2017 University of Tennessee and Tennessee State University Combined Research and Extension Annual Report of Accomplishments and Results

Status:

Accepted

I. Report Overview

1. Executive Summary

The Tennessee Agricultural Research and Extension System serves the needs of Tennesseans with research and outreach in the food, agricultural, natural resources, and human sciences. The University of Tennessee (UT) Extension and the Tennessee Agricultural Experiment Station (UT AgResearch) comprise the 1862 institution and the Tennessee State University (TSU) Cooperative Extension Program and the TSU Institute for Agricultural Research comprise the 1890 institution. This report represents the combined efforts of UT Extension, UT AgResearch, TSU Cooperative Extension Program, and the TSU Institute for Agricultural Research.
UT and TSU Extension extend the knowledge and expertise of the state's two land grant institutions to the 6.7 million people of Tennessee through agents and specialists in all 95 counties. Our work is providing education that produces solutions to societal, economic and environmental issues. Engagement of the state's citizens occurs where they live, work and play through hundreds of programs which are planned, conducted and evaluated by UT and TSU Extension. In FY 2017, Extension continued its leadership in economic development and outreach.
Extension's Excellence in Economic Development: Extension's educational programs in 4-H youth development, agriculture and natural resources, family and consumer sciences and community economic development produce substantial returns for Tennessee. Using research, questionnaires, observations and sales records, an estimated impact was more than $575 million for FY 2017. It was estimated that for every $1 in public funds invested in Extension, $8.65 was returned to the people of Tennessee in increased revenue, increased savings and one time capital purchases.
The recurring economic impacts were estimated at over $325 million. These recurring economic values include increased revenue, increased savings and one time capital purchases associated with Extension programs in crop variety trials/pest control, forage systems, 4-H camping, pesticide safety education, integrated pest management, turfgrass weed management, apiculture, and optimizing beef production. Using a UT System standard formula, an estimated 6,505 jobs were created or maintained because of the recurring economic impacts produced by Tennessee Extension. The one time, non recurring economic values were estimated at over $250 million from Extension programs in nutrition education, health literacy, residential horticulture, Tennessee Saves, and volunteerism.
Extension's Excellence in Outreach: UT and TSU Extension professionals and the volunteers they recruited, trained and managed made more than 5.2 million direct contacts through group meetings, onsite visits (farm, home, and workplace), phone calls, direct mail, and client visits to local Extension offices. In addition, indirect educational methods included mass media, exhibits, and Internet resources.
Data for the Extension portion of this report utilized the Extension reporting system, System for University Planning, Evaluation and Reporting (SUPER). For the past 11 years (2006-2017), this reporting system has been demonstrated to the administrators of 25 state Extension organizations who regarded it as a national model for Extension accountability.
In the attached report, you will see that agricultural research at Tennessee State University in 2017 was closely aligned with priority research areas emphasized by NIFA. In the fall of 2017, NIFA conducted a fiscal review of TSU. Part of the review process included a site visit to TSU in which the review team learned first-hand about the programs being conducted in the College of Agriculture. The college was pleased to receive very complementary reports concerning our programs; the team made special note of the comprehensive nature of our research and Extension programs.

The College of Agriculture at TSU continues to expand, in both human and physical resources. This past

year we added expertise in the areas forestry and alternative energy. Utilizing NIFA funding, we have enhanced our research capacity through construction of a new suite of laboratories that have been created from former office and storage space to provide state-of-the-art support for the research conducted by our faculty. Additionally, new greenhouses and other support facilities have been added at our Agricultural Research and Education Centers to support field and greenhouse research.

The goal of agriculture research at TSU remains the same: to create and communicate new knowledge in the agricultural and environmental sciences for the prosperity of the citizens of Tennessee, the nation and the world. Our faculty continue to dedicate themselves to improving the lives of others. Examples of research accomplishments include:

- Reducing food contamination by developing a new method for rapid identification and subtyping of Salmonella that is beneficial to food producers, processors and food testing laboratories
- Development of new biofuel-forestry intercropping systems to maximize land use efficiencies for small farmers
- Improved understanding of methods to enhance bioenergy crop production without a related increase in greenhouse gases
- Generating revenue and improving the quality of Tennessee forests utilizing GIS technology
- Identification of new soybean mutants for increased yield
- Identification of new, non-chemical, sustainable techniques to reduce pesticide use in nursery production
- Non-invasive, chemical-free techniques to reduce toxins in food processing

