | 0                     | 0                       |

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

**Expected Patent Applications**

**2009 :0                      2010 :0                      2011 :0                      2012 :0                      2013 :0**

**3. Expected Peer Review Publications**

| Year | Research Target | Extension Target | Total |
|------|-----------------|------------------|-------|
| 2009 | 70              | 0                | 0     |
| 2010 | 70              | 0                | 0     |
| 2011 | 70              | 0                | 0     |
| 2012 | 70              | 0                | 0     |
| 2013 | 0               | 0                | 0     |

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

**1. Output Target**

- Number of peer reviewed journal articles

**2009 :50                      2010 :50                      2011 :50                      2012 :50                      2013 :0**

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

**2009 :30                      2010 :30                      2011 :30                      2012 :30                      2013 :0**

- Number of invited papers and invited presentations

**2009 :3                      2010 :3                      2011 :3                      2012 :3                      2013 :0**

- Number of graduate degrees awarded

**2009 :15                      2010 :15                      2011 :15                      2012 :15                      2013 :0**

**V(I). State Defined Outcome**

| <b>O. No</b> | <b>Outcome Name</b>  |
|--------------|--|
| 1            | Research results will improve understanding of management and conservation of natural resources - including water, soil, forests and wildlife. Research will also lead to an improved understanding of the natural environment, ecosystems, weather and climate. |

**Outcome #1****1. Outcome Target**

Research results will improve understanding of management and conservation of natural resources - including water, soil, forests and wildlife. Research will also lead to an improved understanding of the natural environment, ecosystems, weather and climate.

**2. Outcome Type :** Change in Knowledge Outcome Measure

2009 0

2010 :0

2011 :0

2012 0

2013 :0

**3. Associated Institute Type(s)**

- 1862 Research

**4. Associated Knowledge Area(s)**

- 101 - Appraisal of Soil Resources
- 104 - Protect Soil from Harmful Effects of Natural Elements
- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management
- 123 - Management and Sustainability of Forest Resources
- 125 - Agroforestry
- 131 - Alternative Uses of Land
- 133 - Pollution Prevention and Mitigation
- 135 - Aquatic and Terrestrial Wildlife
- 605 - Natural Resource and Environmental Economics

**V(J). Planned Program (External Factors)****1. External Factors which may affect Outcomes**

- Public Policy changes
- Competing Public priorities

**Description**

{NO DATA ENTERED}

**V(K). Planned Program (Evaluation Studies and Data Collection)****1. Evaluation Studies Planned**

- During (during program)

**Description**

We will use annual faculty reporting instruments, including individual report of accomplishments and the CSREES progress reports to evaluate the program progress.

**2. Data Collection Methods**

- {NO DATA ENTERED}

**Description**

{NO DATA ENTERED}



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

**Program #4**

**1. Name of the Planned Program**

4) Food Systems and Biological Engineering

**2. Brief summary about Planned Program**

The Food Systems and Bioengineering program includes multiple research areas that are a part of a broad range of activities needed to convert agricultural biomass (plants and animals) into useful products. Researchers in this program work to develop methods and processes to create food products and nonfood products (such as biomass based plastics, foams and fuels). They also develop sensing and processing technologies to ensure the quality, safety and healthfulness of the products.

**3. Program existence :** Mature (More than five years)

**4. Program duration :** Long-Term (More than five years)

**5. Expending formula funds or state-matching funds :** Yes

**6. Expending other than formula funds or state-matching funds :** Yes

**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 (Situation and Scope)

#### 1. Situation and priorities

Priorities fall under two main categories: helping consumers by 1) developing better, safer food and 2) increasing opportunities for Missouri agricultural producers by developing new and more efficient uses for their output. Food safety and nutrient value are a major public interest as reflected in the national goal of securing a safe and secure food and fiber system. The desire to decrease dependency on fossil fuels is a national priority and represents new opportunities to develop renewable biomass based sources of energy.

#### 2. Scope of the Program

- In-State Research
- Multistate Research
- Multistate Integrated Research and Extension
- Integrated Research and Extension

### V(D). Planned Program (Assumptions and Goals)

#### 1. Assumptions made for the Program

Research will lead to the development of new products, more efficient processes and food products with improved safety and nutrition.

Interest in developing renewable biomass based sources of energy will continue or increase.

**2. Ultimate goal(s) of this Program**

Improve the utilization and delivery of agricultural outputs as high-quality food and nonfood products to consumers in a safe, efficient and environmentally friendly manner.

