

2014 University of Missouri Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Last year, the state of Missouri submitted the 2015-2019 Plan of Work as a consolidated report of Extension, Research and the University of Lincoln. This "2014 University of Missouri Research Annual Report of Accomplishments and Results" will be the last year in which the research component is broken out in a separate report.

The programs included in this final 'research only' report are "Global Food Security and Hunger" and "Natural Resources and Quality of Life". Combining reporting inputs, activities and outputs under these broader programs helps in transitioning into the reporting structure that will be in place for all future annual reports of accomplishments. Therefore, the previously defined programs of "Climate Change", "Sustainable Energy" and "Childhood Obesity" are not being reported on specifically in this final research report.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	72.0	0.0
Actual	0.0	0.0	71.0	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 station project progress reports were used to gauge program progress. In addition, information in media releases and web publications was used to highlight milestone events reported in 2014.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Survey of traditional stakeholder groups

- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals

Brief explanation.

MU Extension sought input from traditional and non-traditional stakeholder groups by invitation and survey processes. Engagement was sought using a variety of methods, including community conversations, diversity discussions, web-based survey, County and Regional Needs Assessments and meetings with State Agencies.

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

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
- Meeting with traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Other (see MU Extension Plan of Work)

Brief explanation.

University of Missouri Extension has gathered opinions of Missouri residents in a variety of ways to assist us in determining the critical issues of strategic importance.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

U 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

The stakeholder input collected using various methodologies was analyzed and used to determine issues of greatest concern and identify priorities. Results of this process, in combination with research and social trends, provides direction for MU Extension programming. Improving economic conditions in the community was a priority area identified in 2014. Fostering entrepreneurship was seen as a driver of economic development. Stakeholders were used to identify perceived strengths, opportunities and impediments to economic progress. The compiled data provides especially valuable information for local and regional Extension planning and for specialists serving individual counties.

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	6235792	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	6227682	0
Actual Matching	0	0	8153135	0
Actual All Other	0	0	1497411	0
Total Actual Expended	0	0	15878228	0

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

Reporting on this Program

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			10%	
205	Plant Management Systems			8%	
206	Basic Plant Biology			5%	
211	Insects, Mites, and Other Arthropods Affecting Plants			2%	
212	Diseases and Nematodes Affecting Plants			5%	
216	Integrated Pest Management Systems			7%	
301	Reproductive Performance of Animals			18%	
302	Nutrient Utilization in Animals			12%	
303	Genetic Improvement of Animals			15%	
304	Animal Genome			2%	
305	Animal Physiological Processes			4%	
306	Environmental Stress in Animals			3%	
307	Animal Management Systems			3%	
404	Instrumentation and Control Systems			3%	
601	Economics of Agricultural Production and Farm Management			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	44.0	0.0
Actual Paid	0.0	0.0	50.0	0.0
Actual Volunteer	0.0	0.0	0.0	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	5168976	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	6767102	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1242851	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, web publications, workshops, conferences, etc.

2. Brief description of the target audience

Researchers, scientists, extension specialists, field operation managers, agricultural producers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: 11

Patents listed

US Patent #8,545,769 Issued on Reusable PCR amplification system and method. V. Korampally, S. Gangopadhyay, K. Gangopadhyay, SA Grant, S. Kleiboeker, S. Bhattacharya, Y. Gao. University of Missouri, Columbia, MO Date: October 1, 2013.

United States Patent No. 8,426,154; issued on April 23, 2013 [Divisional to Patent no. 7,927,828, issued on 19 April 2011].

"Immunoassay for Venom Detection Including Noninvasive Sample Collection" Inventors: William V. Stoecker; Hernan F. Gomez

United States Patent No. 8,431,349 ; issued on April 30 2013; "Compositions and methods for early pregnancy diagnosis Inventors: Nagappan Mathialagan, Robert Michael Roberts, Michael F. McGrath, Jonathan Andrew Green.

The U.S Patent Office issued patent no. 8,594,897 on 26 Nov. 2013 entitled "Variable Product Agrochemicals Application Management" with P.P. Motavalli and K.A. Nelson as the co-inventors.

Nelson, K.A., and P.P. Motavalli. 2013. Variable product agrochemicals application management. U.S. 8594897 B2.

Prather, R., M. Welsh, J. Engelhardt, C. Rogers, Y. Ziyang. "Transgenic animal models of disease", filed 3/5/08. Australia. PCT/US2008/002886. WO 2008/121199 A2. (issued Dec. 10, 2013).

Welsh, M.J., C.S. Rogers, R.S. Prather, J. Engelhardt, Z. Yan. "Transgenic porcine models of cystic fibrosis" Provisional patent filed Sept. 17, 2008, U.S. #8,618,352 (issued Dec. 31, 2013).