Our faculty and staff have been educated and trained at many of the best institutions in the United States and the world. This group of individuals takes pride in partnering with NIFA to advance agricultural and environmental research at Tennessee State University to make a positive difference in our society. We believe the research described in this report illustrates our commitment to serving our stakeholders and improving the lives of the world's citizens.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	450.0	90.0	330.0	74.0
Actual	450.0	82.0	0.0	76.5

II. Merit Review Process

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

- Internal University Panel
- External University Panel
- Expert Peer Review

2. Brief Explanation

The merit review and peer review processes established in the latest Plan of Work were implemented eight years ago. At that time, the external university panel review was completed with program planning and evaluation experts from Virginia Tech and the University of Maryland. This review panel found that the Tennessee Plan of Work was of exceptional quality. The panel's major suggestion was to continue a strong needs assessment and evaluation process focused on measuring substantial outcome indicators. The Plan of Work planned programs have only had minor changes since that time, therefore, an out-of-state review panel was not conducted in FY 2017.

The Merit Review Process at Tennessee State University Extension consists primarily of a review done by

an Internal University Panel which reviewed and approved the annual plans of work and annual reports submitted by extension personnel. Many of the plans were reviewed by experts at TSU and UT at the faculty and administrator level as well. Curriculum developed faculty in conjunction with their annual plans were also peer reviewed by experts at each institution as well.
The program review system for TSU research remains the same has it has in previous years. Each Planned Program in this Annual Report was approved by an internal review panel; some programs had the benefit of an additional review by an external panel. These panels are composed of agricultural researchers and administrators in the 1890 University system. Faculty proposals for Planned Programs are evaluated for relevance, scientific soundness, and appropriateness of planned outcomes. Only those proposed programs that successfully meet all criteria are developed into executable Planned Programs. While we continue to maintain the discipline-specific faculty focus groups described in previous reports to provide support to programs, some new strategies to enhance the merit of our programs were added this year. The TSU College of Agriculture has initiated an annual retreat for faculty. This two day, off-campus event provides an opportunity for focus group members to dedicate time to discuss, evaluate, and plan programs without the distractions of campus life. In addition, the Associate Deans of the college now have individual meetings with faculty members monthly. These meetings facilitate an almost continual avenue for monitoring of progress and problem resolution. These procedures contribute significantly to ensuring the Planned Programs are executed efficiently and with maximum benefit to stakeholders.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups
- Survey of selected individuals from the general public
- Other (Local and State Advisory Councils)

Brief explanation.

In FY 2017, UT and TSU Extension made 8,102 contacts for needs assessment purposes, with these methods highlighted:

- 241 advisory committee meetings;
- 47 focus groups;
- 700 interviews with key informants; and
- 1897 surveys.

Tennessee Extension Agents placed special emphasis on involving youth and other under represented groups in needs assessment activities. Of these needs assessment contacts, 2,956 (36%) were young adults. Both TSU and UT Extension administrators meet with the State Extension Advisory Council at least twice a year to help determine the needs and direct educational programs. Input from non-traditional stakeholder individuals is seen as particularly valuable to the institutions. At the county level, extension agents meet with local advisory councils and various stakeholders to determine programming needs.
TSU research continues to utilize stakeholder input to determine areas of research emphasis. Community groups, industry associations or individual stakeholders are contacted and solicited for input about the research activities conducted in our planned programs. To provide additional avenues of stakeholder input, we have placed a very strong emphasis on our faculty to be

members of, and adopt service/leadership roles in, the industry/trade/commodity/professional organizations associated with their research. Examples of associations in which our faculty have enhanced roles of engagement this past year are the: Tennessee Soybean Board, Tennessee Cattlemen's Association, Amaranth Institute, Tennessee Organic Growers Association, Tennessee Nursery and Landscape Association, SE Branch - Entomological Society of America, International Plant Propagator's Society, Tennessee Goat Producers Association and the Tennessee Urban Forestry Council.
In addition to private groups, our faculty regularly engage public agencies to provide guidance and feedback. Agencies include the Tennessee Department of Agriculture, Tennessee Department of Forestry, Tennessee Plant Material Advisory Committee, Tennessee Wildlife Resources Agency, Tennessee Department of Environment and Conservation, USDA APHIS, USDA ARS, USDA FSA, USDA FS, and USDA RMA.
Additionally, a number of different programs maintain an active presence on social media (Facebook, Twitter) and utilize feedback gained from those sources.

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
- Open Listening Sessions
- Needs Assessments
- Use Surveys
- Other (See below.)

