V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Environment, Energy & Climate

☑ 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%	0%	2%	0%
102	Soil, Plant, Water, Nutrient Relationships	12%	0%	16%	0%
111	Conservation and Efficient Use of Water	2%	25%	7%	20%
112	Watershed Protection and Management	10%	25%	8%	15%
123	Management and Sustainability of Forest Resources	5%	0%	6%	0%
133	Pollution Prevention and Mitigation	8%	25%	3%	15%
134	Outdoor Recreation	0%	10%	0%	10%
135	Aquatic and Terrestrial Wildlife	0%	0%	2%	0%
136	Conservation of Biological Diversity	2%	0%	2%	0%
141	Air Resource Protection and Management	2%	0%	2%	0%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	7%	10%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	21%	0%
204	Plant Product Quality and Utility (Preharvest)	5%	0%	4%	10%
402	Engineering Systems and Equipment	5%	0%	3%	0%
403	Waste Disposal, Recycling, and Reuse	15%	15%	1%	20%
511	New and Improved Non-Food Products and Processes	5%	0%	5%	0%
601	Economics of Agricultural Production and Farm Management	9%	0%	4%	0%
605	Natural Resource and Environmental Economics	5%	0%	5%	0%
610	Domestic Policy Analysis	5%	0%	1%	0%
901	Program and Project Design, and Statistics	0%	0%	1%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	18.3	1.8	129.3	0.9
Actual Paid	15.3	1.3	157.3	2.2
Actual Volunteer	1.1	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**
323283	163406	1121241	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
323767	97514	13997411	115641
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2397696	0	2188643	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Division of Agriculture and UAPB research and extension faculty made contributions to the focus area of Sustainability, including nutrient cycling in organic apple production, alternative residue and water management, trace gas emissions to the atmosphere, poultry production and poultry waste management, and economics of sustainable blackberry production.
The N-STaR program for determining optimum site-specific Nitrogen fertilization rates on rice has been adopted quickly by Arkansas rice producers. 2598 N-STaR samples were analyzed in 2015 and new producers are entering the program every year which increases the scope of N-STaR's impact on Arkansas rice production. More than half of the NSTaR recommendations have called for reduced N rates, making the program an economic and environmentally sustainable practice.
Nitrogen availability and the microbial community involved in nitrogen cycling has been investigated in an apple orchard receiving annual additions of ground covers and organic nutrient sources. Soil microorganisms are responsible for the decomposition of residues and the cycling of nutrients, impacting the sequestration of nutrients such as C and N, the fertility of the system, and the potential for non-point source nutrient pollution if releases are in excess and improperly timed with plant needs.
Since agricultural management practices are closely tied to the perception of long-term sustainability, the effects of alternative residue and water management practices on soil properties and processes and crop production in a wheat-soybean double-crop production system on a silt-loam soil are being investigated. The effects of nutrient source, cultivar, soil texture, crop rotation, and water management scheme on methane emissions from rice are also being investigated.
Improved feed efficiency in animal breeding stocks to maintaining sustainable poultry and livestock industries in the US are under investigation. Swine feed trial data is being incorporated into a NIFA funded GHG model to assist in farm and regional level decision making. As part of this same project manure

separation efficiency trials and thermos-chemical manure conversion to biogas trials have been performed. Research is being conducted to develop rapid and accurate tests for assessing bird health and pathogen defense in poultry. Research continues on poultry litter treatment using liquid anaerobic digestion technology to help poultry producers grow their production by minimizing the nutrient issues associated with poultry litter, to prevent pollution to surface and ground water resources due to nutrient leaching and runoff from land and soil receiving poultry litter application, and to help poultry producers transition to sustainable production practices.

A user-friendly interactive economic decision support tool using spreadsheet software was developed to simulate blackberry production in Arkansas and across the southern United States to assist producers in assessing the economic impacts of different production practices and potential returns available from blackberry production. This tool represents the first of its kind for blackberry production, which, with real farm economic data, may be applicable to any blackberry production system in the US. This economic tool will help existing and new fruit producers to evaluate production and marketing decisions, determine potential returns, prepare budgets and compare different scenarios.

The Arkansas Water Resources Center, funded by the 319 Nonpoint Source Program of the Arkansas Natural Resources Commission, collected water samples from 20 streams in the Upper Illinois River Watershed and the Upper White River Basin. These water samples were analyzed for chloride, nitrogen, phosphorus, sediment and sulfate at its water quality lab, which is certified by the Arkansas Department of Environmental Quality. The data was organized, and then water quality trends were evaluated using flow-adjusted concentrations and appropriate statistical techniues.

The Arkansas Water Resources Center noticed three distinct findings that were important to the State. First, the increases in algae (measured as chlorophyll-a) in Beaver Lake coincided with increased nitrogen inputs from the watershed - this is important in understanding why Beaver Lake might not meet its water quality standards. Second, the recent reductions in phosphorus from the City of Springdale's wastewater treatment plant has reduced phosphorus concentrations in Spring Creek - however, these improvements have not been observed further downstream in the Illinois River yet. Finally, there is an increasing trend in chloride and sulfate concentrations in these streams - why is an important question, but it might be related to salt use during winter. These data are critical to our understanding of how we influence water quality with what we do in our watersheds.

Division scientists conducted research on production of sweet sorghum, hybrid Populus and genetically superior Loblolly pine with a view toward bioenergy/renewable energy production.

