

2009 University of Missouri Research Annual Report of Accomplishments and Results

Status: Accepted
Date Accepted: 06/25/2010

I. Report Overview

1. Executive Summary

While some glimmers of recovery began to emerge late in 2009, dire economic conditions, punctuated by high unemployment and lack of investment, have had a dramatic economic impact on both the public and private sectors. Academic institutions have not been insulated from this historic recession and are faced with the challenge of advancing science in the face of frozen or declining resources.

It is in the context of this economic environment, as well as expectations in Congress, that NIFA has responded with a transformational change in how agricultural research, education, and extension is designed and implemented. Five new high-priority areas, where efforts will be tightly focused, will help demonstrate the relevance and impact of agricultural research.

In response to the charge to realign research efforts to reflect the five priority areas, this annual report has been reorganized. In preparing the 2009 Annual Report, priority was given to show performance in the new focus areas, rather than maintaining consistency with the objectives and outputs of the previously published 2009 and 2010 Plans of Work. Therefore, during this transition to the new format that takes full effect in the 2011 POW, previous output target measures do not align with the updated planned programs.

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. Lastly, 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.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	42.0	0.0
Actual	0.0	0.0	75.0	0.0

II. Merit Review Process

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

- Other (see below)

2. Brief Explanation

Annual faculty reporting instruments, including individual report of accomplishments and the 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 2009.

III. Stakeholder Input

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

- 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

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

- Other (see MU Extension Plan of Work)

Brief explanation.

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

3. A statement of how the input will be considered

- 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

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	5257127	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	4648188	0
Actual Matching	0	0	4648188	0
Actual All Other	0	0	58018662	0
Total Actual Expended	0	0	67315038	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from				
Carryover	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

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**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
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%	
	Total			100%	

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	23.0	0.0
Actual	0.0	0.0	45.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c 0	1890 Extension 0	Hatch 3017484	Evans-Allen 0
1862 Matching 0	1890 Matching 0	1862 Matching 3017484	1890 Matching 0
1862 All Other 0	1890 All Other 0	1862 All Other 38133529	1890 All Other 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**

2009	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: 2009

Plan: 0

Actual: 6

Patents listed

Disclosure number 09UMC041

Disclosure number 09UMC042

Disclosure number 09UMC043

Disclosure number 09UMC044

Disclosure number 09UMC045

Amino acid oligomer dietary supplement

3. Publications (Standard General Output Measure)**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	75	

Actual	0	314	0
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V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Target	Actual
2009	70	206

Output #2

Output Measure

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

Year	Target	Actual
2009	9	86

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Target	Actual
2009	2	190

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Target	Actual
2009	7	37

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.

Outcome #1**1. Outcome Measures**

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

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

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

Given the finite or diminishing stock of natural resources available to support agricultural production, scientific breakthroughs will be critical in meeting the world's growing demand for food. The basic research of mapping the soybean's genetic code can lead to significantly faster improvements in soybean yields, production area possibilities, biotic and abiotic stress tolerance, and health properties.

What has been done

Members of the National Center for Soybean Biotechnology at the University of Missouri, working in cooperation with scientists from other institutions, have completed the genome sequence for soybeans. This ambitious project has resulted in the identification of the location of approximately 1.1 billion base pairs in the soybean. The genome team has identified more than 90 distinct traits that affect plant development, productive characteristics, disease resistance, seed quality and nutritional traits.

Results

The genome sequence will be a new tool for plant breeders, industrial engineers, geneticists, biochemists and technologists, nutritionists and others who use soybeans. With knowledge of which gene controls which soybean trait, scientists will be better able to adapt plant varieties to improve qualities such as drought tolerance or disease resistance. For example, the gene that confirms resistance to the devastating Asian Soybean Rust disease has been identified. This knowledge can lead to development of resistant soybean strains that can significantly increase soybean production in areas of the world where this disease has caused crop losses between 10 and 80 percent.

4. Associated Knowledge Areas

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

Outcome #2**1. Outcome Measures**

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

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

In livestock breeding, selecting for and turning desirable traits into inheritable traits in the breeding herd takes generations of time. Animal genomic science provides tools to greatly accelerate the time and accuracy of developing improved traits in cattle production by providing a genetic road map.

What has been done

Animal scientists at the University of Missouri, in cooperation with scientists from Nebraska and Maryland have developed a device called the SNP chip to identify DNA markers for economically important traits in livestock, including disease susceptibility, milk production, reproduction and growth. The genetic device allows scientists -in a more efficient and economical way - to examine an animal's entire genome to detect variations that cause trait variation.

