2013 University of Missouri Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The University of Missouri Agricultural Experiment Station is characterized by strong integration between research and extension activities. Faculty are known for using collaborative efforts to solve real world problems in agriculture. In addition, a high percentage of faculty who receive experiment station funding have appointments that include both research and extension. This integration ensures that discoveries in basic and applied research are translated through extension programs to serve the needs of the state.

This "2013 University of Missouri Research Annual Report of Accomplishments and Results" will be the last year that Missouri breaks out the reporting function into research and extension. In this current report of accomplishments, the programs of "Climate Change", "Sustainable Energy" and "Childhood Obesity" are not being reported on specifically. The inputs, activities and outputs associated with these programs have been incorporated under the programs of "Global Food Security and Hunger" and "Natural Resources and Quality of Life". These broader programs provide a transition into the reporting structure that will be in place for the 2014 annual report of accomplishments. The research component of the 2015 plan of work is found within the "2015 Lincoln University of Missouri and University of Missouri Combined Research and Extension Plan of Work." As a result, one single combined plan of work will be submitted for the state of Missouri.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2013	Extension		Research	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	73.0	0.0
Actual	0.0	0.0	70.0	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 guage program progress. In addition, information in media releases and web publications was used to highlight milestone events reported in 2013.

III. Stakeholder Input

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

- Other (see below)

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 below)

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.
> The methods used in our stakeholder input gathering were as follows:
> • Community Conversations
> • Diversity Discussions
> • Web-based Survey
> • County and Regional Needs Assessments
> • Meetings with State Agencies

3. A statement of how the input will be considered

- Other (see below)

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

> Our stakeholders continue to articulate the need for more programming from us at a time of

diminishing budget. We continue to incorporate the use of technology in our delivery systems in order to leverage the human capacity that we have. MU is contributing to programming efforts in eXtension and has developed a more comprehensive and accessible website for our stakeholders. We are also seeking alternative funding from grants, gifts, and fee generation to further leverage the resources that we receive from our state, federal, and county partners.

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	5540507	0

2. Totaled Actual dollars from Planned Programs Inputs			
Extension		**Research**	
	Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
Actual Formula	0	0	7226560	0
Actual Matching	0	0	7226560	0
Actual All Other	0	0	1141644	0
Total Actual Expended	0	0	15594764	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	Pathogens 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%	
601	Economics of Agricultural Production and Farm Management			2%	
602	Business Management, Finance, and Taxation			1%	
610	Domestic Policy Analysis			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	44.0	0.0

Actual Paid Professional	0.0	0.0	47.0	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	5275389	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	5275389	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	833400	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

2013	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: 2013

Actual: 5

Patents listed

Prather, R.S. ?Porcine reproductive and respiratory syndrome virus resistant animals?, Provisional Patent filed May 16, ?11. PCT/US12/38193.

Scharf, Peter C. and Victoria C. Hubbard. 2012. Method of predicting crop yield loss due to N-deficiency.

Li, R., L Spate, C.N. Murphy, R.S. Prather. "High throughput cryopreservation of swine embryos" Provisional patent filed August 29, '08. US 61/190,515.

Zhang Z (2012) Novel strategy for gene stacking through coordinated transgene expression. Patent disclosure.

United States Patent No. 8,192,946; issued on June 5, 2012; ?Assays for detecting pregnancy-associated glycoproteins? Inventors: Jonathan Andrew Green, Bhanu Prakash Telugu.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	368	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

● Number of peer reviewed journal articles

Year	Actual
2013	217

Output #2

Output Measure

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

Year	Actual
2013	116

Output #3

Output Measure

● Number of invited papers and invited presentations

Year	Actual
2013	189

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Output #4

Output Measure

● Number of graduate degrees awarded

Year	Actual
2013	46

V(G). State Defined Outcomes

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
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
University of Missouri plant science researchers have found a receptor in plants that could be a vital component in the way plants respond to danger, including pests, environmental changes and plant wounds. This discovery may lead to herbicides, fertilizers and insect repellants that naturally work with plants to make them stronger.