According to the American Coal Ash Association, over half of the 115 million tons of coal combustion residuals (CCRs) that were generated in 2013 by coal-fired power plants in the U.S. were disposed of in landfills or in surface impoundments. These disposal methods are expensive and pose significant environmental concerns. The bulk of the 52 million tons of CCRs that were beneficially reused in 2013 were used in the manufacture of either concrete or wallboard. However, not all CCRs are suitable for use in these products and other beneficial uses need to be identified. Among the criteria that the USEPA uses to define a beneficial reuse of CCRs are: 1) the CCR must provide a functional benefit, 2) it must substitute for the use of a virgin material, and 3) in the absence of specific regulatory standards, it must not be used in "excess quantities" (http://www.epa.gov/coalash/frequent-questions-about-coal-ash-disposal-rule). Based on nearly eight months of field monitoring following a single application of CCR to a managed grassland, we have recently shown that a representative, locally-generated CCR meets these criteria when applied to soil as a substitute for agricultural lime and as a source of plant-available calcium and sulfur. In order for land application to become a USEPA-approved beneficial reuse of CCRs, it must be demonstrated that land application of CCRs to managed grasslands results in "environmental releases to ground water, surface water, soil, and air that are comparable to or lower than those from analogous products made without CCRs". Our preliminary results suggest that application of a CCR to managed grassland results in releases of environmentally sensitive elements to soil and water that are comparable to those when CCR is not applied. Additional research will be needed in order to confirm these results, but the preliminary results appear to be very promising.

Soil chemical analyses have been used as the basis for P, K and micronutrient recommendations for nearly 100 years and this process represents the best science for estimating fertilizer needs to ensure crop nutrient requirements are met, but not exceeded. Unfortunately, interpretation of soil analyses and the fertilizer recommendations have seldom been validated. Division research sought to validate the accuracy of existing P and K fertilizer recommendations for flood-irrigated rice. Twenty-four field trials were established from 2013 to 2015 in which six composite soil samples were collected from each site to determine the recommended P and K rates, resulting in improved accuracy of recommendations on 20-25% of the Arkansas rice acres.
Wildlife education activities included addressing nuisance wildlife problems, habitat management, developing wildlife enterprises, and youth education.
To assess contribution of stocked fish to the 2014-year class at age-1 crappies were stocked into eight study lakes during fall 2014. Approximately 91,000 Black Crappie Pomoxis nigromaculatus from the Charlie Craig Hatchery were marked with oxytetracycline (OTC) and stocked into Sugar Loaf, Iron Fork, Beaver Fork, and Calion Lakes. Approximately 92,000 White Crappie P. annularis from the Joe Hogan Hatchery were marked with OTC and stocked into Charles, Poinsett, Saracen, and Des Arc Lakes. All lakes were stocked at a density of 50 fish/acre, per the 2002 AGFC Crappie Management Plan. Approximately 30 fish per vat used during OTC marking process were transferred to UAPB. Those fish were held for 60 d and fed Artemia and formulated feed. The objective was to facilitate growth that would add rings to the otoliths and separate the margin from the OTC mark. Those fish were euthanized and stored in a freezer until otoliths could be extracted. Fish were removed from the freezer, thawed, and sagittal otoliths were removed. Otoliths were view under fluorescence to verify the efficacy of the OTC mark. The OTC marking efficacy rate was 100% for Black Crappie and 100% for White Crappie.
Rice straw, one of the largest biomass in the world, and big bluestem (Andropogon gerardii Vitman), a warm season perennial grass, have been considered a potential biomass feedstocks for lignocellulosic ethanol production. Nevertheless, the association of lignin with cellulose and hemicellulose has hindered the efficient utilization of rice straw and big bluestem for cellulosic bio-fuel. The objective of this study was, therefore, to down-regulate genes involved in lignin biosynthesis pathway such as cinnamate 4-hydroxylase (C4H), hydroxycinnamoyl CoA: shikimate hydroxycinnamoyl transferase (HCT), coumarate 3-hydroxylase (C3'H), cinnamoyl CoA reductase (CCR), and cinnamyl alcohol dehydrogenase (CAD) to reduce lignin in rice and cinnamoyl CoA reductase (CCR), and cinnamyl alcohol dehydrogenase (CAD) to reduce lignin in big bluestem through terminator-less constructs.

2. Brief description of the target audience

Youth
Agri Business
Row Crop Agricultural Producers
Small and limited-resource Farmers
Consultants
Forest Landowner Groups
Forest Industry
Loggers
Natural Resource Professionals
Landowners
Educators
Agency personnel
Livestock producers
Watershed and other Not-for-profit organizations
General public
Researchers
Policy makers

Research funding personnel and agencies
Pond Owners
Fisheries Biologists with Arkansas Game & Fish Commission, U.S. Fish & Wildlife Service, and U.S. Forest Service.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	70801	24994	2616	221

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

Patent Applications Submitted

Year: 2015
Actual: 1

Patents listed
Stalk Cutter Device and Method of Use. Roberts, Trenton / Greub, Chester. U.S 62/109,917

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	166	144	310

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational programs and events held related to Environment, Energy & Climate.

Year	Actual
2015	27

Output #2

Output Measure

- Number of field days related to Environment, Energy & Climate.

Year	Actual
2015	6

Output #3

Output Measure

- Number of educational materials, curricula, newsletters, web-based modules and fact sheets developed, produced and delivered related to Environment, Energy & Climate.

Year	Actual
2015	35

Output #4

Output Measure

- Number of locations for bioenergy crop demonstrations.

Year	Actual
2015	2

Output #5

Output Measure

- Number of research-based, non-refereed publications published related to Environment, Energy & Climate.

