

# 2010 University of Missouri Research Annual Report of Accomplishments and Results

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## I. Report Overview

### 1. Executive Summary

During the second half of 2010 there were dramatic increases in world food prices, resulting from tight supplies and strong demand for agricultural commodities. The price of corn more than doubled over that time period. According to a report recently released by the World Bank, food prices are at dangerous levels, pushing millions into extreme poverty and contributing to political instability.

These conditions underscore the relevance of the NIFA priority - Global Food Security and Hunger - and focus attention on the need for basic and applied research to provide the scientific innovations necessary to keep up with the demand for agricultural products. Increasing the productivity in plant and animal agriculture is key to getting the most out of limited resources. Researchers at MU are developing new production methods using central pivot irrigation that will expand the area where rice can be produced. By expanding production possibilities for rice - a food staple for over half the world's population, this research can help improve the ability of producers to respond to changes in rice demand. In animal research, scientists are analyzing the function of proteins at the cellular level for insight into traits that determine feed efficiency. Results will facilitate selective breeding for improved feed efficiency, thereby improving economic returns, especially important in face of rising feed prices.

In the priority area of sustainable energy, MU researchers are developing alternative crops to use in place of corn in ethanol production. This research is particularly timely given current corn prices and represents the next generation of biofuels based on non-food crops. In the area of food safety, food scientists at MU are developing a faster and more accurate way to test poultry and eggs for live salmonella contamination. And in order to improve health in the fight against obesity, researchers are developing a soybean variant that provides a healthy alternative to trans fat. Finally, under the planned program that addresses quality of life, the Missouri Hunger Atlas 2010 was created to evaluate the breadth and extent of "food insecurity" at the county level, and the performance of public and private programs in meeting hunger need.

#### **Notes about the process used to reorganize this Annual Report under the NIFA National Priorities.**

This Annual Report has been reorganized along the prescribed focus areas. To accomplish this reorganization, the titles of existing programs were edited and the knowledge areas, outputs and outcomes were realigned under the new structure, following guidelines in the December 2009 Beachy memo. This reorganization was functionally achieved by remapping the knowledge areas to the high-priority focus areas. Because PI's classify their station projects by Knowledge Areas (KAs), it was straightforward to realign the associated outputs, such as peer reviewed publications, with the high-priority focus areas. Because it was not possible to delete previous state defined outcomes in the Annual Report, the option "Not reporting on this outcome" was used and "Previously Unknown Outcome Measure" was used to add the relevant outcome of the new program. Specifically, the State Defined Outcome #1, should be ignored in the Climate Change, Childhood Obesity, Food Safety, and Natural Resources planned programs because they are vestiges of a previous, unrelated planned program.

In addition to the five high-priority areas, an additional program "Natural Resources and Quality of Life" was added since activity in this program was not well categorized under any of the five high-priority areas. Because the available choices in the KA listing do not fully represent work in the Sustainable Energy area, some interpretation, beyond KAs, was used to better capture outputs in this area.

Lastly, the reorganization of the POW and annual report has caused a disconnect between targets pre-populated from the vestiges of the prior planned program into the current priority planned programs. Therefore, target values in the Annual Report of Accomplishments will not have appropriate meaning until the 2011 annual report in which the targets align with the high priority planned programs.

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	71.0	0.0
Actual	0.0	0.0	77.0	0.0

**II. Merit Review Process**

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

- Internal University Panel
- External University Panel
- External Non-University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review
- Other (see below )

**2. Brief Explanation**

Annual faculty reporting instruments, including individual report of accomplishments and the NIFA 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 2010.

**III. Stakeholder Input**

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Survey specifically with non-traditional groups

- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public
- Other (see MU Extension Plan of Work)

**Brief explanation.**

MU Extension sought input from traditional and non-traditional stakeholder groups by invitation and survey processes.

**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
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys
- Other

**Brief explanation.**

Program administrators met with commodity groups and advisory boards to collect their input.

**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**

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Survey of the general public
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public
- Other (see MU Extension Plan of Work)

**Brief explanation.**

{NO DATA ENTERED}

**3. A statement of how the input will be considered**

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities
- Other (see MU Extension Plan of Work)

**Brief explanation.**

MU Extension personnel share results of the stakeholder input process with AES researchers. Most faculty appointments include both research and extension responsibilities, further strengthening the linkages between extension and research.

