2011 University of Missouri Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The impact of agricultural research continues to be highly relevant because it improves productivity in a world with increasing demand in food and non-food products. The trend of high commodity prices, short supplies and high price volatility of recent years persisted in 2011. Concerns about the implications for world hunger and the potential impact on financial and political stability were strong enough to prompt G-20 leaders to ask a group of international agencies, coordinated by the FAO and the OECD, to develop options on how to better mitigate and manage the risks associated with the price volatility of food and other agriculture commodities.

The resulting report, PRICE VOLATILITY IN FOOD AND AGRICULTURAL MARKETS: POLICY RESPONSES, catalogs well known factors of demand that have given rise to higher commodity prices and increased price volatility. These forces include a) the growing population and income in emerging and developing countries, b) short commodity supplies, and c) the use of food and feed crops in the production of biofuel. These concerns further substantiate the broad reaching relevance of NIFA priorities, particularly the Global Food Security and Hunger planned program. Basic and applied research provides the scientific innovation necessary to keep up with the growing demand for agricultural food and non-food products.

Climatic conditions such as drought can be expected to have an increasing impact on world food markets given the demand forces stated above. Researchers at MU use a drought simulator to study the effect of water-deficit stress under field conditions. The experiments allow basic plant drought research to be translated into real-world cultivars and practices. Results lead to the development of new drought resistant germplasm, the discovery of genetic and physiological mechanisms that underlie drought adaptation, and evaluation of cultural practices that increase crop productivity.

Using genomic science, MU researchers are developing commercial crops that can tolerate herbicide combinations in order to provide an effective strategy for controlling glyphosate resistant 'super' weeds. In animal research, MU researchers have developed a new cost effective turkey ration that substitutes more expensive grains with less expensive grains, while maintaining overall health and weight gain targets.

Decreasing the waste stream to landfills reduces unwanted greenhouse gas production and also provides utilization of previously wasted nutrients. Researchers at MU have developed a composting system using University waste food products and paper that diverts material from the landfill and yields nutrient rich compost for use in place of petroleum based nitrogen fertilizer. MU researchers are also developing technologies that reduce the negative externalities of concentrated animal feeding operations by creating cost effective biofilters that significantly reduce odor emissions.

In order to improve health in the fight against obesity, nutritionists at the University of Missouri investigated the impact of teens eating breakfast on eating habits, as compared to a control group that skipped breakfast. Results suggest that breakfast is an effective strategy to improving eating habits in teens.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	71.0	0.0
Actual	0.0	0.0	74.0	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 2011.

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.

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

See MU Extension Plan of Work

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	6060527	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	5692290	0
Actual Matching	0	0	5692290	0
Actual All Other	0	0	19410415	0
Total Actual Expended	0	0	30794995	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

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			6%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			9%	
205	Plant Management Systems			8%	
206	Basic Plant Biology			8%	
211	Insects, Mites, and Other Arthropods Affecting Plants			4%	
212	Pathogens and Nematodes Affecting Plants			8%	
216	Integrated Pest Management Systems			5%	
301	Reproductive Performance of Animals			9%	
302	Nutrient Utilization in Animals			7%	
303	Genetic Improvement of Animals			2%	
304	Animal Genome			2%	
305	Animal Physiological Processes			5%	
306	Environmental Stress in Animals			2%	
307	Animal Management Systems			3%	
311	Animal Diseases			10%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			3%	
402	Engineering Systems and Equipment			2%	
404	Instrumentation and Control Systems			2%	
602	Business Management, Finance, and Taxation			3%	
604	Marketing and Distribution Practices			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	45.0	0.0
Actual Paid Professional	0.0	0.0	46.0	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	3601682	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	3601682	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	10465238	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

2011	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: 2011
Actual: 5

Patents listed
J.T. English, F.J. Schmdit, S. Bishop-Hurley, R. O. Morris, G. P. Smith. 2010 Phage Display Selection of Anti-Fungal Peptides. Patent #7,811,994.