Year	Actual
2015	167

Output #6

Output Measure

- Number of research-based scientific presentations at scientific or professional meetings related to Environment, Energy & Climate.

Year	Actual
2015	242

Output #7

Output Measure

- Number of research projects on biomass crops conducted in Arkansas.

Year	Actual
2015	0

Output #8

Output Measure

- Number of research projects on biofuels performance and emissions conducted in Arkansas.

Year	Actual
2015	5

Output #9

Output Measure

- Funded research amounts (in dollars) related to Environment, Energy & Climate.

Year	Actual
2015	3745000

Output #10

Output Measure

- Number of current year Environment, Energy & Climate relevant research programs.

Year	Actual
2015	19

Output #11

Output Measure

- Number of current year Environment, Energy & Climate relevant educational programs.

Year	Actual
2015	4

Output #12

Output Measure

- Number of research projects on populations of important fisheries in Arkansas.

Year	Actual
2015	1

Output #13

Output Measure

- Number of Evaluations of Swine Manure Solids as Value-Added Products

Year	Actual
2015	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of individuals adopting one practice from the recommended list of energy conserving practices.
2	Number of energy audits conducted.
3	Number of graduate students working on bioenergy projects or biofuels labs.
4	Life cycle inventory methodology and data for row crops for greenhouse gases.
5	Number of N-StaR samples processed.
6	Number of new assessment and management tools developed, including models and measurements of greenhouse gas emmisions
7	Number of current year citations of climate related publications.
8	Number of program participants who indicate a change in behavior, based on lessons learned during Environment, Energy & Climate programs.
9	Number of participants (both youth and adult) indicating new knowledge gained as a result of Environment, Energy & Climate programs.
10	Number of program participants indicating new knowledge of water quality and conservation best management practices
11	Number of producers who changed or adopted new production and/or conservation management practices or technologies
12	Number of program participants indicating the adoption or implementation of new water quality and conservation best management practices.
13	Number of farm pond owners who indicate new knowledge of pond management
14	Number of fisheries biologists indicating new knowledge of populations of important Arkansas fisheries
15	Number of soil-test phosphorus (P) and potassium (K) validation studies for rice
16	Number of research projects on organic ground cover
17	Number of Comprehensive Conservation/Water Quality Projects

18	Number of Technologies developed for Improving Drinking Water Quality and Availability
19	Number of landowners and managers trained to develop forest stewardship plans
20	Number of evaluations of new biofuels sources
21	Number of demonstrations of biodegradable plastic groundcover

Outcome #1

1. Outcome Measures

Number of individuals adopting one practice from the recommended list of energy conserving practices.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
136	Conservation of Biological Diversity
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis

Outcome #2

1. Outcome Measures

Number of energy audits conducted.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of graduate students working on bioenergy projects or biofuels labs.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Life cycle inventory methodology and data for row crops for greenhouse gases.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2015	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
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
136	Conservation of Biological Diversity
601	Economics of Agricultural Production and Farm Management

Outcome #5

1. Outcome Measures

Number of N-StaR samples processed.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2598

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Arkansas rice producers have relied on soil test recommendations for applying Nitrogen to the crop which are based on response curves from limited test sites. Scientists have been seeking a site specific-test for making N recommendations in rice. N-STaR is a unique, field specific test which identifies the available N from soil samples submitted to the University of Arkansas N-STaR Soil Testing Lab. Recommendations from N-STaR may reduce N rate recommendations significantly without sacrificing yield, thus saving money and potentially reducing N losses to the environment.

What has been done

The Division of Agriculture's soil fertility team were the first to identify a novel method of soil testing and analysis to customize N recommendations on silt loam soils of Arkansas. A series of laboratory experiments and field trials led to the development of N-STaR (Nitrogen-Soil Test for Rice), a field-specific soil N test for rice in Arkansas. N-STaR is a soil-based N test that quantifies the N that will become available to rice during the growing season. Using a steam distillation procedure and analyzing an 18 in deep soil sample (in contrast with a typical 4 in sample), researchers were able to accurately predict the N needs of rice produced on silt loam soils 89% of the time. N-STaR samples submitted by rice growers ensure proper N recommendations to achieve optimum rice yields on a field-specific basis. N-STaR recommendations should optimize rice yields on all fields, but yields can be increased substantially where native soil N is very high or very low. N-STaR has been available for rice produced on silt loam soils in Arkansas for the 2012-2015 rice crops. N-STaR for clayey soils was on a limited release in 2014 and is now available for
all soils in Arkansas.

Results

N-STaR has been adopted quickly by Arkansas rice producers. In 2012, 2500 N-STaR samples were submitted for analysis. The number of N-STaR samples increased to 3300 in 2013, 4500 in 2014, but dropped slightly during 2015 to 2598 due to the adverse weather conditions that prevented many fields from being sampled. New producers are entering the program every year which increases the scope of N-STaR's impact on Arkansas rice production. More than half of the N-STaR recommendations have called for reduced N rates, making the program an economic and environmentally sustainable practice. The success of N-STaR technology in rice has led researchers to explore similar programs targeting wheat and corn in Arkansas.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
601	Economics of Agricultural Production and Farm Management

Outcome #6

1. Outcome Measures

Number of new assessment and management tools developed, including models and measurements of greenhouse gas emmisions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
601	Economics of Agricultural Production and Farm Management

Outcome #7

1. Outcome Measures

Number of current year citations of climate related publications.