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

{NO DATA ENTERED}

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	5454425	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	5454424	0
<b>Actual Matching</b>	0	0	5454424	0
<b>Actual All Other</b>	0	0	54550290	0
<b>Total Actual Expended</b>	0	0	65459138	0

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

## V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Global Food Security and Hunger
2	Climate Change
3	Sustainable Energy
4	Childhood Obesity
5	Food Safety
6	Natural Resources and Quality of Life

**Add previously unplanned program**

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

**Program # 1**

**1. Name of the Planned Program**

Global Food Security and Hunger

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

**1. Program Knowledge Areas and Percentage**

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
201	Plant Genome, Genetics, and Genetic Mechanisms			8%	
202	Plant Genetic Resources			3%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			7%	
205	Plant Management Systems			7%	
206	Basic Plant Biology			9%	
211	Insects, Mites, and Other Arthropods Affecting Plants			3%	
212	Pathogens and Nematodes Affecting Plants			8%	
216	Integrated Pest Management Systems			3%	
301	Reproductive Performance of Animals			10%	
302	Nutrient Utilization in Animals			5%	
303	Genetic Improvement of Animals			3%	
304	Animal Genome			5%	
305	Animal Physiological Processes			4%	
306	Environmental Stress in Animals			3%	
307	Animal Management Systems			2%	
311	Animal Diseases			5%	
404	Instrumentation and Control Systems			3%	
601	Economics of Agricultural Production and Farm Management			5%	
602	Business Management, Finance, and Taxation			2%	
610	Domestic Policy Analysis			5%	
	<b>Total</b>			100%	

**Add knowledge area**

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

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	24.0	0.0
Actual	0.0	0.0	47.0	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	3811624	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	3811624	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	34451617	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**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010  
 Plan: 0  
 Actual: 5

**Patents listed**

Methods and Compoisitons for Evaluation of Fertility (Thioredoxin-Based Sperm Quality Assay). PS & Antonio Miranda-Vizuete, Co-inventors; US patent #7,485,430 B2

Cai L, JF Taylor, K-A Smyth, B Findeisen, C Lehn, SLF Davis and SK Davis. 2009. Quantitative trait loci and somatostatin. U.S. Patent #7,585,956.

J.A. Viator, R.M. Weight, P.S. Dale, P. Sutovsky, Continuation in Part, ?Photoacoustic detection device and method?, U.S. Patent Application No. 60/819,941

Prather, R.S., B.N. Day & R. Hawley. Knockout swine and methods for making the same" U.S. #7,547,816

US Patent #7,575,861 Compositions and method for accurate early pregnancy diagnosis M. C. Lucy and N. Mathialagan

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

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
Plan	0	100	
Actual	0	326	0

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

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	85	215

**Output #2**

**Output Measure**

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

Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	9	87

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	40	160

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	12	43

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
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.
2	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 and improved animal production efficiency. In addition, students will be trained for positions in animal production, industry, government, and research/teaching.

**Add Cross-cutting Outcome/Impact Statement or Unintended or Previously Unknown Outcome Measure**

### **Outcome #1**

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

Not Reporting on this Outcome Measure

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. Associated Institution Types**

1862 Research

#### **3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	0	0

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

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

Rice is the critical staple for over half of the world population. Accordingly, rice shortages can lead to hunger and starvation in countries across the world. Under conventional practices, areas where rice can be grown are limited to fields that can be flooded during the production cycle. Developing alternative production methods could increase the acreage where it is possible to grow rice.

##### **What has been done**

Researchers at the University of Missouri are conducting experiments to grow rice in areas where it has not been grown before, using center-pivot sprinkler irrigation. The researchers at MU's Delta Research Center in Portageville planted two rice varieties and one rice hybrid with several combinations of irrigation, fertilizers and herbicides to see which programs worked best under the overhead watering system. One critical test was weed control. In conventional rice growing, flooding fields helps drown unwanted weeds such as pigweeds. The researchers tried various brands and amounts of herbicides. Of the 46 herbicide combination tested, four types stood out as being most effective.