J.T. English, Z.D. Fang, F.J. Schmidt,G. Stacey. 2010. Method fo inducing resistance to fungal infection in transgenic plants using plant defense peptides. Patent #7,700,831.

United States Patent Application No. 20080057093, Wan, J, Stacey, G, Stacey, M, and Zhang, X. LysM receptor-like kinases to improve plant defense response against fungal pathogens.

Guo, Y. and J. Tan, 2009. Method and Procedure for Herbicide Measurement, Provisional Patent No. 10UMC018.

Tan, J. and Y. Guo, Method and Apparatus for Plant Drought Stress Measurement, Provisional Patent No. 10UMC013.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	414	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2011	242

Output #2

Output Measure

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

Year	Actual
2011	142

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2011	164

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2011	33

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
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Gylphosate, originally patented as RoundUp, was celebrated as a miracle herbicide when it was introduced 37 years ago because it effectively controlled a wide variety of weed species and had low persistence. Gylphosate, in combination with genetically engineered gylphosate resistant crops, such as RoundUp Ready soybeans, allowed excellent weed control with no till or reduced till methods. Unfortunately, time has led to the natural selection of gylphosate resistant weeds. These superweeds are now widespread and costly to control. A new method of dealing with gylphosate resistant weeds is needed.

What has been done
The herbicide 2,-4D is a hormone regulator and therefore works on a different principal than gylphosate, which targets amino acid synthesis. Many superweeds that are resistant to gylphosate can be controlled with 2,-4D. MU researchers are working in collaboration with scientist at Dow Agrosciences to engineer traits into commercial crops, such as soybeans, to make them tolerant to 2,-4D. That way, herbicides that contain both gylphosate and 2,-4D will provide weed control for these engineered crops.

Results
If commercial crops can be engineered to tolerate herbicides that contain both 2,-4D and gylphosate, then farmers will have an effective strategy for controlling gylphosate resistant weeds. Because 2,-4D has low cost and low persistence, it is beneficial from both an economic and environmental standpoint.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
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
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Rising commodity and energy prices have squeezed profit margins for turkey producers. The corn and soybeans used in turkey feed have recently increased by more than 30%. Feed cost accounts for 70% of the production cost. Improvements in feed rations that decrease these costs can have a significant impact on the profitability of turkey production.

What has been done
MU researchers are conducting fundamental nutritional analysis on turkeys to come up with the minimum requirements for digestible amino acids sufficient to provide full growth potential. Researchers are investigating the relationship between protein and the energy nutrition requirements of the growing turkey to find how a more precise addition of amino acids can

decrease the need of corn and soybean meal in the ration. With this knowledge, nutritional requirements can be met with less expensive grains, in a more efficient ration that does not exceed amino acid requirements.

Results
A new cost effective ration that can save turkey producers between $13-25 per ton in feed costs has been developed. The new ration substitutes more expensive grains with less expensive grains, while still meeting weight gain and health targets. Because Missouri is the 4th largest turkey producer in the US, accounting for 10 percent of total production, savings in feed costs can have a significant impact on this component of the agricultural sector.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
304	Animal Genome
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

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

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			50%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			50%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual Paid Professional	0.0	0.0	2.0	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	208727	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	208727	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	731332	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, atmoshperic scientists, agricultural scientists, agricultural producers, extension specialists

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	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: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	6	0

V(F). State Defined Outputs

Output Target

<u>Output #1</u>

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2011	6

Output #2

Output Measure

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

Year	Actual
2011	1

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2011	1

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2011	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	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

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	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Drought can have a devastating effect on agricultural production and is the leading cause of crop failure. Many predictions of climate change include increased variability in precipitation patterns and increased incidence of drought. An important tool in developing crops with improved drought tolerance is to be able to simulate drought conditions in the field so that science developed in controlled facilities, such as greenhouses, can be translated to actual field settings.