United States Patent No. 8, 558,056 B2, Jinrong Wan, Minviluz G. Stacey, Gary Stacey, Xuecheng Zhang, LysM receptor-like kinases to improve plant defense response against fungal pathogens, Oct. 15, 2013

Photo-acoustic Detection Device and Method. Inventors: John A. Viator, Paul S. Dale, Ryan M. Weight, Peter Sutovsky, US Patent No 8,501,099, issued 9/6/2013

Zhang Z, Park SY, Yin X. 2013. Methods for improving Agrobacterium-mediated transformation of plants. U.S. provisional patent.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	369	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2014	233

Output #2

Output Measure

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

Year	Actual
2014	103

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2014	175

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2014	62

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	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nitrogen fertilizer enhances crop yields. However, applying more than the plants can utilize is an unnecessary expense that reduces profitability. In addition, nitrogen that is not absorbed by crops becomes an environmental liability. Excess nitrogen in the field is transported through rainwater to streams and rivers and ultimately gives rise to algae blooms that deplete oxygen and even lead to dead zones in aquatic environments.

What has been done

Using sensors, technology has been developed that allows variable rate fertilizer application that is based on each plant's need. Tractor-drawn active-light sensors detect nitrogen levels in plants by sensing the amount of pulsed light that bounces back from plant canopies. Data is sent continuously to a computer in the tractor cab which uses the information to adjust fertilizer rates spontaneously. Applicators equipped with sensors increase nitrogen amounts in areas with short, light-green plants and decrease amounts in areas that are tall and dark green. MU agronomy specialists have studied this sensor technology in different field plots of corn over time to evaluate its efficacy and impact on yield and fertilizer expenses.

Results

Sensors give more accurate information than traditional methods such as soil samples because sensors detect and control needs for specific areas. Researchers used eight field-scale experiments to measure the most profitable N rate across the field, and found that it varied widely from place to place within the field. In seven of the eight fields studied, researchers found that nitrogen applied at the same rate for the entire field would have been off target by more than 35 pounds per acre in more than half of the field. Sensor-guided nitrogen application can save corn producers money and increase yields.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
206	Basic Plant Biology
404	Instrumentation and Control Systems

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	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Energy expenses account for the greatest cost component in producing turkeys in colder climates such as Missouri. These energy costs are even greater for Minnesota, the largest turkey production state. A new system is being developed by researchers at the University of Missouri that saves up to 50 percent of energy expenses by recycling heat previously wasted.

What has been done

The Air Heat Recovery System works by capturing the air ventilated from poultry barns. This warm air is pushed through a grid of tubing of fresh air that is being directed into the barn. About 60 percent of the heat that would normally be exhausted to the outside is transferred into the grid and put back into the building. Thus the system captures waste heat normally expelled from barns where turkey and broiler chickens are raised, while maintaining the extensive ventilation these birds need to grow and thrive.

Results

The system can save the typical Missouri poultry operation about half of the 7,000 gallons of propane used each year ? more than \$10,000 in savings at today's prices. The cost reduction

would be even greater in colder regions. The recovery system also improves the air quality going into the barn, reducing dust, ammonia and carbon dioxide levels. Air exchange in poultry barns is critical to maintain air quality for workers and birds. Better air quality means the birds will require fewer antibiotics. There is also evidence that improved air quality helps birds gain weight faster, have greater feed conversion and less mortality. The reduction of water and dust also helps control odor. The cost to install the system would be recovered in three to five years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals
307	Animal Management Systems
404	Instrumentation and Control Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

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

- Peer reviewed publications
- Grant submission
- Presentations and communication of results
- Popular media exposure

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

- Reporting on this Program

Reason for not reporting

Research in response to changing climatic conditions, such as improving drought tolerance in plant varieties or improved irrigation systems, is being reported under Global Food Security and Hunger, which encompasses a broad array of research aimed at improving agricultural productivity.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.0	0.0
Actual Paid	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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. Plant scientists will conduct basic and applied research necessary to develop crop varieties and production strategies that can maintain high productivity in the face of increased climate variability and change.

2. Brief description of the target audience

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

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	8	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2014	0

Output #2

Output Measure

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

Year	Actual
2014	0

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2014	0

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2014	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Improved models of long range forecasting and climate change and development of crop varieties that are less vulnerable to climate stress.

Outcome #1

1. Outcome Measures

Improved models of long range forecasting and climate change and development of crop varieties that are less vulnerable to climate stress.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

{No Data Entered}

What has been done

{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

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

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

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

- Reporting on this Program

Reason for not reporting

We use knowledge areas specified in station projects to associate research with planned programs. The knowledge area structure does not specifically break out activity focused on sustainable energy. Research in this area is included under Global Food Security and Hunger, which encompasses a broad array of research aimed at improving agricultural productivity.