##### **Results**

Research will be ongoing across years to evaluate costs, yields and economic returns of growing rice with center-pivot irrigation. Initial results suggest that this new technique may allow farmers to produce the crop in areas where it cannot be grown now, helping produce more food for a hungry world.

#### 4. Associated Knowledge Areas

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 202 - Plant Genetic Resources
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 216 - Integrated Pest Management Systems
- 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 Management Systems
- 311 - Animal Diseases
- 404 - Instrumentation and Control Systems
- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 610 - Domestic Policy Analysis

#### Outcome #2

##### 1. Outcome Measures

- Not Reporting on this Outcome Measure

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 and improved animal production efficiency. In addition, students will be trained for positions in animal production, industry, government, and research/teaching.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

In cattle production, feed constitutes approximately 60 percent of production costs. Unprecedented prices for corn and other commodities in 2010 will increase this percentage, making feed efficiency even more important to the economic returns in cattle. Increased feed efficiency translates into improved profitability to cattle producers.

#### What has been done

A team of animal scientists at the University of Missouri are doing research to determine what traits influence a cow's feed efficiency. At the cellular level, these researchers study the electron transport chain, which synthesizes ATP, adenosine triphosphate, within the cell mitochondria to determine which animals synthesize ATP faster and more efficiently than other animals. The researchers think that they know the genetic traits of the more efficient cows. In order to verify this hypothesis, cows are tagged with an electronic ID in the ear so that precise measurements of feed intake and body weight can be collected and compared to a control group.

#### Results

Conventional methods of measuring feed intake and periodic weighing does not yield the precise data needed to effectively evaluate feed efficiency. The research results will add to the understanding of the role of proteins in the electron transport chain. And because these traits are inheritable, selective breeding can lead to significantly improved feed efficiency and thus improved returns to cattle producers.

### 4. Associated Knowledge Areas

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 202 - Plant Genetic Resources
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 205 - Plant Management Systems
- 206 - Basic Plant Biology
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 216 - Integrated Pest Management Systems
- 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 Management Systems

- 311 - Animal Diseases
- 404 - Instrumentation and Control Systems
- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 610 - Domestic Policy Analysis

#### **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
- Populations changes (immigration, new cultural groupings, etc.)
- Other

##### **Brief Explanation**

{No Data Entered}

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

##### **(OPTIONAL SECTION)**

##### **1. Evaluation Studies Planned**

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention
- Other

## **Evaluation Results**

Individual faculty were reviewed by their respective Division Directors. Faculty submitted their research goals and accomplishments. Besides evaluating individual progress, the Division Directors reviewed research progress and accomplishments in the context of the planned program. Results show continued progress in both basic and applied research.

Points of evaluation included the following:

Research focus: Was it relevant and consistent with the objectives of the planned program?

Successful scholarship: Were research results conveyed through peer reviewed publications?

Successful grantsmanship: Was the research quality high enough to successfully compete for external grant funds?

## **Key Items of Evaluation**

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

**Program # 2**

**1. Name of the Planned Program**

Climate Change

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

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
132	Weather and Climate			100%	
	<b>Total</b>			100%	

Add knowledge area

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

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	9.0	0.0
Actual	0.0	0.0	2.0	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	134513	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	134513	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1215411	0

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

**1. Brief description of the Activity**

Models of long range forecasting and climate change will be developed and results disseminated via scientific publications, scientific meetings, websites, workshops, conferences, etc.

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

Researchers, atmospheric scientists, agricultural scientists, agricultural producers, extension specialists.

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

**1. Standard output measures**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	0	0	0	0
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010  
 Plan: 0  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
<b>Plan</b>	0	25	
<b>Actual</b>	0	10	0

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

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles
- Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	12	9

**Output #2**

**Output Measure**

- Number of other peer reviewed publications (book chapters, proceedings, abstracts, etc.)
- Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	15	2

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	15	1

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	8	5

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Research will improve understanding of social and economic factors, such as ag policy and business organizations, that effect agriculture and rural communities.