2. Associated Institution Types

- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	41

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
601	Economics of Agricultural Production and Farm Management

Outcome #8

1. Outcome Measures

Number of program participants who indicate a change in behavior, based on lessons learned during Environment, Energy & Climate programs.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	465

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A number of studies indicate children today have fewer outdoor learning experiences than previous generations, and that future generations will have poorer health from sedentary indoor lifestyles. The Arkansas 4-H Wildlife Program offers youth (ages 5 to 19 years) the opportunity to get outdoors while learning wildlife science. Youth develop life skills and gain a deeper understanding of wildlife and its management through program activities at local, county, district, and state levels and interacting with resource professionals.

What has been done
The Arkansas 4-H Wildlife Program curriculum is based on the national award-winning 4-H Wildlife Habitat Education Program (WHEP). Learning focuses on species biology and life history, habits and habitats, habitat evaluation and practices, and plan writing.

At the district and state level, the Arkansas 4-H Wildlife Program supports local and county programs by offering various opportunities to 4-H youth for learning about wildlife throughout the year. The activity year begins with a Practice Session in February to prepare youth and leaders for the State Contest in April; District and State Wildlife O-Rama's in June and July; WHEP National Invitational in July; Forestry and Wildlife Camp for 9 to 19 year olds at the C.A. Vines Arkansas 4-H Center in September; a Wildlife Field Day in the fall; and a new Food Plot Contest to be piloted in March - December 2016. Based on reports from club leaders and county agents, plus participation records in state programs, on average each dedicated youth receives at least 20 contact hours of instruction, with Senior team members who represent Arkansas at the National Invitational reporting more than 80 contact hours.

Keys to success include: (1) a diverse advisory committee of professionals and volunteers; (2) committed county agents and volunteer 4-H club leaders who teach youth locally; (3) clear and consistent program structure; (4) keeping the program fresh by rotating species, habitats, and field locations annually; (5) an affordable, family-friendly learning environment, and (6) a focus on education with (a) attention to stages of development (i.e., Cloverbud, Junior, Senior) and (b) resources for learning beyond the competitions.

Results

An estimated 3,000+ Arkansas youth and 4-H leaders have participated in the Arkansas 4-H Wildlife Program since its inception in 1994.

Through these experiences, several program graduates decided to pursue wildlife careers. Many others will become well-informed landowners who understand how to improve wildlife habitat on their land. All have a better understanding of wildlife science and deeper connections to the outdoors.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
136	Conservation of Biological Diversity
403	Waste Disposal, Recycling, and Reuse

Outcome #9

1. Outcome Measures

Number of participants (both youth and adult) indicating new knowledge gained as a result of Environment, Energy & Climate programs.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	385

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Rice straw, one of the largest biomass in the world, and big bluestem (Andropogon gerardii Vitman), a warm season perennial grass, have been considered a potential biomass feedstocks for lignocellulosic ethanol production. Nevertheless, the association of lignin with cellulose and hemicellulose has hindered the efficient utilization of rice straw and big bluestem for cellulosic bio-fuel.

What has been done

Experiments were designed to down-regulate genes involved in lignin biosynthesis pathway such as cinnamate 4-hydroxylase (C4H), hydroxycinnamoyl CoA: shikimate hydroxycinnamoyl transferase (HCT), coumarate 3-hydroxylase (C3'H), cinnamoyl CoA reductase (CCR), and cinnamyl alcohol dehydrogenase (CAD) to reduce lignin in rice and cinnamoyl CoA reductase (CCR), and cinnamyl alcohol dehydrogenase (CAD) to reduce lignin in big bluestem through terminator-less constructs.

Results

In rice, four of the ten silenced lines tested, CAD-1, C4H-3, CCR-12, CCR-16, showed reduced lignin content ranging 3.2-5.6%.In big bluestem, CAD transgenic lines showed reduced lignin content up to 17% and in CCR transgenic lines, lignin content was reduced up to 12%.

Lignin analyses in progenies selected lines with reduced lignin for cellulosic bioethanol assays will continue in 2016-2017.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity
204	Plant Product Quality and Utility (Preharvest)
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis

Outcome #10

1. Outcome Measures

Number of program participants indicating new knowledge of water quality and conservation best management practices

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	389

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Irrigation of cropland is critical to long term success in the Arkansas Delta. If groundwater levels continue to decline at current levels, certain areas in Arkansas will be without the ability to irrigate crops. As the water levels decline, there would be a $12 per acre ft increase in pumping costs as the well depth increased just 30 feet.

What has been done
In response to producer demand for more efficient and effective irrigation events, a computer hole selection program (Pipe Planner) was used to determine the number and size of holes needed to irrigate an irregularly shaped field in a more efficient and timely manner. The goal was to reduce the amount of time and/or eliminate excess water at the bottom of the field resulting in significant savings of inputs. The estimated cost of using flood irrigation was $60 per acre.

Results
A research verification field of 46 acres was formerly irrigated using levees. Each irrigation took 168 hours (7 days) to complete. Pipe Planner illustrated the best fit for this irregular field based on shape and well flow rate was to divide the field into two sections and irrigate separately. The program also chose the proper hole diameter for each row to supply the correct water flow. Results show that irrigation time was reduced by 96 hours, cost per irrigation was reduced by $20 per acre compared to $60 per acre, the field watered more uniformly, there was less water induced stress and minimal waste on the bottom of the field.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
511	New and Improved Non-Food Products and Processes

Outcome #11

1. Outcome Measures

Number of producers who changed or adopted new production and/or conservation management practices or technologies

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	28

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The production of animal derived food and products generates manure and mortality byproducts. Management of these byproducts has potentially significant impacts on food production, societal wellbeing, human and animal health, and environmental quality. Concerns of farmers, neighbors, and consumers has resulted in numerous regulations and policies that livestock producers and those that manage manure and mortality byproducts must adhere. This presents challenges for regulatory agencies, service organizations, livestock producers, and the general public in navigating the regulations and policies.