V(B). Program Knowledge Area(s)

- 1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.0	0.0
Actual Paid	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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, web publications, workshops, conferences, etc.

2. Brief description of the target audience

Researchers, scientists, extension specialists, agricultural producers

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	35	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2014	0

Output #2

Output Measure

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

Year	Actual
2014	0

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2014	0

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2014	0

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.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

{No Data Entered}

What has been done

{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Childhood Obesity

Reporting on this Program

Reason for not reporting

Research on health and nutrition is included under the quality of life aspects in the Natural Resources and Quality of Life planned program.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual Paid	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	10	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2014	0

Output #2

Output Measure

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

Year	Actual
2014	0

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2014	0

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2014	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Development of new foods and lifestyle strategies that will help in the fight against obesity.

Outcome #1

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	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

{No Data Entered}

What has been done

{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Public Policy changes
- Competing Public priorities

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety

Reporting on this Program

Reason for not reporting

Research on Food Safety is included under the Global Food Security and Hunger planned program.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.0	0.0
Actual Paid	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

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

2. Brief description of the target audience

Food industry scientists, researchers, scientists, extension specialists

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	20	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2014	0

Output #2

Output Measure

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

Year	Actual
2014	0

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2014	0

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2014	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 and processes to improve food safety.

Outcome #1

1. Outcome Measures

Research will lead to the development of new technologies and processes to improve food safety.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

{No Data Entered}

What has been done

{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Natural Resources and Quality of Life

Reporting on this Program

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			10%	
102	Soil, Plant, Water, Nutrient Relationships			18%	
104	Protect Soil from Harmful Effects of Natural Elements			5%	
111	Conservation and Efficient Use of Water			8%	
112	Watershed Protection and Management			15%	
121	Management of Range Resources			6%	
133	Pollution Prevention and Mitigation			12%	
134	Outdoor Recreation			2%	
135	Aquatic and Terrestrial Wildlife			6%	
605	Natural Resource and Environmental Economics			4%	
608	Community Resource Planning and Development			3%	
801	Individual and Family Resource Management			5%	
802	Human Development and Family Well-Being			2%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			4%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	15.0	0.0
Actual Paid	0.0	0.0	21.0	0.0
Actual Volunteer	0.0	0.0	0.0	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	1058706	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1386033	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	254560	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Basic and applied research will be 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 will also be conducted in human environmental science. Research findings will be disseminated via appropriate scientific publications, conferences, workshops, trainings, etc.

2. Brief description of the target audience

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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: 1

Patents listed

The U.S Patent Office issued patent no. 8,594,897 on 26 Nov. 2013 entitled "Variable Product Agrochemicals Application Management" with P.P. Motavalli and K.A. Nelson as the co-inventors.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	183	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2014	126

Output #2

Output Measure

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

Year	Actual
2014	53

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2014	60

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2014	37

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research efforts will result in new knowlege that will lead to improved quality and sustainability of natural and human environments.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Since the 1980s switchgrass has been researched as a renewable energy crop. It is a hardy, deep-rooted warm season grass that grows from Canada to Mexico and has many desirable environmental attributes. Switchgrass is a perennial that translocates nutrients back into the soil in the fall and is used for soil conservation and ground cover for wildlife. Switchgrass was been investigated as a feed stock for cellulosic ethanol. But in the last decade, interest has increased towards using it as a source of thermal energy. In most of these applications, switchgrass is pressed into pellets that are burned in stoves designed for the pellets. Researchers at the University of Missouri are investigating alternative methods of using switchgrass in thermal energy.

What has been done

MU researchers are evaluating the economic and environmental aspects of using baled switchgrass as a substitute fuel in wood furnaces. BTU output from burning baled switchgrass was compared to cordwood, as well propane. The furnace in the test was typical of those used on many farms and rural businesses. In addition, the broader impacts of using baled switchgrass on the farm were considered, such as harvesting equipment, land use and soil conservation.

Results

The BTU output of baled switchgrass was about the same as cordwood, per equal weight. The energy output of a ton of switchgrass was found to be equivalent to about 200 gallons (1,660 pounds) of propane. The method is especially suited for serving heating needs on the farm where switchgrass can be grown on marginal land and harvested with conventional hay equipment, thereby making it a very low cost fuel. Burning switchgrass bales resulted in less ash than wood and was powdery and could be spread back into the soil as fertilizer. The furnace tested was typical of those used on many farms and rural businesses. The system has the potential to be scaled up to small commercial power plants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

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

- Peer reviewed publications
- Grant submission
- Presentations and communication of results
- Popular media exposure

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes with climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.