**Add Cross-cutting Outcome/Impact Statement or Unintended or Previously Unknown Outcome Measure**

**Outcome #1**

**1. Outcome Measures**

- Not Reporting on this Outcome Measure

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

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	0	0

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

**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
- Populations changes (immigration, new cultural groupings, etc.)
- Other

**Brief Explanation**

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

**(OPTIONAL SECTION)**

**1. Evaluation Studies Planned**

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention
- {NO DATA ENTERED}

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

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

**Program # 3**

**1. Name of the Planned Program**

Sustainable Energy

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

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources			15%	
124	Urban Forestry			5%	
125	Agroforestry			25%	
131	Alternative Uses of Land			6%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			6%	
204	Plant Product Quality and Utility (Preharvest)			10%	
205	Plant Management Systems			21%	
511	New and Improved Non-Food Products and Processes			12%	
	<b>Total</b>			100%	

Add knowledge area

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

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	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	169716	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	169716	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	5132242	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, forest product producers, farmers.

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

**1. Standard output measures**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	{NO DATA}	{NO DATA}	{NO DATA}	{NO DATA}
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010  
 Plan:  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
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<b>Actual</b>	0	38	0
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**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	{No Data Entered}	22

**Output #2**

**Output Measure**

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

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	{No Data Entered}	15

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	{No Data Entered}	21

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	{No Data Entered}	5

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Research across disciplines will be conducted to improve the viability of biomass as an energy source by improving biomass production efficiency, developing new crops and uses, and improving handling and delivery processes for bioenergy products.

**Add Cross-cutting Outcome/Impact Statement or Unintended or Previously Unknown Outcome Measure**

**Outcome #1**

**1. Outcome Measures**

Not Reporting on this Outcome Measure

Research across disciplines will be conducted to improve the viability of biomass as an energy source by improving biomass production efficiency, developing new crops and uses, and improving handling and delivery processes for bioenergy products.

**2. Associated Institution Types**

1862 Research

**3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

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

**Issue (Who cares and Why)**

Ethanol is considered a source of fuel that can help the US make the transition away from petroleum based energy sources. Current ethanol production in the US is based on corn. Alternative sources of biomass, which are less input intensive than corn, will be the key to developing cost effective alternative feedstock to ethanol production. Sweet sorghum, a corn-like grass related to sugar cane, can produce as much ethanol as corn but with far less intensive inputs, such as fertilizer. While sweet sorghum can and does grow in temperate zones such as Missouri, it often struggles or dies from cold temperatures when it is planted before early May.

**What has been done**

Agronomists at the University of Missouri are working to genetically adapt sweet sorghum to improve its productivity in Missouri. Most varieties of this native African plant do not grow fast enough in the American Midwest to make it a better ethanol producer than corn. Researchers are genetically blending sweet sorghum with other grass species such as sudangrass, in order to make a hybrid that is more cold-tolerant and yield a profitable crop in Midwestern states. Test plots with alternative varieties and different seasonal timings are being used to identify plants with better natural cold-tolerance and highest sugar content. The best-performing varieties may be candidates for efforts to genetically engineer a crop better suited to Missouri.

**Results**

Sweet sorghum uses less nitrogen and water in the growing process and returns more nutrients to the soil than corn. If cold tolerant varieties can be developed, it would be possible to get two harvest per season instead of one. Tests in Missouri so far show that sweet sorghum grown in high-quality silt loam soil plots produced stalks that contained enough sucrose and glucose to

produce 600 gallons of biofuel per acre when fermented properly. Corn plots in the same study produced the same amount of ethanol, but required approximately three times the amount of fertilizer.

#### 4. Associated Knowledge Areas

- 123 - Management and Sustainability of Forest Resources
- 124 - Urban Forestry
- 125 - Agroforestry
- 131 - Alternative Uses of Land
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 511 - New and Improved Non-Food Products and Processes

#### 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
- Populations changes (immigration, new cultural groupings, etc.)
- Other

##### Brief Explanation

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

##### (OPTIONAL SECTION)

##### 1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)

- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention
- Other

## **Evaluation Results**

Individual faculty were reviewed by their respective Division Directors. Faculty submitted their research goals and accomplishments. Besides evaluating individual progress, the Division Directors reviewed research progress and accomplishments in the context of the planned program. Results show continued progress in both basic and applied research.

Points of evaluation included the following:

Research focus: Was it relevant and consistent with the objectives of the planned program?