Brief explanation.

All Tennessee Extension Agents receive instruction in selecting needs assessment strategies and in selecting individuals for Advisory Committees. Community leaders selected for Advisory Committees
are chosen to represent the diversities (i.e., gender, age, racial/ethnic, socio-economic, political, educational, etc.) of the county or area served. Extension Agents recruit individuals who have participated in past and current Extension programs; and they recruit individuals who have not used Extension to serve on local advisory committees and participate in open listening sessions. Surveys are also given to traditional and non-traditional stakeholders as well.
The methods used by TSU research to identify appropriate stakeholders are consistent with those used in previous years. We do not employ a single defined strategy to identify stakeholders, rather they are identified through methods most suitable for a specific program. Our goal is to identify stakeholders in a manner that will provide the most useful and accurate feedback possible about stakeholder concerns. Groups that serve the stakeholders (community based groups) or groups that represent stakeholders (industry and trade associations) are a primary source of input. Examples of groups are listed in the previous section, Actions to Seek Stakeholder Input.

Individual stakeholders are utilized where there are no associated groups representing the program area (such as biodiesel producers), or when an opportunity for face-to-face interaction (i.e. at an association meeting, field site visit, or community event) is presented. In these cases, individuals involved the program outputs are identified and queried for input.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Survey specifically with non-traditional individuals

Brief explanation.

The System for University Planning, Evaluation and Reporting (SUPER) tracks Extension's needs assessment efforts across Tennessee. In FY 2017, Extension conducted 47 different focus groups and 700 interviews with key informants. Regarding interviews with key informants, 35% involved individuals who were not previously active in Extension (defined as those not previously on an Extension mailing list). These individuals were identified in various ways such as asking Advisory Committee members and community leaders to suggest names.
Most stakeholder input for TSU research is collected in either face-to-face discussions, interaction with commodity groups, or via survey instruments. Each of these methods are effective. The face-to-face discussions are often held with individual stakeholders, community group representatives or trade association representatives, or with individual stakeholders in a group setting. This allows for questions and answers to direct and stimulate discussion of areas of importance to stakeholders. For example, our some of our environmental research utilizes before-after opinion surveys where opinions/views are solicited from an audience prior to hearing details of the research, then the same stakeholders are surveyed to determine if our research results prompt any opinions regarding the conservation and management of a species.

Survey instruments are a useful tool to assess information from broader groups of stakeholders. Our nursery research programs regularly employ surveys of producers to solicit feedback on important issues; surveys for feedback on individual topics are also used following informational talks at educational programs, field days, etc. While some stakeholders prefer the anonymity and brevity of a survey instrument (often resulting in increased level of input gained), a survey instrument does not always allow for discussion of previously unrecognized areas of concern. The increased acceptance of social media has also presented opportunities for stakeholder input. A number of our program maintain an active presence on social media and these platforms serve as a source of information on stakeholder needs and concerns. All research presentations to non-academic stakeholders now solicit feedback via evaluations The information gained from these surveys is incorporated into program focus areas.

3. A statement of how the input will be considered

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

Brief explanation.

The State Action Agendas (state plans of work) delineated programs, curricula, partners and resources for addressing stakeholder concerns. Individual plans were created and implemented by

Extension Agents and Specialists based on the results of the needs assessment. The plans were monitored and adjusted by Regional Program Leaders and Department Heads. In FY 2017, stakeholder input was used to identify volunteer leaders, identify new audiences, and identify and secure locations for Extension programs. Stakeholder input was used to modify these Extension programs:

- As part of our **Human Development** planned program, our Extension after-school programs were strengthened to address the needs of Tennessee youth. The Tennessee Department of Education holds schools accountable for the success of their students based on standardized test scores and grades. Over 45% of schools in Tennessee have been "failing" the annual Tennessee School Report Card which assesses school system objectives. In 2017, UT Extension operated nine after-school programs across the state serving 710 children. Consistently, 51% of our students below the proficient level in both math and/or reading, increase their overall grade point average in those two subjects by one full letter grade by the end of the school year. The state average for other state funded after-school programs is 39%.
- Our **Forestry, Wildlife, and Fisheries** planned program emphasized forest landowner education. In 2017, our efforts resulted in 105 forest landowners becoming members of their County Forestry Association representing 35,000 forest acres. Also, 73 landowners now understand the ecology of forest development as they have contacted a professional forester or developed a forest management plan for 7,090 forested acres.
- Our **Health and Safety** and **4-H Youth Development** planned programs focused on youth substance abuse prevention as identified by our network of county and state advisory groups. During the 2016-2017 school year, the 4-H Health Rocks! program reached 15,523 youth in 18 counties. Youth in this program developed attitudes toward a healthy lifestyle, improved skills in managing stress, and built assets for productive living. [Our full report on this program appears in the the Health and Safety planned program.]