What has been done
In keeping with the land grant mission of dispersal of research based information, a series of functional relationships among regulatory agencies, service organizations, livestock producers have been developed and maintained over the years. These relationships serve both as access to information and conduits to the dispersal of knowledge. At times this manifests itself as an

independent consultant providing input into the dialog between a regulatory agency, a design engineer, and a livestock producer seeking an acceptable management system and necessary permit to operate.

Results
The results of these facilitated interactions are a more informed manure/mortality management community that has an increased capacity to make and implement beneficial policies and practices. The recipients of these benefits are livestock producers, regulatory agencies, service organizations, neighbors, and consumers of animal based products.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics

Outcome #12

1. Outcome Measures

Number of program participants indicating the adoption or implementation of new water quality and conservation best management practices.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	38

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A number of technologies and management practices have the potential to reduce the overdraft on the Mississippi Valley Alluvial and Sparta Aquifers. In Arkansas groundwater withdraws from the alluvial aquifers are only about 42 percent sustainable and 54.6 percent sustainable from the Sparta/Memphis aquifer. Recent success with on-farm demonstrations in Mississippi has shown a 47% reduction in water use while maintaining profitability. Implementation of such practices on a large scale will improve water sustainability in Arkansas. Without sustainable irrigation practices, yields could be 30-50% less in the future if water becomes limited. Aquifer overdrafts pose a real concern about the future of row crop production. For example, in Arkansas 3.8 Million acres are expected to have limited or no water resources by 2050 according to a recent study.

What has been done

Twenty-six on-farm demonstrations were conducted to compare Irrigation Water Management Practices to farmer managed irrigation practices. Flow meters were installed on paired fields of furrow irrigated corn, soybeans, cotton and peanut fields. IWM fields consisted of computerized hole selection, surge irrigation, ET-based scheduling with an Atmometer, and soil moisture monitoring. Agents and producers followed Extension recommendations for termination. Cost of water was determined for the irrigation pumps at each demonstration.

Results

Results:

-No significant difference in yields between control fields, CHS fields, or IWM fields ($p=0.864$) were found.

-For water use, IWM fields used 25% less water with IWM demonstrations than the control fields ($p<0.001$). Given the season, this is only an indication of the potential savings for a normal or dry year. In soybeans this equated to about 2.6 ac-in/ac difference.

-No significant difference between 30 or 60 inch beds in a sandy loam soil was found in one trial this year.

-Three termination studies were conducted as part of these demonstrations and in two of the three, no yield difference was observed. Additional work to validate existing termination recommendations may be warranted. One demonstration evaluated deep tillage and found a significant yield increase of 4 bu/ac, where deep tillage with IWM had the highest yield. This result is similar to a three-year, three-site research study evaluating deep tillage.

-Several of the pumps tested shows savings potential, one pump in particular if slowed 150 rpm in engine speed would have reduced the irrigation cost by $447 for the year.

-Another demonstration showed that by not using one of the three pumps in a pump network system that they could have saved $291 annually and still met crop water demand.

-One farmer was so impressed with the improvement of surge irrigation, he purchased surge valves for all of this fields. Others observed the improvement it made in the soil water profile from the soil moisture sensors. This often resulted in fewer irrigations and improved ability to capture

and certainty of being able to wait on rain events.
Impact:
County agent led Irrigation Water Management (IWM) demonstrations found a 25% reduction in water use while maintaining yields in 2015 on 26 furrow corn, soybean, cotton and peanut irrigated fields. Wide-spread adoption of these IWM practices could have a dramatic impact on the overdraft of Arkansas aquifers if implemented. Additional improvements in profitability from pump evaluation and deep tillage were also proven.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse
601	Economics of Agricultural Production and Farm Management

Outcome #13

1. Outcome Measures

Number of farm pond owners who indicate new knowledge of pond management

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Number of fisheries biologists indicating new knowledge of populations of important Arkansas fisheries

2. Associated Institution Types

- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2015 40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
White and black crappie are important species of game fish in Arkansas.

What has been done
To assess contribution of stocked fish to the 2014-year class at age-1 crappies were stocked into eight study lakes during fall 2014. Approximately 91,000 Black Crappie Pomoxis nigromaculatus from the Charlie Craig Hatchery were marked with oxytetracycline (OTC) and stocked into Sugar Loaf, Iron Fork, Beaver Fork, and Calion Lakes. Approximately 92,000 White Crappie P. annularis from the Joe Hogan Hatchery were marked with OTC and stocked into Charles, Poinsett, Saracen, and Des Arc Lakes. All lakes were stocked at a density of 50 fish/acre, per the 2002 AGFC Crappie Management Plan. Approximately 30 fish per vat used during OTC marking process were transferred to UAPB. Those fish were held for 60 d and fed Artemia and formulated feed. The objective was to facilitate growth that would add rings to the otoliths and separate the margin from the OTC mark. Those fish were euthanized and stored in a freezer until otoliths could be extracted. Fish were removed from the freezer, thawed, and sagittal otoliths were removed. Otoliths were view under fluorescence to verify the efficacy of the OTC mark.