Successful scholarship: Were research results conveyed through peer reviewed publications?

Successful grantsmanship: Was the research quality high enough to successfully compete for external grant funds?

## **Key Items of Evaluation**

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

**Program # 4**

**1. Name of the Planned Program**

Childhood Obesity

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

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
502	New and Improved Food Products			52%	
702	Requirements and Function of Nutrients and Other Food Components			32%	
703	Nutrition Education and Behavior			16%	
	<b>Total</b>			100%	

Add knowledge area

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

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	6.0	0.0
Actual	0.0	0.0	2.0	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	150546	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	150546	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2289511	0

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

1. Brief description of the Activity

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

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

Food industry scientists, researchers, nutritional scientists, extension specialists.

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

**1. Standard output measures**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	0	0	0	0
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010  
 Plan: 0  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
<b>Plan</b>	0	50	
<b>Actual</b>	0	15	0

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

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	25	11

**Output #2**

**Output Measure**

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

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	25	5

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	22	2

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	12	0

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Research will lead to the development of new technologies, processes and products to improve food and nonfood uses of biomass.
2	Development of new foods and lifestyle strategies that will help in the fight against obesity.

**Add Cross-cutting Outcome/Impact Statement or Unintended or Previously Unknown Outcome Measure**

**Outcome #1**

**1. Outcome Measures**

Not Reporting on this Outcome Measure

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

**2. Associated Institution Types**

1862 Research

**3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	0	0

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

**Outcome #2**

**1. Outcome Measures**

Not Reporting on this Outcome Measure

Development of new foods and lifestyle strategies that will help in the fight against obesity.

**2. Associated Institution Types**

1862 Research

**3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

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

**Issue (Who cares and Why)**

Oils used in processed foods are hydrogenated in order to stabilize and improve the shelf life. However, hydrogenated oils, known as trans fat, have undesirable health consequences. Trans fat raises bad (LDL) cholesterol levels and lowers good (HDL) cholesterol levels. Trans fats have been shown to increase the risk of heart disease and stroke. It is also associated with increasing the risk of developing type 2 diabetes.

**What has been done**

A research team at the MU has created a soybean variant with a higher percentage of stable fatty acid. Oleic acid inherently resists spoilage so does not need hydrogenation to ensure flavor and long shelf life. The new soybeans produce more than 80 percent oleic acid compared to 20 percent found in typical soybean oil. This improved soybean was developed by combining variant genes from two different soybean plants into a new variant. In addition, the new variant has one-fourth less saturated fat than current commercially available soybean oils.

**Results**

Developing a soybean variant to have a much higher percentage of oleic fatty acid will provide a healthier alternative to hydrogenated oil but at the same time providing stability in processed foods. The end result will be healthier fatty acids in perishable foods such as baked goods.

**4. Associated Knowledge Areas**

- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior

**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
- Populations changes (immigration, new cultural groupings, etc.)
- Other

**Brief Explanation**

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

**(OPTIONAL SECTION)**

**1. Evaluation Studies Planned**

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention
- Other

**Evaluation Results**

Individual faculty were reviewed by their respective Division Directors. Faculty submitted their research goals and accomplishments. Besides evaluating individual

progress, the Division Directors reviewed research progress and accomplishments in the context of the planned program. Results show continued progress in both basic and applied research.

Points of evaluation included the following:

Research focus: Was it relevant and consistent with the objectives of the planned program?

Successful scholarship: Were research results conveyed through peer reviewed publications?

Successful grantsmanship: Was the research quality high enough to successfully compete for external grant funds?

### **Key Items of Evaluation**

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

**Program # 5**

**1. Name of the Planned Program**

Food Safety

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

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies			34%	
504	Home and Commercial Food Service			4%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			9%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			44%	
723	Hazards to Human Health and Safety			9%	
	<b>Total</b>			100%	

**Add knowledge area**

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

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	16.0	0.0
Actual	0.0	0.0	3.0	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	361557	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	361557	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2968984	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**

Food industry scientists, researchers, extension specialists, food-related industry and agency professionals.