As previously stated, TSU research utilizes stakeholder input during planning and execution of research programs. Information gained through this process did not result in any overt changes in research direction or scope this past year. Rather, it provided information on additional facets for research. For example, when discussion plant pathology program with stakeholders, stakeholders suggested additional diseases that were problematic to them. These are the new, or additional information changes, are the sorts of stakeholder-inspired modifications we encounter most frequently.

Brief Explanation of what you learned from your Stakeholders

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counties. Youth in this program developed attitudes toward a healthy lifestyle, improved skills in managing stress, and built assets for productive living.
Stakeholders have communicated to TSU research the importance of faculty proficiency in communication skills and knowledge of current discipline needs and trends rather than the traditional items such publication and grant history/potential. Also, as continued from previous years, a concern of stakeholders, regardless of area of research, is in the areas of economics and health. Examples of concerns are curtailing expenses, increasing efficiency, finding new markets and, finally, staying in business. Much of our research, regardless of topic or emphasis, addresses these economic themes.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8952846	0	0	3308108
Actual Matching	41717889	0	0	3308108
Actual All Other	7351166	0	0	0
Total Actual Expended	58021901	0	0	6616216

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

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

4-H Positive Youth Development

☑ 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
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	25%	25%	0%	0%
806	Youth Development	75%	75%	0%	0%
	Total	100%	100%	0%	0%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	158.0	17.0	0.0	0.0
Actual Paid	153.0	0.0	0.0	0.0
Actual Volunteer	23.0	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**
3043969	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
14184084	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
200000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• **Clubs/Project Groups -** Approximately 65 Tennessee counties organized more than 2,500 4-H clubs where workforce preparation was the major emphasis. Project work was a strong component of all 4-H work, and the experiential learning model was used to highlight jobs and careers aligned with 4-H projects. All curriculum emphasized practical skills aligned with jobs and careers.

• **School Enrichment -** Various school enrichment programs in 50 Tennessee counties focused on science, engineering and technology. Youth were exposed to jobs and careers associated with science fields.

• **Mass media and Social Media** - Mass media was used to inform parents, participants and stakeholders about program opportunities and achievements.

• **Youth from Under-Served and Limited Resource Families:** TSU Extension 4-H Youth Development programs placed special emphasis on science, technology, engineering, and mathematics programs in clubs, afterschool settings and other venues to reach youth. Our efforts increased science literacy among the state's young people. TSU Extension successfully reached under-served and limited resource youth.

2. Brief description of the target audience

Tennessee youth in grades 4-12 were targeted for this program. To encourage participation of underserved and minority youth, the majority of UT and TSU Extension programs were organized and taught in public schools.

3. How was eXtension used?

The 4-H Positive Youth Development Program was enhanced through the service of seven Tennessee Extension personnel on the "For Youth, For Life" and "Military Families" Community of Practice (CoP). Tennessee Extension personnel shared implementation strategies, outcome measurement, and evaluation protocols with their CoP colleagues.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	436754	0	1243091	15645081

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	51	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of volunteers utilized in delivering this program.

Year	Actual
2017	1649

Output #2

Output Measure

- Number of exhibits produced.

Year	Actual
2017	998

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Achieving Goals: Number of youth who now put their goal in writing.
2	Achieving Goals: Number of youth who now report they set high goals.
3	Achieving Goals: Number of high school youth who have set a goal for their job or career.
4	Communicating: Number of youth who can express ideas with a poster, exhibit, or other display.
5	Communicating: Number of youth who can use technology to help themselves express ideas.
6	Communicating: Number of youth who have learned at least five jobs in which communication skills are important.
7	Communicating (Public Speaking): Number of youth who can deal with their nervousness when giving a speech or talk.
8	Communicating (Public Speaking): Number of youth who can select a topic for a speech or talk.
9	Communicating (Public Speaking): Number of youth who can speak loudly enough to be heard when giving a speech or talk.
10	Communicating (Public Speaking): Number of youth who feel comfortable sharing their thoughts and feelings in a speech or talk.
11	SET: Number of youth who can design a scientific procedure to answer a question.