Results
The OTC marking efficacy rate was 100% for Black Crappie and 100% for White Crappie

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
134	Outdoor Recreation
601	Economics of Agricultural Production and Farm Management

Outcome #15

1. Outcome Measures

Number of soil-test phosphorus (P) and potassium (K) validation studies for rice

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil samples are collected by farmers and consultants, submitted to a soil-test laboratory for analysis and the report along with fertilizer recommendations is sent back to the client. Soil chemical analyses have been used as the basis for P, K and micronutrient recommendations for nearly 100 years and this process represents the best possible science for estimating fertilizer needs to ensure crop nutrient requirements are met, but not provided in excess. Unfortunately, the accuracy of interpretation of soil analyses and eventually the fertilizer recommendations have seldom been validated.

What has been done
Our ongoing research sought to validate the accuracy of existing P and K fertilizer recommendations for flood-irrigated rice. Twenty-four field trials were established from 2013 to 2015 in which six composite soil samples were collected from each site to determine the recommended P and K rates. Each trial contained six P and K fertilizer treatments, which included a no P or K treatment, the recommended rates of P and K rates, and alternate combinations of P and K to examine the accuracy of the rate calibration.
The trial yield results showed that existing fertilizer recommendations based on soil-test P and K accurately predicted crop response to P fertilization in 33% and 38% of the trials when significance was interpreted as significant at the 0.10 level and results were weighted across soil-test categories (e.g., suboptimal, medium and optimal or greater fertility). The accuracy of the P recommendations was not affected by the level of significance (0.05 to 0.25) and the interpretation for K improved slightly as the level of significance became more liberal. For both nutrients, the accuracy of the recommendations varied among the three fertility categories. Crop response prediction errors were greatest for soils that had suboptimal fertility levels and received fertilizer recommendations and seldom occurred for soils having optimal soil fertility levels.

Results
Despite lower than desired accuracy for predicting crop yield response to fertilization, P and K availability indices were positively correlated with plant P and K concentrations at key stages. The soil-test P values that define the suboptimal soil fertility levels were adjusted for the 2016 cropping season and will improve the accuracy of recommendations on 20-25% of the Arkansas rice acres.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #16

1. Outcome Measures

Number of research projects on organic ground cover

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A common practice in organic fruit production is the application of organic ground covers to supply nutrients while enhancing other soil properties. Organic farmers need regionally appropriate information for proper soil management to optimize organic production.

What has been done
Two studies were conducted to determine how 12 treatment combinations of four ground covers (compost, wood chips (tree trimmings), paper mulch, and mow-and-blow) and three organic fertilizers (poultry litter, organic commercial fertilizer, and a no-fertilizer control) applied every year in April from 2006 to 2013 affected soil properties. Soil biological and chemical properties were measured at the 0-10 cm soil depth before (March) and after (May) yearly ground cover applications (April) to determine how nutrient contents and microbial populations responded to additions immediately (May) and long-term (March) and if responses were the same each year or changed through life of the orchard. In addition to biochemical and chemical analyses, molecular analysis was performed on soils from March 2007 and 2013 to determine treatment effects on the denitrifying community.
Many results were apparent in the analysis of soils collected each March and May that were not apparent when soils were analyzed only in 2007 and 2013, showing how dynamic the system is and how subject the system and/or results are to prevailing environmental conditions each year. Soil organic carbon (C) and nitrogen (N), microbial biomass C and N, ammonium-N, and enzyme activities increased through time, peaked during 2009-2011, and declined to levels with relatively few differences between 2007 and 2013 values. In contrast, molecular analysis of denitrifiers showed measurable treatment effects of compost differentiating from other treatments in 2007. The dissolved organic C was also greatest in compost treatments in 2007. Organic matter increased through time in all ground cover treatments, with compost resulting in the greatest increase. Soil water content, electrical conductivity, microbial biomass nitrogen (N), ammonium-N,

and nitrate-N were all greater in 2013 than in 2007. Denitrifier species richness increased from 2007 to 2013 in soil receiving compost and wood chips and was greatest in soil receiving these two ground covers in 2013. Diversity of denitrifiers in wood chips significantly increased from among the least in 2007 to among the most in 2013.
Organic ground covers and fertilizers add nutrients that are released through time by the activity of microorganisms. Microorganisms decompose organic substances and in that process release nutrients.

Results
Our results indicate that annual additions of surface ground covers and nutrients alter the microbial community such that it is not continually growing over time which is significant because the additions have added organic matter to the soil, and thus the expectation might be of accumulation of a larger microbial biomass. However, the microbial composition, as evidenced by the subset of the community investigated (denitrifers), is quite dynamic, and altered differently (i.e. shifting in composition and diversity) and at different timelines by the applications. Microbes responded by the first sampling (1 year after the first set of applications) in the compost treatments compared to others, and, by year seven, microorganisms were responding positively to woodchips.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
136	Conservation of Biological Diversity

Outcome #17

1. Outcome Measures

Number of Comprehensive Conservation/Water Quality Projects

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Division of Agriculture teams assess the impacts of on-farm conservation through the Arkansas Discovery Farms Program and the operation of the C&H Farm at Mt. Judea, Newton County, on the quality of receiving waters.

What has been done
The two programs have assessed:
1.Conservation practices that limit nutrient runoff from poultry production facilities
2. Adoption of rotational grazing on soil health and water quality, and use of cover crops to minimize sediment and nutrient runoff from row crop settings, fate and transport of nutrients and bacteria from land-applied swine effluent to pastures of the C&H Farm
3. The impact of farming operations (effluent holding ponds and land-application of effluent) on the quality of critical water features on and surrounding the C&H Farm including springs, ephemeral streams, creeks and ground water.