Results

Result The new tool easily and quickly identifies regions within the bovine genome that harbor variants that cause animals to differ in the outward expression of important traits. This information allows scientist to predict an animal's total genetic merit from its SNP profile. The result is greatly enhanced breeding selection programs that will result in the selection of animals with superior feed efficiency, growth, carcass composition, and fertility traits.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

- During (during program)

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%	
	Total			100%	

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

Year: 2009	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	111315	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	111315	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	889369	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**

2009	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: 2009

Plan: 0

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	8	
Actual	0	12	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Target	Actual
2009	5	9

Output #2

Output Measure

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

Year	Target	Actual
2009	4	2

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Target	Actual
2009	1	3

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Target	Actual
2009	2	7

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.
2	Increased understanding of the synoptic and planetary-scale atmospheric processes and improved models of long range forecasting and climate change.

Outcome #1

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Increased understanding of the synoptic and planetary-scale atmospheric processes and improved models of long range forecasting and climate change.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Long term weather forecasting models can be improved if the there is a better understanding of how a warming climate may influence weather patterns.

What has been done

Research is being conducted at MU to investigate atmospheric blocking, a little known weather phenomena that leads to the stagnation of weather patterns. Atmospheric blocking is an important weather occurrence because it can cause abnormally high temperatures and less-than-normal precipitation. When blocking occurs, normal weather movement can stall for several days or even weeks. Scientists are investigating whether increased carbon dioxide in the atmosphere and resulting atmospheric warming will affect the onset and duration of future blocking events.

Results

Atmospheric blocking can have a major impact on agricultural production, because of its effect on temperature and precipitation patterns. A better understanding of the impacts of climate change on the incidence and duration of atmospheric blocking will help agricultural scientist and producers plan for and adapt to changing environmental conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

- During (during program)

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

Tony Lupo, an associate professor of atmospheric science and part of the MO AES, is a contributing author and expert reviewer for the Intergovernmental Panel on Climate Change (IPCC) which shared the 2007 Nobel Peace Prize with former vice president Al Gore, Jr.

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
122	Management and Control of Forest and Range Fires			5%	
123	Management and Sustainability of Forest Resources			41%	
124	Urban Forestry			5%	
125	Agroforestry			31%	
131	Alternative Uses of Land			6%	
511	New and Improved Non-Food Products and Processes			12%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2009	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	112582	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	112582	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	3689840	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.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2009

Plan:

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan			
Actual	0	52	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Target	Actual
2009	{No Data Entered}	32

Output #2

Output Measure

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

Year	Target	Actual
2009	{No Data Entered}	17

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Target	Actual
2009	{No Data Entered}	17

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Target	Actual
2009	{No Data Entered}	10

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.

Outcome #1

1. Outcome Measures

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.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

- During (during program)

Evaluation Results

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%	
	Total			100%	

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.0	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	94019	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	94019	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1087172	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

2009	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: 2009
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	20	
Actual	0	11	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Target	Actual
2009	10	3

Output #2

Output Measure

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

Year	Target	Actual
2009	12	7

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Target	Actual
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2009

3

5

Output #4

Output Measure

- Number of graduate degrees awarded

Year

Target

Actual

2009

4

5

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.

Outcome #1**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #2**1. Outcome Measures**

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

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

The health benefits of soy-based foods are well known, providing a lower calorie, cholesterol-friendly, high protein alternative to meat. While food scientists have had success in creating soy products with acceptable flavor and color, the lack of texture has hindered its adoption as a meat substitute.

What has been done

Researchers at MU have developed a soy product that looks, feels, pulls apart and, most importantly, chews like real chicken. Using an extrusion cooking process, color, flavor and fiber are added to the soy protein isolate (SPI) to produce a food product with the taste and texture of white chicken meat.

Results

This new food product will provide people with a healthy alternative to meat and can be useful in the fight against obesity. Soy analogs provide important bio-active components, such as isoflavones, which help maintain healthy bones, and prevent prostate, breast and colorectal cancers. Soy foods are also a good source of essential fatty acids and contain no cholesterol.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
702	Requirements and Function of Nutrients and Other Food Components

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

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

1. Evaluation Studies Planned

- During (during program)

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%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	15.0	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	402239	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	402239	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2571581	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**

2009	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: 2009

Plan: 1

Actual: 0

Patents listed**3. Publications (Standard General Output Measure)****Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	150	
Actual	0	42	0

V(F). State Defined Outputs**Output Target****Output #1****Output Measure**

- Number of peer reviewed journal articles

Year	Target	Actual
2009	80	17

Output #2**Output Measure**

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

Year	Target	Actual
2009	70	23

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Target	Actual
2009	12	10

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Target	Actual
2009	15	5

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.