Outcome #1

1. **Outcome Measures**

Achieving Goals: Number of youth who now put their goal in writing.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	3506

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. **Outcome Measures**

Achieving Goals: Number of youth who now report they set high goals.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4208

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. Outcome Measures

Achieving Goals: Number of high school youth who have set a goal for their job or career.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	680

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #4

1. **Outcome Measures**

Communicating: Number of youth who can express ideas with a poster, exhibit, or other display.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	8159

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
806	Youth Development

Outcome #5

1. **Outcome Measures**

Communicating: Number of youth who can use technology to help themselves express ideas.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	6159

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #6

1. Outcome Measures

Communicating: Number of youth who have learned at least five jobs in which communication skills are important.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	6672

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #7

1. **Outcome Measures**

   Communicating (Public Speaking): Number of youth who can deal with their nervousness when giving a speech or talk.

2. **Associated Institution Types**

   - 1862 Extension
   - 1890 Extension

3a. **Outcome Type:**

   Change in Action Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	14266

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
806	Youth Development

Outcome #8

1. **Outcome Measures**

   Communicating (Public Speaking): Number of youth who can select a topic for a speech or talk.

2. **Associated Institution Types**

   - 1862 Extension
   - 1890 Extension

3a. **Outcome Type:**

   Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	16802

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #9

1. Outcome Measures

Communicating (Public Speaking): Number of youth who can speak loudly enough to be heard when giving a speech or talk.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	14245

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #10

1. **Outcome Measures**

   Communicating (Public Speaking): Number of youth who feel comfortable sharing their thoughts and feelings in a speech or talk.

2. **Associated Institution Types**

   - 1862 Extension
   - 1890 Extension

3a. **Outcome Type:**

   Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	11951

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
806	Youth Development

Outcome #11

1. **Outcome Measures**

   SET: Number of youth who can design a scientific procedure to answer a question.

2. **Associated Institution Types**

   - 1862 Extension
   - 1890 Extension

3a. **Outcome Type:**

   Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2999

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

V(H). Planned Program (External Factors)

- Other (Program Delivery in Public Schools)

Brief Explanation

Our outcomes for the 4-H Positive Youth Development planned program were higher than expected due to many programs being offered in public schools which reached more youth than other methods such as community clubs.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The National Science Foundation's (NSF), "Science and Engineering Indicators 2016," concluded that most Tennessee 4th and 8th graders did not demonstrate proficiency in the knowledge and skills taught at their grade level in science and mathematics. Therefore, Extension 4-H programs emphasized science, technology, engineering, and mathematics to bolster science literacy and inform youth about career pathways. In FY 2017, we evaluated 4-H programming using surveys. Our evaluation results showed that Tennessee 4-H programs improved science literacy with the following results:

- 3,247 youth can use specific scientific knowledge to form a question.
- 3,652 youth can ask a question that can be answered by collecting data.
- 2,999 youth can design a scientific procedure to answer a question.
- 4,444 youth can record data accurately.
- 6156 youth get excited about new discoveries.
- 6128 youth like experimenting and testing ideas.

Key Items of Evaluation

Our evaluation results showed that Tennessee 4-H programs improved science literacy with the following results:

- 3,247 youth can use specific scientific knowledge to form a question.
- 3,652 youth can ask a question that can be answered by collecting data.
- 2,999 youth can design a scientific procedure to answer a question.
- 4,444 youth can record data accurately.
- 6156 youth get excited about new discoveries.
- 6128 youth like experimenting and testing ideas.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Agronomic Crop Systems

☑ 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	0%	0%	2%	0%
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	16%	0%
104	Protect Soil from Harmful Effects of Natural Elements	0%	0%	2%	0%
111	Conservation and Efficient Use of Water	0%	0%	1%	0%
133	Pollution Prevention and Mitigation	0%	0%	2%	0%
136	Conservation of Biological Diversity	0%	0%	5%	0%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	13%	30%
202	Plant Genetic Resources	0%	0%	13%	30%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	0%	10%
204	Plant Product Quality and Utility (Preharvest)	0%	0%	1%	10%
205	Plant Management Systems	50%	50%	6%	10%
211	Insects, Mites, and Other Arthropods Affecting Plants	5%	5%	13%	0%
212	Pathogens and Nematodes Affecting Plants	5%	5%	7%	10%
213	Weeds Affecting Plants	0%	0%	5%	0%
402	Engineering Systems and Equipment	0%	0%	7%	0%
404	Instrumentation and Control Systems	0%	0%	2%	0%
511	New and Improved Non-Food Products and Processes	0%	0%	3%	0%
601	Economics of Agricultural Production and Farm Management	40%	40%	0%	0%
611	Foreign Policy and Programs	0%	0%	2%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	1.0	70.0	13.0