Results
Discovery Farms: While preliminary, results after two years, suggest that elevated nutrient and sediment runoff from around poultry production areas are decreased three fold by directing runoff into ponds or through grassed waterways. Further, the concentration of N and P in runoff from the poultry houses was greatly reduced when it enters a farm pond. This decrease can be attributed to P sorption by suspended and deposited sediment, dilution, as well as by algal and macrophyte uptake. While conservation tillage and cover crops decrease nutrient and sediment runoff, no significant difference between conventional and conservation operations is yet to be realized. A decrease in dissolved P between irrigation water added to several fields and concentrations in surface runoff water were observed for rice and corn fields on a Discovery Farm. Approximately 30 kg P ha-1 was added to each of the fields prior to rice and corn plants.

Big Creek: Nitrate-N concentration in Big Creek below the C&H Farm continue to be greater than those measured at the upstream site. Based on numerous stream-water monitoring studies conducted by USGS, U.S. EPA, and Land-Grant entities, we know that there are temporal and spatial factors, such as land use in the drainage watershed, which influence stream water nitrate-N concentrations. We will continue to monitor nitrate-N and other constituents to determine if and when they exceed known standards. For nitrate-N, the drinking water standard is 10.0 mg/L., which has not been exceeded. Standards or thresholds related to recreational or increased algal productivity involve phosphorus and not nitrogen forms. Bacteria concentrations in Big Creek were high both above (20,140 and 173,290 MPN/100 mL as E.coli and total coliform, respectively) and below the C&H Farm (1,203 and 20,120 MPN/100 mL as E.coli and total coliform, respectively) during storm flow grab sampling on 10/13/2014, as well as trench flow below the holding ponds. However, no consistent or prolonged trends in nutrients or bacteria concentrations were evident at or among any of the monitoring locations. Two fields measured in December, 2015; one background site and one that had hog manure application in April 2014. Several datasets were collected and the following observations were made from the Electrical Resistivity Imaging (ERI) analysis:ERI provided delineation of boundaries between soil, epikarst, and competent bedrock,the potential for rapid transport pathways in the underlying bedrock as joints or potential karst features were observed as conductive electrical features in a resistive background, Soil depth was measured to range from 0.7 to 3.0 meters (2.25 to 10 feet). On both fields, the depth of soil is less moving away from the stream and towards higher elevations, which

is consistent with the direction to which the alluvium would be deposited near the stream,the average epikarst thickness is highly variable, ranging from 2 to 23 meters thick (6 to 75 feet), and there seems to be a correlation between the presence of applied hog manure and increased electrical conductivity in soil, but additional work is required to evaluate this potential relationship.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #18

1. Outcome Measures

Number of Technologies developed for Improving Drinking Water Quality and Availability

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Most reservoirs in the U.S. used for drinking water were built 40 to 50 years ago. These reservoirs typically have a lifespan of 50 years. Therefore, much of this drinking water supply is nearing the end of its effective life. Since it is very difficult to build new drinking water reservoirs, researchers and engineers are attempting to create methods to extend the life of our existing reservoirs.

What has been done
Division of Agriculture researchers have developed water treatment technology to solve problems that impair drinking water quality. One of the greatest problems managers of drinking water reservoirs face is the buildup of nutrients (nitrogen and phosphorus) in these water bodies. Water

flowing into the reservoirs naturally contains nutrients and organic matter that is absorbed as rain falls in the watershed, flows across the surface into streams and into the reservoir. Water can be contaminated with excess nutrients from fertilizer, animal waste, and wastewater treatment plant effluent if not properly managed. Excess nutrients can cause problems when reaching reservoirs by causing algae blooms. Algae can rapidly remove dissolved oxygen from the water causing fish kills that will create food for bacteria that will cause even further oxygen removal from the water. Water without oxygen will also allow metals such as iron and manganese to dissolve in water. These dissolved metal create problems when treating raw water for use as drinking water and can greatly increase the expense for treating the water. The nitrogen contained in water can be removed through natural ecological processes, but phosphorus is very difficult to remove from the reservoir once it enters the water body. As reservoirs age, more and more phosphorus will build up in the reservoir eventually overwhelming its ability to retain quality water. The key to improving water quality and extending the life of a reservoir is to not only reduce the amount of new nutrients entering the reservoir, but to create conditions to allow natural processes to remove the nitrogen and convert the phosphorus to a chemical state that is not available to algae. It is also desirable to remove the phosphorus from the reservoir.

Results

A new technology developed in the Division of Agriculture to oxygenate reservoir sediments to reduce the oxygen demand that is exerted on the water and reduce the likelihood that the oxygen is removed from water. A key requirement for implementing this technology is to understand and quantify the rate of oxygen demand exerted by the water body including that from the water itself and also sediment oxygen demand.

Another application of the technology is to use ozone to treat drinking water from impacted reservoirs and help offset the negative impacts of eutrophic waters in a more cost effective manner than the treatment chemicals currently used.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment

Outcome #19

1. Outcome Measures

Number of landowners and managers trained to develop forest stewardship plans

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	844

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources

Outcome #20

1. Outcome Measures

Number of evaluations of new biofuels sources

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Over 65 million pigs in the US produce 4.67 kilograms per day of manure per animal. Thus, the total amount of swine manure generated annually is more than 110 million metric tons. Disposal of the high volume of swine manure creates environmental and economic opportunities and issues. There are no available data related to the energy contents and the thermal degradation behavior of the chemically coagulated swine manure solids. Also, there is no data on the maximum values of coagulants that will hinder the use of the final product as biofuel and/or compost feedstock.