What has been done
Researchers are focusing on the molecule adenosine triphosphate (ATP). ATP is the main energy source inside a cell and is considered to be the high energy molecule that drives all life processes in animals and humans. Outside the cell, membrane receptors that attract ATP drive muscle control, neurotransmission, inflammation and development. Researchers screened 50,000 plants over two years to identify the ATP receptors. By isolating a key gene in the remaining plants, scientists found the receptor that aids in plant development and helps repair a plant during major events.

Results
Researchers found evidence that when ATP is outside of the cell it is probably a central signal that controls the plant's ability to respond to a whole variety of stresses. With further study, researchers may be able to identify ways to naturally work with a plant's own processes to protect it from major environmental events, plant wounds and insects. Future research will focus on how this ATP receptor works with ATP, its protein structure, how it reacts to pests and how it may signal growth.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
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

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
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A dairy cow's health after giving birth significantly affects the quantity and quality of the milk it produces. Researchers at the University of Missouri have found that subclinical hypocalcemia, which is the condition of having low levels of calcium in the blood and occurs in many cows after giving birth, is related to higher levels of fat in the liver. Higher levels of fat in the liver are often tied to health problems such as increased risk f or uterus and mammary infections as well as ketosis.

What has been done
Researchers studied 100 dairy cows over a two year period to determine how subclinical hypocalcemia affected a cow?s health after giving birth. Previous research done at MU found that this condition negatively impacted fertility and reproduction. While researchers did not find direct links to health problems from low calcium levels, correlations with higher levels of fat in the liver were found.

Results
This study suggests potential risks associated with subclinical hypocalcemia in dairy cows and calls for further research into ascertaining the impacts of low blood calcium levels. Farmers should monitor blood calcium levels in cows after calving. Adding anionic salts to their diets or providing calcium solutions orally or by injection at the time of calving could be beneficial to overall health and productivity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management 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 cliamatic 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 resarch 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: 2013	Extension		Research	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	5.0	0.0
Actual Paid Professional	{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, atmoshperic scientists, agricultural scientists, agricultural producers, extension specialists

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2013	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: 2013
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

<u>Output #1</u>

Output Measure

● Number of peer reviewed journal articles

Year	Actual
2013	0

Output #2

Output Measure

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

Year	Actual
2013	0

Output #3

Output Measure

● Number of invited papers and invited presentations

Year	Actual
2013	0

Output #4

Output Measure

● Number of graduate degrees awarded

Year	Actual
2013	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
2013	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 knowlege areas specified in station projects to associate research with planned programs. The knowlege 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 resarch 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: 2013	Extension		Research	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	8.0	0.0
Actual Paid Professional	{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**

2013	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: 2013
    Actual: {No Data Entered}

Patents listed
{No Data Entered}

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

    Number of Peer Reviewed Publications

2013	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
2013	0

Output #2

Output Measure

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

Year	Actual
2013	0

Output #3

Output Measure

● Number of invited papers and invited presentations

Year	Actual
2013	0

Output #4

Output Measure

● Number of graduate degrees awarded

Year	Actual
2013	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
2013	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 childhood obesity is too specific to constitute a planned program.
   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: 2013	Extension		Research	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	2.0	0.0
Actual Paid Professional	{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

2013	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: 2013
Actual: {No Data Entered}

Patents listed
{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	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

2013   0

Output #2

Output Measure

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

Year	Actual
2013	0

Output #3

Output Measure

● Number of invited papers and invited presentations

Year	Actual
2013	0

Output #4

Output Measure

● Number of graduate degrees awarded

Year	Actual
2013	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
2013	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

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			60%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			20%	
723	Hazards to Human Health and Safety			20%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	3.0	0.0
Actual Paid Professional	0.0	0.0	0.0	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	433593	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	433593	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	68498	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Basic and applied research will be conducted and the results disseminated via scientific publications, 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?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	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: 2013
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	40	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

● Number of peer reviewed journal articles

Year	Actual
2013	22

Output #2

Output Measure

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

Year	Actual
2013	18

Output #3

Output Measure

● Number of invited papers and invited presentations

Year	Actual
2013	14

Output #4

Output Measure

● Number of graduate degrees awarded

Year	Actual
2013	4

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
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nanomaterials are increasingly used in food packaging, pesticides, cosmetics, water treatment and other areas. Silver nanoparticles are used as a pesticide because of its usefulness in suppressing the growth of harmful organisms. There is a growing concern that these particles could pose a potential health risk to humans and the environment. In a new study, researchers at the University of Missouri have developed a reliable method for detecting silver nanoparticles in foods.