Actual Paid	45.0	0.0	0.0	9.9
Actual Volunteer	7.0	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**
895285	0	0	430054
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
4171789	0	0	430054
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
100000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Row crops including cotton, soybean, corn, and wheat are valued at close to $1 billion annually and are grown on about three million acres in Tennessee. Improving profit margins benefits the economy of Tennessee. Crop production also impacts environmental quality. Yield improvements may be obtained with proper variety selection, insect, disease and weed management, appropriate use of fertilizers and irrigation, and other best management practices. These and other factors directly affect the profitability of crop production and environmental quality. The Extension portion of this report includes cotton, irrigation, entomology, plant pathology and row crops management and marketing issues. It is organized via the Innovation-Decision Process (Rogers, 1995). It is important to organize the agronomic crop systems planned program activity in this way because producers of various row crops, in various locations in the state are in different stages of this process for the array of research-based practices. Based on needs assessments conducted by Extension Specialists, the following practices were targeted: conservation-tillage; planting insect-tolerant crops; planting herbicide-tolerant crops; spaying crops with foliar fungicide to manage disease; using recommended varieties (based on UT field trial results)

Knowledge: Newspaper articles, radio programs, websites and newsletters were used to build awareness of UT Extension resources and practices for more profitable production. Mass media was used to highlight pests and pesticides in a timely manner.

Persuasion: Farm visits and group meetings were used to showcase practices.

Decision: Group meetings and classes were held in which Extension specialists delivered detailed instruction to producers.

Implementation: On-farm demonstrations were conducted, particularly in the 31 West Tennessee counties, to highlight research-based practices. Integrated research and extension activities were conducted such as result demonstrations and test plots in all 31 West Tennessee counties.

Confirmation: Farm visits and telephone calls were used to assist producers to continue use of the practices, respond to environmental factors, and realize greater profits.

The research portion of this program will improve disease and insect resistance mechanisms in crops, develop new varieties, increase yields, discover new markets, improve production practices, and reduce production inputs.

2. Brief description of the target audience

The primary audience for this program were Tennessee row crop producers, and the secondary

audience is the professionals, business owners/cooperatives, and government officials who serve row crop producers.

3. How was eXtension used?

Tennessee Extension personnel were part of the eXtension "Plant Breeding and Genetics" Community of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	50904	9183073	5594	112

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	25	11	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote awareness and participation in this planned program.

Year	Actual
2017	8

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual

2017	31

Output #3

Output Measure

- Research Fertilizer Efficiency Enhancers (Yin)

Year	Actual
2017	0

Output #4

Output Measure

- Fight Fungal Pathogens of Snapbean and Soybean (Canaday)

Year	Actual
2017	0

Output #5

Output Measure

- Develop New Cereal Varieties (West)

Year	Actual
2017	0

Output #6

Output Measure

- Engineer Drought-Tolerant Bioenergy Crops (Cheng)

Year	Actual
2017	0

Output #7

Output Measure

- Enhance Bioactive Food Components (Kopsell, Armel, Sams, Deyton)

Year	Actual
2017	0

Output #8

Output Measure

- Genetically Improve Soybean Yields (Pantalone)

Year	Actual
2017	0

Output #9

Output Measure

- Address Genetic Resistance to Bt Toxins (Jurat-Fuentes)

Year	Actual
2017	0

Output #10

Output Measure

- Use Remote Sensing for Variable-rate Nitrogen Application (Gwathmey, Yin)

Year	Actual
2017	0

Output #11

Output Measure

- Understand Soybean Mosaic Virus Virulence (Hajimorad)

Year	Actual
2017	0

Output #12

Output Measure

- Evaluate New Crop Varieties (Allen)

Year	Actual
2017	0

Output #13

Output Measure

- Fact Sheet of recommendations to farmers/producers to grow/manage pigeon pea in Tennessee and surrounding states. (Duseja)

Not reporting on this Output for this Annual Report

Output #14

Output Measure

- Investigate Appropriate Use of Unmanned Aircraft Systems (Freeland)

Year	Actual
2017	0

Output #15

Output Measure

- Evaluate a Foldable Tractor RollOver Protection System (Ayers)