What has been done

Fresh swine manure was collected from an Arkansas farm. Three coagulants, namely agricultural lime [CaCO3], hydrated lime powder [Ca(OH)2], and lime slurry [Ca(OH)2], were used to coagulate solids from fresh swine manure. They were added to fresh swine manure based on the calcium (Ca) mass per liter of liquid manure. Four levels of coagulants concentrations (0.00, 4.89, 9.77 and 19.77 gm Ca/liter) were tested, in triplicates, during the course of this study. Physical, chemical, and thermochemical characteristics of the solid separated swine manure were determined in triplicates.

Results

From the experimental work described, several important arguments can be drawn. Manure separated solids contain the majority of nutrients and volatile solids. Increasing the coagulant concentration decreased the acceptability of the solid separated swine manure as a biofuel source. On the other hand, increasing the coagulant concentration increased the acceptability of the solid separated swine manure as a composting source.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management

Outcome #21

1. Outcome Measures

Number of demonstrations of biodegradable plastic groundcover

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
650 to 700 acres of commercial tomatoes are produced in Bradley County, AR annually. To maximize production, tomato producers use plastic mulch and drip irrigation to reduce weed competition and water conservation. After the cropping season, the mulch and drip irrigation have to be removed by hand and properly disposed.

What has been done
After seeing an informational article on biodegradable mulch in a vegetable produce magazine, the county agent contacted local industry personnel for additional information. A producers meeting was conducted and included representatives of the biodegradable mulch company. During the meeting, he explained how the product performed and how the breakdown was triggered.

Results
A total of 10 acres of bio-degradable mulch was laid on two Bradley County tomato producer farms. Farm visits were made on a regular basis to evaluate the mulch integrity. Initial breakdown of the mulch was noticed on top of the beds around the first of June. By mid-July, the top of the beds were mostly broken down. After the field was cleaned up and cultivated, the residual mulch under the ground along the edges was mostly intact. With additional cultivation and exposure to the sun, the residual mulch showed continued breakdown. If the mulch continues to degrade as anticipated, producers could save between $120 to $150 per acre per year on field cleanup costs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

The outlook for forestry and forest products, at least in the short term, does not provide incentive for Arkansas forest landowners to make substantial investments in improvements of forest land. In Arkansas, where very little infrastructure related to biofuels has evolved, there is little incentive for producers of biofuels feedstocks to invest in alternative biofuels crops and related equipment. Interest in growing alternative biofuel crops in the state today is low, where traditional row crops enjoy reasonable profitability and the short term outlook for oil prices does not favor investment in biofuel alternatives. With oil currently at very low prices, there is little interest in renewable biofuels in Arkansas.
The Big Creek research effort led by the Division's team of water resource protection scientists is authorized to continue monitoring water quality, including nutrients and bacterial concentrations, in a sensitive watershed, but the state funding for this long-term effort is uncertain.
The emergence of a viable and dynamic Carbon Market could have a big impact among Arkansas forestland and cropland managers.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Since the interest in sustainable energy has declined due to low energy costs, the evaluation process is stalled. Feld demonstrations of renewable energy crops and technology for developing sustainable energy through biomass sources were decreased substantially and it is widely believed that these technologies are not economically viable in the short term. If oil and gas prices rebound, the evaluations may include: benefit/cost analyses, participant surveys of knowledge gained, and adoption of recommended practices.
Development and implementation of greenhouse gas (GHG) estimates from agricultural

supply chains requires a retrospective assessment of the activities associated with production of an agricultural product, inventorying current activities, and analysis of case studies for validation of the analyses. Innovations for reducing GHG emissions require comparisons by regions, production practices, climate, and soil type.
Several strategies have been used for program assessment to determine program results, outcomes and impacts. Extension educators use a variety of recommended methods to gather needed information. Collection methodology and assessment tools will be programmatic and audience centered, often by before-after program assessments, behavioral changes, observation, and questionnaires. Data relevant to shifts in production methods, acreage, cropping systems, and enrollment will be compared to historic levels and trends.
Longitudinal evaluation will be conducted by subcomponents of this program through various research based methods. Data will be collected from producers, consultants, and other agricultural practitioners, through telephone and mail surveys and questionnaires at producer meetings and other on-site visits and observations made by Extension faculty. NASS will continue to be a dependable source of indirect data. Electronic audience response (clickers) will be increasingly available and useful in broad based audience participation. Methodologies and survey content is being explored and tested in the current fiscal year.
Comprehensive program and departmental evaluation reviews for Research, Extension and Teaching Programs are conducted on a five to seven year cycle by various research based evaluation methods. In 2015, the Division's Poultry Science Department and Animal Sciences Departments were reviewed by an elite team of peer reviewers. The Review Boards are composed of a Chairman, focused reviewers for the teaching program, the research program and the Extension program in each department. Each team has a local, knowledgeable stakeholder reviewer. A comprehensive report of findings and recommendations is submitted by the Review Board and each department is asked to write a detailed response to the report, which is submitted to the Division administration. The Department of Agricultural Education, Communication and Technology is scheduled to be reviewed in 2016.

Key Items of Evaluation

Adoption of N-STaR can be predicted and quantified by the number of soil samples submitted for N-STaR analysis. While the numbers were lower in 2015 than 2014, the prolonged rainy season prevented farmers and consultants from pulling soil samples. The number of new N-STaR indicates that more farmers are adopting the N-STaR recommendations, which frequently call for reduced rates of N on rice.
Patents awarded are a good evaluation of novel research discoveries, but the full impact of those discoveries is best measured by the number of successful commercial licenses and revenue from those licenses.