What has been done
Pears were immersed in a silver nanoparticle solution, similar to a pesticide application. The fruit was then washed and rinsed repeatedly. Results showed that four days after the treatment and rinsing, silver nanoparticles were still attached to the pear skin, and the smaller particles were able to penetrate the skin and reach the pulp.

Results
When ingested, silver nanoparticles pass into the blood and lymph system, circulate through the body and reach potentially sensitive sites such as the spleen, brain, liver and heart. Researchers at the University of Missouri have developed a method to detect, identify and quantify silver nanoparticles that may be present in food. A reliable method of detection is critical in studying the possible impacts of nanoparticles in the food supply.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
723	Hazards to Human Health and Safety

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

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 # 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			6%	
102	Soil, Plant, Water, Nutrient Relationships			18%	
111	Conservation and Efficient Use of Water			5%	
112	Watershed Protection and Management			16%	
121	Management of Range Resources			3%	
133	Pollution Prevention and Mitigation			5%	
134	Outdoor Recreation			3%	
135	Aquatic and Terrestrial Wildlife			22%	
605	Natural Resource and Environmental Economics			4%	
801	Individual and Family Resource Management			6%	
802	Human Development and Family Well-Being			5%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			5%	
805	Community Institutions, Health, and Social Services			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.0	15.0	0.0
Actual Paid Professional	0.0	0.0	0.0	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	1517578	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1517578	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	239746	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?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2013	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: 2013
Actual: 3

Patents listed

Mustapha, A. M. Kerley and J. Ahn. 2012. Microencapsulated probiotics for reducing fecal shedding of pathogenic microbes in animals. US patent No. 13/559,361

US Patent #8,173,077 Issued on "Reusable PCR amplification system and method", Shantanu Bhattacharya, Yuanfang Gao, Venumadhav Korampally, S.A. Grant, Steven B. Kleiboeker, Keshab Gangopadhyay, Shubhra Gangopadhyay, University of Missouri, Columbia, Date May 8, 2012

J.A. Viator, P.S. Dale, D. McCormack, ?Photoacoustic detection of analytes in solid tissue and detection system?, U.S. Patent No. 8,293,176, October 23, 2012

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	221	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

● Number of peer reviewed journal articles

Year	Actual
2013	137

Output #2

Output Measure

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

Year	Actual
2013	72

Output #3

Output Measure

● Number of invited papers and invited presentations

Year	Actual
2013	60

Output #4

Output Measure

● Number of graduate degrees awarded

Year	Actual
2013	33

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 sustainablity of natural and human environments.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A significant negative externality in swine production is the undesirable odor associated with hog facilities. Bad odors are a major concern to neighbors and communities and litigation on this issue abounds. Researchers at the University of Missouri are working to discover biofilters to reduce the odor, dust and gas emissions from typical swine operations.

What has been done
Researchers are investigating different materials to use in filtering emissions. Wood chips are the main type of media used in the filters, although puffed plastic material is also being evaluated. Individual ventilation control systems are monitored over the Internet. The system uploads all the data to a server and sends a daily email with data from the previous 24 hours. The data are used to evaluate whether the pigs are comfortable and monitor environmental metrics to make sure the whole system is working.

Results
The results of testing small-scale biofilters at commercial hog farms show that these biofilters could be scaled up to reduce emissions in larger hog operations. Biofiltration is one of the least expensive ways to reduce odors and dust. As producers expand their hog operations, using best management practices in biofiltration will help reduce conflicts with their neighbors and community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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.
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