Outcome #1**1. Outcome Measures**

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.

Not Reporting on this Outcome Measure

Outcome #2**1. Outcome Measures**

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

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

The United States has the safest food supply in the world, yet there are still an estimated 76 million cases of foodborne illness annually. Many of these cases are preventable through the adoption of safe food handling practices. Though people know many of these food handling practices such as hand washing, observational studies reveal that they often do not handle food properly, contrary to what they might report when asked. One potential reason that people do not regularly adopt properly food handling practices is that they do not understand the rationale for the practice.

What has been done

By demonstrating the scientific basis of proper food handling practices through an interactive exhibit, it is intended that people will be more likely to adopt a food-handling practice because they have a greater understanding of its purpose. A team at MU designed an interactive kitchen exhibit that allows visitors to the YouZeum, a science center in Columbia that is focused on health, to discover the microbiology behind safe food-handling practices. The kitchen exhibit consists of five learning stations or modules that work together to promote the microbiological aspect of food safety. It incorporates multiple learning modalities into the display's individual learning modules to facilitate learning through multiple cognitive and sensory experiences. The exhibit design uses computer-based simulations so the exhibit can be used at other science centers in non-traditional science settings, such as fairs, malls, festivals, libraries and other community events in rural areas.

Results

Testing of the exhibit determined that the exhibit engages youth in the target age range in a subject about which it

is difficult to generate interest in both the museum setting and through the traveling exhibit. The expected impact of the exhibit on food safety education, Extension programming, and Agriculture is a greater understanding by consumers (especially middle/high school students and their parents in rural areas not usually served by science museums) of the effects of food-handling practices. This project will further contribute to research focused on defining the behavioral determinants of food safety practices. Additionally, the way in which an exhibit is designed for cost-effective replication will contribute to the field of research.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

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

1. Evaluation Studies Planned

- During (during program)

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%	
121	Management of Range Resources			1%	
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			3%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			10%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures			1%	
805	Community Institutions, Health, and Social Services			2%	
	Total			100%	

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	15.0	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 0	1890 Extension 0	Hatch 910549	Evans-Allen 0
1862 Matching 0	1890 Matching 0	1862 Matching 910549	1890 Matching 0
1862 All Other 0	1890 All Other 0	1862 All Other 11647171	1890 All Other 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**

2009	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: 2009

Plan: 0

Actual: 1

Patents listed

Motavalli, P.P., and K.A. Nelson. 2008. Software management tool for variable source fertilizer application. Univ. of MO Confidential Invention Disclosure Form.

3. Publications (Standard General Output Measure)**Number of Peer Reviewed Publications**

2009	Extension	Research	Total
Plan	0	70	
Actual	0	95	0

V(F). State Defined Outputs**Output Target****Output #1****Output Measure**

- Number of peer reviewed journal articles

Year	Target	Actual
2009	50	65

Output #2**Output Measure**

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

Year	Target	Actual
2009	30	24

Output #3**Output Measure**

- Number of invited papers and invited presentations

Year	Target	Actual
2009	3	71

Output #4**Output Measure**

- Number of graduate degrees awarded

Year	Target	Actual
2009	15	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.

Outcome #1**1. Outcome Measures**

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.

Not Reporting on this Outcome Measure

Outcome #2**1. Outcome Measures**

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

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

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

Through their purchasing patterns, a growing segment of consumers are demonstrating their interest in forest products grown by sustainable processes. Since producing forest products in this manner is more expensive than traditional methods, foresters need information about what premium consumers are willing to pay for these products. With this information, foresters can determine whether getting sustainable certification is a sound business decision.

What has been done

Researchers at MU analyzed survey data collected from 1995 to 2005 and quantified the premium that US consumers would be willing to pay for certified wood products. Roughly 93 percent of all consumers surveyed indicated that they would like furniture and paper products to be from a sustainably managed forest. Almost 70 percent indicated that they would be willing to pay more, at a premium of 12 percent for certified products over non-certified alternatives.

Results

New business opportunities will arise as interest in forest certification programs grows. Premiums for certified furniture and paper products can offset additional costs associated with sustainable management. Certification also offers an opportunity for producers to differentiate their products and increase product appeal.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

- During (during program)

Evaluation Results

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Key Items of Evaluation