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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

| Year | Extension |      | Research |      |
|------|-----------|------|----------|------|
|      | 1862      | 1890 | 1862     | 1890 |
| 2009 | 0.0       | 0.0  | 8.0      | 0.0  |
| 2010 | 0.0       | 0.0  | 8.0      | 0.0  |
| 2011 | 0.0       | 0.0  | 8.0      | 0.0  |
| 2012 | 0.0       | 0.0  | 8.0      | 0.0  |
| 2013 | 0.0       | 0.0  | 8.0      | 0.0  |

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

**1. Activity for the Program**

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

**2. Type(s) of methods to be used to reach direct and indirect contacts**

| Extension   |   |
|---|---|
| Direct Methods  | Indirect Methods  |
| <ul style="list-style-type: none"> <li>Other 1 (see MU Extension Plan of Work)</li> </ul> | <ul style="list-style-type: none"> <li>Other 1 (see MU Extension Plan of Work)</li> </ul> |

**3. Description of targeted audience**

researchers, scientists, extension specialists, food industry scientists

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

**1. Standard output measures**

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

|      | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|------|------------------------|--------------------------|-----------------------|-------------------------|
| Year | Target                 | Target                   | Target                | Target                  |
| 2009 | 0                      | 0                        | 0                     | 0                       |
| 2010 | 0                      | 0                        | 0                     | 0                       |
| 2011 | 0                      | 0                        | 0                     | 0                       |
| 2012 | 0                      | 0                        | 0                     | 0                       |
| 2013 | 0                      | 0                        | 0                     | 0                       |

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

**Expected Patent Applications**

**2009 :0                      2010 :0                      2011 :0                      2012 :0                      2013 :0**

**3. Expected Peer Review Publications**

| Year | Research Target | Extension Target | Total |
|------|-----------------|------------------|-------|
| 2009 | 20              | 0                | 0     |
| 2010 | 20              | 0                | 0     |
| 2011 | 20              | 0                | 0     |
| 2012 | 20              | 0                | 0     |
| 2013 | 0               | 0                | 0     |

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

**1. Output Target**

- Number of peer reviewed journal articles

**2009 :10                      2010 :10                      2011 :10                      2012 :10                      2013 :0**

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

**2009 :12                      2010 :12                      2011 :12                      2012 :12                      2013 :0**

- Number of invited papers and invited presentations

**2009 :3                      2010 :3                      2011 :3                      2012 :3                      2013 :0**

- Number of graduate degrees awarded

**2009 :4                      2010 :4                      2011 :4                      2012 :4                      2013 :0**

**V(I). State Defined Outcome**

| <b>O. No</b> | <b>Outcome Name</b>  |
|--------------|--|
| 1            | Research will lead to the development of new technologies, processes and products to improve food and nonfood uses of biomass. |

**Outcome #1**

**1. Outcome Target**

Research will lead to the development of new technologies, processes and products to improve food and nonfood uses of biomass.

**2. Outcome Type :** Change in Knowledge Outcome Measure

|        |         |         |        |         |
|--------|---------|---------|--------|---------|
| 2009 0 | 2010 :0 | 2011 :0 | 2012 0 | 2013 :0 |
|--------|---------|---------|--------|---------|

**3. Associated Institute Type(s)**

- 1862 Research

**4. Associated Knowledge Area(s)**

- 402 - Engineering Systems and Equipment
- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 511 - New and Improved Non-Food Products and Processes
- 702 - Requirements and Function of Nutrients and Other Food Components

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

**1. External Factors which may affect Outcomes**

- Competing Public priorities
- Government Regulations
- Public Policy changes

**Description**

{NO DATA ENTERED}

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

**1. Evaluation Studies Planned**

- During (during program)

**Description**

We will use annual faculty reporting instruments, including individual report of accomplishments and the CSREES progress reports to evaluate the program progress.

**2. Data Collection Methods**

- {NO DATA ENTERED}

**Description**

{NO DATA ENTERED}

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

**Program #5**

**1. Name of the Planned Program**

5) Agricultural Policy and Rural Development

**2. Brief summary about Planned Program**

AES research in applied social sciences is built around the broad theme of public and private decision support. On the public side, faculty conduct research that helps public decision makers improve the process of making policy choices. Stakeholders include the US Congress, Missouri government agencies and several levels of local /regional governments. For example, investigators work directly with the US Congress to provide analysis of different public policy choices in the area of agricultural and rural policy. Their approach is not to develop policy options themselves but rather to provide the best possible analysis of the consequences of different options being proposed which should ultimately result in improved decision making.

On the private side, research focuses on studying how firms/organizations operate and how decision support tools can be harnessed to provide for improved efficiency and better economic returns. In this area "firms" can range from a single farm to much larger organizations such as cooperatives and other agribusiness enterprises. One example of work being done in this area is analysis of the governance and structure of agricultural cooperatives. Cooperatives, as a business unit, have some unique organizational and governance challenges which are largely ignored in business schools.