What has been done
Two drought simulators, which look like 50-by-100 foot greenhouses on rail road tracks are now operational at the University of Missouri?s Bradford Research Center. MU researchers use the simulators to vary the amount of water that test plants receive, mimicking everything from short dry spells to persistent and severe drought conditions. By varying the position of the greenhouse, researchers can precisely allow a specified amount of rainfall to fall on the plants. Test plots of the same plants just outside the drought simulators provide a scientific control.

Results
The ability to manage the timing, duration and intensity of water-deficit stress under field conditions is essential to examine plant responses to drought. This ability will allow basic plant drought research to be translated into real-world products and practices. Results will include development of new germplasm with increased drought tolerance, discovery of the genetic and physiological mechanisms that underlie drought adaptation in plants, and evaluation of drought-related cultural practices that increase crop productivity.

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)

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 # 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			7%	
123	Management and Sustainability of Forest Resources			35%	
124	Urban Forestry			4%	
125	Agroforestry			35%	
131	Alternative Uses of Land			3%	
403	Waste Disposal, Recycling, and Reuse			4%	
511	New and Improved Non-Food Products and Processes			12%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.0	0.0
Actual Paid Professional	0.0	0.0	8.0	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	361140	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	361140	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2986924	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, agricultural producers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	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: 2011

Actual: 1

Patents listed

Suppes, G., Hsieh, F., Tu, Y.C. and Kiatsimkul, P. 2010. Soy based polyols. US Patent 7,696,370.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	42	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2011	31

Output #2

Output Measure

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

Year	Actual
2011	8

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2011	23

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2011	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.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Government estimates show that food waste makes up 18 percent of the total waste stream in the U.S. and Americans throw away nearly 40 percent of the food they purchase. Waste food products decomposing in landfills contribute to the unwanted production of methane, a greenhouse gas. Alternatively, nutrients in food waste, such as nitrogen, can be captured through the process of aerobic composting, and used to replace petroleum based fertilizer.

What has been done
Researchers at the University of Missouri Bradford Research Center have designed and created a 2,400 sq. foot Aerated Static Pile composting facility to process food, paper and animal bedding refuse from the waste stream from the University. The facility can handle at least 2 tons of waste per day. This waste material will create approximately 175 tons of compost annually that can be applied to vegetable and field crops at Bradford to meet most, if not all, of the nutritional needs of the crops grown there. Vegetable crops grown at the farm are then sold back to the MU dining services, thereby completing the loop

Results
The composting facility will process 250 tons of food waste and 1,500 tons of waste paper products annually. Diverting this material from the landfill will result in substantial cost savings to the University of Missouri as well as reducing negative environmental impacts. In addition, the composting facility provides utilization of previously wasted nutrients that can be used in place of petroleum based nitrogen fertilizer.

4. Associated Knowledge Areas

KA Code	Knowledge Area

403 Waste Disposal, Recycling, and Reuse

511 New and Improved Non-Food Products and Processes

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

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 # 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			47%	
702	Requirements and Function of Nutrients and Other Food Components			32%	
703	Nutrition Education and Behavior			21%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual Paid Professional	0.0	0.0	2.0	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	142998	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	142998	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	457609	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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	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: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	9	0

V(F). State Defined Outputs

Output Target

<u>Output #1</u>

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2011	4

Output #2

Output Measure

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

Year	Actual
2011	5

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2011	6

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2011	6

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
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
More than 25 million young people are overweight or obese, according to the Centers for Disease Control. While obesity trends are leveling off in adults, they continue to increase for children, the CDC reports. Unhealthy weight gain can lead to serious health complications which continue into adulthood.

What has been done
Nutritionists at the University of Missouri are researching the impact that skipping breakfast has on teens. In the three week study, one group of volunteer teens skipped breakfast, and the other group consumed one of two 500-calorie breakfast meals. One breakfast meal had a normal percentage of protein while the other represented a high protein meal. At the end of each week, volunteers completed appetite and satiety questionnaires. Just before lunch, the volunteers also completed a brain scan, using an MRI, to identify food-related brain activation responses.