Year	Actual
2017	0

Output #16

Output Measure

- Evaluate Spent Microbial Biomass for Amending Corn and Fescue (Eash)

Year	Actual
2017	0

Output #17

Output Measure

- Release High Oleic Soybean to Eliminate Hydrogenation (Pantalone)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Row Crops Production: Number of participants who implemented one or more management practices based on data provided by UT (e.g., conservation tillage, plant population, growth retardants, IPM strategies, disease and weed control).
2	Row Crops Production: Number of producers, farm workers and other ag professionals who received pesticide certification, recertification and pesticide safety training.
3	Row Crops Production: Number of participants who improved their income by following the recommended best management practices for crop production, including plant pest management.
4	Soybeans: Number of producers who learned soybean best management practices that can improve production potential (e.g., conservation tillage, winter covers, plant population, row spacing, planting dates, plant growth regulators, harvest, variety selection, irrigation, fertility).
5	Create Genetic Mapping Populations of Soybean (Pantalone)
6	Investigate Insect Resistance to Biopesticides (Jurat-Fuentes)
7	Identify Molecular and Genomic Plant Defense Mechanisms (Chen, Grant)
8	Explore Nematode and Arthropod Biodiversity (Bernard)
9	Attack the Soybean cyst Nematode (Hewezi, Hajimorad)
10	Precision protocols will be developed for nucleic acid extraction from isolated cotton pollen and microspores towards molecular marker based analyses of cotton lines. (Aziz)
11	Agricultural and Environmental Sciences research knowledge will be enhanced for undergraduate and/or graduate students through laboratory experiential learning. (Aziz)
12	Improve amaranth as an alternative crop and increase profitability of farming in small acreages through the production of alternative crops. (Blair)
13	Increase soybean genetic diversity. (Taheri)
14	Identify vegetable cultivars suitable for organic management system and to improve efficiency of organic farming by proper allocation of inputs. (Nandwani)
15	Research to better understand the bacterial wilt disease process and the role of individual genes in the disease process. (Dumenyo)
16	Define the natural enemy complex for the Brown Marmorated Stink Bug (Moore)
17	Engineer drought-tolerant bioenergy crops (Cheng)
18	Extension Corn Production Programs Increase Total Farm Income
19	Extension Soybean Production Programs Increase Total Farm Income

20	Extension Wheat Production Programs Increase Total Farm Income
21	Tennessee Row Crop Irrigation (Integrated Research and Extension)
22	Tennessee Extension Leads Variety Test Program for Corn Grain, Silage, and Soybeans

Outcome #1

1. Outcome Measures

Row Crops Production: Number of participants who implemented one or more management practices based on data provided by UT (e.g., conservation tillage, plant population, growth retardants, IPM strategies, disease and weed control).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	5490

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #2

1. Outcome Measures

Row Crops Production: Number of producers, farm workers and other ag professionals who received pesticide certification, recertification and pesticide safety training.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	7381

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #3

1. Outcome Measures

Row Crops Production: Number of participants who improved their income by following the recommended best management practices for crop production, including plant pest management.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	5490

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

Soybeans: Number of producers who learned soybean best management practices that can improve production potential (e.g., conservation tillage, winter covers, plant population, row spacing, planting dates, plant growth regulators, harvest, variety selection, irrigation, fertility).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	908

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants

Outcome #5

1. Outcome Measures

Create Genetic Mapping Populations of Soybean (Pantalone)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

Outcome #6

1. Outcome Measures

Investigate Insect Resistance to Biopesticides (Jurat-Fuentes)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #7

1. Outcome Measures

Identify Molecular and Genomic Plant Defense Mechanisms (Chen, Grant)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #8

1. Outcome Measures

Explore Nematode and Arthropod Biodiversity (Bernard)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #9

1. Outcome Measures

Attack the Soybean cyst Nematode (Hewezi, Hajimorad)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

Outcome #10

1. Outcome Measures

Precision protocols will be developed for nucleic acid extraction from isolated cotton pollen and microspores towards molecular marker based analyses of cotton lines. (Aziz)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Individual gamete genotyping provides several advantages including minimum sample requirement, genetic identification of parent, overcoming the complexity of polyploidy, reducing the costs of genetic analyses, and facilitating gametic merit assessment. Such molecular markers? based analyses on Upland cotton (Gossypium hirsutum) lines with chromosome or segment substituted from Pima cotton (G. barbadense) would supplement plant breeding efforts for improving cotton seed oil and protein traits for food/feed usage.