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

**1. Standard output measures**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	0	0	0	0
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010  
 Plan: 1  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
<b>Plan</b>	0	150	

<b>Actual</b>	0	22	0
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**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	90	12

**Output #2**

**Output Measure**

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

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	70	10

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	50	11

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

Not reporting on this Output for this Annual Report

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2010	20	2

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
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.
2	Development of technologies and methods to insure the safe production and delivery of high-quality food to consumers.

**Add Cross-cutting Outcome/Impact Statement or Unintended or Previously Unknown Outcome Measure**

### **Outcome #1**

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

- Not Reporting on this Outcome Measure

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. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

- Change in Knowledge Outcome Measure  
 Change in Action Outcome Measure  
 Change in Condition Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	0	0

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

#### **4. Associated Knowledge Areas**

### **Outcome #2**

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

- Not Reporting on this Outcome Measure

Development of technologies and methods to insure the safe production and delivery of high-quality food to consumers.

#### **2. Associated Institution Types**

1862 Research

**3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

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

**Issue (Who cares and Why)**

Food safety was again a national headline in 2010, when over half a billion eggs were recalled due to a salmonella outbreak in August which resulted in approximately 2,000 people being sickened by infected eggs. The incident prompted a congressional panel investigation and the Food and Drug Administration imposed mandatory controls including random egg testing. Timely test results are critical to identifying and stopping a salmonella outbreak.

**What has been done**

Food scientists at the University of Missouri have developed a faster and more accurate way to test poultry and eggs for live salmonella contamination. The process modifies a DNA identification system known as polymerase chain reaction (PCR) which amplifies a few pieces of DNA to several orders of magnitude, generating thousands to millions of copies. Large clumps of salmonella DNA are more easily detected and accurately measured. An MU scientist has greatly improved the existing PCR test by developing a process which ignores dead cells and only replicates live salmonella DNA for detection.

**Results**

The new technique to test poultry for contamination can accurately measure any contamination in hours, rather than days. Poultry and egg producers wishing to adapt the new test will need to make an initial capital investment to buy a PCR machine and train personnel to use it. Once installed, however, the system requires less labor and time than conventional testing techniques, resulting in long-term savings. Most importantly, potential pathogens can be found earlier in the production process ? before the food leaves the processing facility.

**4. Associated Knowledge Areas**

- 501 - New and Improved Food Processing Technologies
- 504 - Home and Commercial Food Service
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and
- 723 - Hazards to Human Health and Safety

## 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
- Populations changes (immigration, new cultural groupings, etc.)
- Other

### Brief Explanation

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

### (OPTIONAL SECTION)

#### 1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention
- Other

### Evaluation Results

Individual faculty were reviewed by their respective Division Directors. Faculty submitted their research goals and accomplishments. Besides evaluating individual progress, the Division Directors reviewed research progress and accomplishments in the context of the

planned program. Results show continued progress in both basic and applied research.

Points of evaluation included the following:

Research focus: Was it relevant and consistent with the objectives of the planned program?

Successful scholarship: Were research results conveyed through peer reviewed publications?

Successful grantsmanship: Was the research quality high enough to successfully compete for external grant funds?

**Key Items of Evaluation**

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

**Program # 6**

**1. Name of the Planned Program**

Natural Resources and Quality of Life

**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			6%	
102	Soil, Plant, Water, Nutrient Relationships			15%	
104	Protect Soil from Harmful Effects of Natural Elements			1%	
111	Conservation and Efficient Use of Water			5%	
112	Watershed Protection and Management			8%	
123	Management and Sustainability of Forest Resources			1%	
133	Pollution Prevention and Mitigation			5%	
134	Outdoor Recreation			1%	
135	Aquatic and Terrestrial Wildlife			21%	
605	Natural Resource and Environmental Economics			6%	
608	Community Resource Planning and Development			7%	
801	Individual and Family Resource Management			7%	
802	Human Development and Family Well-Being			4%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			10%	
805	Community Institutions, Health, and Social Services			3%	
	<b>Total</b>			100%	

**Add knowledge area**

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

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890

Plan	0.0	0.0	16.0	0.0
Actual	0.0	0.0	15.0	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	826468	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	826468	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	8492525	0

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

**1. Brief description of the Activity**

Basic and applied research was conducted to address 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 was also conducted in human environmental science to address quality of life issues, such as family finance. Research findings were disseminated via appropriate scientific publications, conferences, workshops, trainings, etc.