Results
Questionnaire results showed that, compared to breakfast skipping, both breakfast meals led to increased feelings of fullness and reductions in hunger throughout the morning. MRI results showed that brain activation in regions controlling appetite, food motivation and reward were reduced in the breakfast-eating teens. The higher protein breakfast led to even greater positive changes in appetite, satiety and reward-driven eating behavior. The findings suggest that a protein-rich breakfast might be an effective strategy to improve appetite control and prevent unhealthy snacking and overeating in young people. Improved health in youth will reduce serious health complications in adults brought on by obesity.

4. Associated Knowledge Areas

KA Code	Knowledge Area

702 Requirements and Function of Nutrients and Other Food Components
703 Nutrition Education and Behavior

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Public Policy 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 # 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			29%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			59%	
723	Hazards to Human Health and Safety			12%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.5	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	401165	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	401165	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	953136	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?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2011	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: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	34	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2011	9

Output #2

Output Measure

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

Year	Actual
2011	21

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual
2011	9

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2011	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 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.

Not Reporting on this Outcome Measure

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

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			8%	
111	Conservation and Efficient Use of Water			4%	
112	Watershed Protection and Management			9%	
133	Pollution Prevention and Mitigation			7%	
134	Outdoor Recreation			4%	
135	Aquatic and Terrestrial Wildlife			15%	
202	Plant Genetic Resources			8%	
605	Natural Resource and Environmental Economics			2%	
607	Consumer Economics			2%	
608	Community Resource Planning and Development			6%	
801	Individual and Family Resource Management			10%	
802	Human Development and Family Well-Being			4%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			7%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures			2%	
901	Program and Project Design, and Statistics			4%	
903	Communication, Education, and Information Delivery			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Extension	Research

Year: 2011	1862	1890	1862	1890
Plan	0.0	0.0	17.0	0.0
Actual Paid Professional	0.0	0.0	14.0	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	976578	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	976578	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3816176	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

2011	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: 2011

Actual: 3

Patents listed

P.P.Motavalli and K.A. Nelson. Patent application submitted in October, 2010. ?Variable Product Agrochemicals Application Management?

Motavalli, P.P., and K.A. Nelson. 2010. Variable product agrochemicals application management. U.S. Provisional Application No. 61/388,414. Filed 30 Sept. 2010.

J.A. Viator, P.S. Dale, D. McCormack, ?Photoacoustic detection of analytes in solid tissue and detection system?, US 2010/0285518 A1, April 20, 2010

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	142	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer reviewed journal articles

Year	Actual
2011	80

Output #2

Output Measure

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

Year	Actual
2011	53

Output #3

Output Measure

- Number of invited papers and invited presentations

Year	Actual

2011	32

Output #4

Output Measure

- Number of graduate degrees awarded

Year	Actual
2011	24

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
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Concentrated animal feeding operations (CAFOs) are an important economic force in rural areas bringing an estimated 1.1 billion annually to northwest Missouri alone. However, odor from these facilities has a significant negative impact on neighboring property owners and residents. This inherent conflict often takes the form of huge lawsuits and active debate in the state assembly. Scientists have worked for years to develop methods of controlling odor but producers need a practical, lower cost solution that they can implement

What has been done
MU researchers are working to develop effective biofilters that producers can use to filter out and break down compounds that create pungent odors. Biofilters made from materials like wood chips support microbial colonies that thrive on nutrients provided by the CAFO exhaust stream, which is made up of nutrient rich odors, dust, and ammonia and hydrogen sulfides. Researchers are working out design details in material selection and composition, filter size, and positioning and moisture control that can be implemented at a relatively low cost. In addition, a computer model has been developed that allows large producers to inexpensively estimate the extent of their emission problem, based on simple information about their operation.

Results
Development of technologies that reduce the negative externalities of concentrated animal feeding operations will allow rural regions in northwest Missouri to benefit from this source of economic opportunity without sacrificing air quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

605	Natural Resource and Environmental Economics
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

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

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Key Items of Evaluation

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