**3. Program existence :** Mature (More than five years)

**4. Program duration :** Long-Term (More than five years)

**5. Expending formula funds or state-matching funds :** Yes

**6. Expending other than formula funds or state-matching funds :** Yes

**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 (Situation and Scope)**

**1. Situation and priorities**

The global economy has made competition in the food and agricultural sector a fact of life. Organizations (whether firms or farms) must be efficient and look for ways to add value to what they produce. Due to the high cost of labor and land in the United States, it will be increasingly difficult to be a "low cost" producer in the global context. Therefore, firms operating in the food sector are going to need new strategies for generating profit.

In the public sector increased pressure for reduced government spending, the specter of massive budget deficits and the general push towards making more efficient use of government tax revenue all point to the need for the development of decision support systems that improve policy decision making.

**2. Scope of the Program**

- In-State Research
- Integrated Research and Extension
- Multistate Integrated Research and Extension
- Multistate Research

**V(D). Planned Program (Assumptions and Goals)**

**1. Assumptions made for the Program**

Public policy will continue to be a major component in the agricultural sector and the need for information will persist.

Better public policy decisions can be made with better information.

**2. Ultimate goal(s) of this Program**

To provide public and private decision makers with information which will allow them to make improved decisions for the long term betterment of public policy or firm efficiency.

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

**1. Estimated Number of professional FTE/SYs to be budgeted for this Program**

| Year | Extension |      | Research |      |
|------|-----------|------|----------|------|
|      | 1862      | 1890 | 1862     | 1890 |
| 2009 | 0.0       | 0.0  | 6.0      | 0.0  |
| 2010 | 0.0       | 0.0  | 6.0      | 0.0  |
| 2011 | 0.0       | 0.0  | 6.0      | 0.0  |
| 2012 | 0.0       | 0.0  | 6.0      | 0.0  |
| 2013 | 0.0       | 0.0  | 6.0      | 0.0  |

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

**1. Activity for the Program**

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. Type(s) of methods to be used to reach direct and indirect contacts**

| Extension                                 |   |
|---|---|
| Direct Methods                            | Indirect Methods                          |
| ● Other 1 (see MU Extension Plan of Work) | ● Other 1 (see MU Extension Plan of Work) |



**3. Description of targeted audience**

researchers, policy makers, public policy analysts

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

**1. Standard output measures**

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

|      | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|------|------------------------|--------------------------|-----------------------|-------------------------|
| Year | Target                 | Target                   | Target                | Target                  |
| 2009 | 0                      | 0                        | 0                     | 0                       |
| 2010 | 0                      | 0                        | 0                     | 0                       |
| 2011 | 0                      | 0                        | 0                     | 0                       |
| 2012 | 0                      | 0                        | 0                     | 0                       |
| 2013 | 0                      | 0                        | 0                     | 0                       |

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

**Expected Patent Applications**

**2009 :0                      2010 :0                      2011 :0                      2012 :0                      2013 :0**

**3. Expected Peer Review Publications**

| Year | Research Target | Extension Target | Total |
|------|-----------------|------------------|-------|
| 2009 | 8               | 0                | 0     |
| 2010 | 8               | 0                | 0     |
| 2011 | 8               | 0                | 0     |
| 2012 | 8               | 0                | 0     |
| 2013 | 0               | 0                | 0     |

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

**1. Output Target**

- Number of peer reviewed journal articles

**2009 5                      2010 5                      2011 :5                      2012 5                      2013 0**

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

**2009 4                      2010 4                      2011 :4                      2012 4                      2013 0**

- Number of invited papers and invited presentations

**2009 1                      2010 1                      2011 :1                      2012 1                      2013 0**

- Number of graduate degrees awarded

**2009 2                      2010 2                      2011 :2                      2012 2                      2013 0**

**V(I). State Defined Outcome**

| <b>O. No</b> | <b>Outcome Name</b>  |
|--------------|--|
| 1            | Research will improve understanding of social and economic factors, such as ag policy and business organizations, that effect agriculture and rural communities. |

**Outcome #1**

**1. Outcome Target**

Research will improve understanding of social and economic factors, such as ag policy and business organizations, that effect agriculture and rural communities.

**2. Outcome Type :** Change in Knowledge Outcome Measure

|        |         |         |        |         |
|--------|---------|---------|--------|---------|
| 2009 0 | 2010 :0 | 2011 :0 | 2012 0 | 2013 :0 |
|--------|---------|---------|--------|---------|

**3. Associated Institute Type(s)**

- 1862 Research

**4. Associated Knowledge Area(s)**

- 601 - Economics of Agricultural Production and Farm Management
- 610 - Domestic Policy Analysis
- 803 - Sociological and Technological Change Affecting Individuals, Families and Communities

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

**1. External Factors which may affect Outcomes**

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

**Description**

{NO DATA ENTERED}

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

**1. Evaluation Studies Planned**

- Other ()

**Description**

We will use annual faculty reporting instruments, including individual report of accomplishments and the CSREES progress reports to evaluate the program progress.

**2. Data Collection Methods**

- {NO DATA ENTERED}

**Description**

{NO DATA ENTERED}