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

Researchers, scientists, extension specialists, conservation managers, policy makers, community leaders.

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

**1. Standard output measures**

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

**Patent Applications Submitted**

Year: 2010  
 Plan: 0  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2010	Extension	Research	Total
Plan	0	90	
Actual	0	102	0

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

**Output Target**

**Output #1**

**Output Measure**

- Number of peer reviewed journal articles

Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	60	57

**Output #2**

**Output Measure**

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

Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	30	41

**Output #3**

**Output Measure**

- Number of invited papers and invited presentations

Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	30	49

**Output #4**

**Output Measure**

- Number of graduate degrees awarded

Not reporting on this Output for this Annual Report

Year	Target	Actual
2010	20	15



**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
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.
2	Research efforts will result in new knowlege that will lead to improved management of natural resources and quality of life in human environments.

**Add Cross-cutting Outcome/Impact Statement or Unintended or Previously Unknown Outcome Measure**

**Outcome #1**

**1. Outcome Measures**

- Not Reporting on this Outcome Measure

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. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2010	0	0

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 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
- 133 - Pollution Prevention and Mitigation
- 134 - Outdoor Recreation
- 135 - Aquatic and Terrestrial Wildlife
- 605 - Natural Resource and Environmental Economics
- 608 - Community Resource Planning and Development

- 801 - Individual and Family Resource Management
- 802 - Human Development and Family Well-Being
- 803 - Sociological and Technological Change Affecting Individuals, Families, and
- 805 - Community Institutions, Health, and Social Services

## **Outcome #2**

### **1. Outcome Measures**

- Not Reporting on this Outcome Measure

Research efforts will result in new knowledge that will lead to improved management of natural resources and quality of life in human environments.

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

- Change in Knowledge Outcome Measure
- Change in Action Outcome Measure
- Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Quantitative Target</b>	<b>Actual</b>
2010	{No Data Entered}	0

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

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

Fueled by high unemployment rates brought on by economic recession, hunger in America has become a major issue. It is estimated that more than 50 million Americans, including 17 million children, were "food insecure" in 2009. Keeping track of the severity, scope, and location of the problem is key to combating hunger.

#### **What has been done**

To be treated effectively, hunger must be identified at the local level. Faculty at the University of Missouri have collaborated to produce the Missouri Hunger Atlas 2010. At the county level, this report documents the breadth and extent of hunger need, and the performance of public and private programs in meeting that need.

#### **Results**

This report will help public officials identify the best places to target their efforts, identify those agencies that are successful in their missions, and bring more awareness to the hunger issue. The Missouri Hunger Atlas is the only tool in the country studying the problem at a local level throughout the state.

### **4. Associated Knowledge Areas**

- 101 - Appraisal of Soil Resources
- 102 - Soil, Plant, Water, Nutrient Relationships
- 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
- 133 - Pollution Prevention and Mitigation
- 134 - Outdoor Recreation
- 135 - Aquatic and Terrestrial Wildlife
- 605 - Natural Resource and Environmental Economics
- 608 - Community Resource Planning and Development
- 801 - Individual and Family Resource Management
- 802 - Human Development and Family Well-Being
- 803 - Sociological and Technological Change Affecting Individuals, Families, and
- 805 - Community Institutions, Health, and Social Services

#### **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
- Populations changes (immigration, new cultural groupings, etc.)
- Other

##### **Brief Explanation**

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

##### **(OPTIONAL SECTION)**

##### **1. Evaluation Studies Planned**

- After Only (post program)
- Retrospective (post program)

- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention
- Other

### **Evaluation Results**

Individual faculty were reviewed by their respective Division Directors. Faculty submitted their research goals and accomplishments. Besides evaluating individual progress, the Division Directors reviewed research progress and accomplishments in the context of the planned program. Results show continued progress in both basic and applied research.

Points of evaluation included the following:

Research focus: Was it relevant and consistent with the objectives of the planned program?

Successful scholarship: Were research results conveyed through peer reviewed publications?

Successful grantsmanship: Was the research quality high enough to successfully compete for external grant funds?

### **Key Items of Evaluation**