What has been done

Uninucleate free microspores or pollen grains of Upland cotton, Pima cotton and their two chromosome substitution progeny lines were individually isolated through micro-injector or insect-pin mounted over micro-manipulator. Pollen grains were then germinated to release their DNAs, and genomic DNA was increased by modified primer extension pre-amplification (PEP) procedure. The microspore DNA was extracted as well as amplified through multiple displacement amplification (MDA). Nineteen simple sequence repeat (SSR) as well as 28 amplified fragment length polymorphism (AFLP) molecular markers were used to analyses the parental samples along with PEP and MDA amplified individual gamete DNAs.

Results

On average, each of the 28 primer pairs used produced six scorable AFLPs, confirming the detection of parental cotton DNA-markers in isolated individual cotton gametes for genotyping applications towards enhancing plant breeding efficiencies. Also 19 SSR DNA primer pairs linked to protein and oil traits produced 16 microsatellites that were used in the analyses to verify the inheritance of these parental genetic markers in individually isolated gametes. This is a first report on simultaneous amplification of parental SSR and AFLP markers from both mature pollen as well as uninucleate microspores from cotton. Use of single mature pollen grains with individual isolated early free microspores of cotton allowed the genetic assessments of entire (100%) gamete population while avoiding any segregation distortion of parental markers in subsequent analyses.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

Agricultural and Environmental Sciences research knowledge will be enhanced for undergraduate and/or graduate students through laboratory experiential learning. (Aziz)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
NIFA's priority area includes enhancing student recruitment and retention in TSU agricultural sciences to increase the educational opportunities for target populations. The need for students is to heighten interest in science, engineering, and technology (SET), as well as research through unique approaches while pipelining them into the degree programs in natural resources through SET education.

What has been done
This project supported pre-college and undergraduate and graduate educational endeavors by providing laboratory-based training as per students? levels. During the entire academic year students were prepared for practical aspects of the agriculture discipline at all three possible levels through higher educational training opportunities. Thus, two pre-college students (June-July 2017), three undergrad students (October 2016- September 2017) and one graduate student (October 2016- August 2017), were involved through the research-based training in cotton genetics.

Results
Two pre-college students, trained through this project, made presentation to an audience of faculty, staff, graduate students, precollege students and precollege students? families. Three undergraduate students made their presentations for 14th Annual Tennessee Louis Stokes Alliance for Minority Participation Undergraduate Research Conference, Fall Seminar Series of TSU Department of Agricultural and Environmental Sciences and TSU?s 39th Annual University-Wide Research Symposium competition. A TSU graduate student involved in this project also participated in TSU?s 39th Annual University-Wide Research Symposium competition while being involved in precollege and undergraduate research training.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

Improve amaranth as an alternative crop and increase profitability of farming in small acreages through the production of alternative crops. (Blair)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Alternative crops are needed by Tennessee farmers who rely on a small gamut of possible crops (corn, soybean, forage and cotton) on most acreage in the state. One attractive new crop is the Grain Amaranth, a C4 plant like maize but which is from the broadleaf family of plants (dicotyledons) and which is harvested for small seed and forage potential.

What has been done

Grain Amaranth adaptation to low soil fertility was measured by keeping fertilization completely organic and not adding fertilizers other than crop residues from a previous season. No pesticides were used to allow diseases and insect to take their effect on the crop. Direct seeding into a no till opened slot was developed for planted Grain Amaranths directly in the field in late May to early June. Three repetitions were planted but only one was harvested to avoid seed contamination. In addition to agronomic testing in the field, molecular analysis was performed. DNA was extracted for 260 individuals and submitted to marker analysis with 42 KASP assays while the most promising 94 were extracted for genotyping by sequencing (GBS) analysis.

Results

This year we selected the top 12 genotypes from USDA and Seed Savers Exchange (SSE) germplasm growing them in 30 m long double row plots for seed multiplication. This year we selected the top 12 genotypes from USDA and Seed Savers Exchange (SSE) germplasm growing them in 30 m long double row plots for seed multiplication. These grain amaranth varieties are now available for growing conditions in Tennessee. Since the only commercial type that is widely available is Hopi Red, the new genotypes provide an alternative for production. Production statistics are still being analyzed but show a yield of 2.5 kg or more per 30 m rows

translating into a yield of 1,667 kg / ha or more. The most adapted varieties included those with rapid germination such as the replicated materials USDA38, USDA42, USDA61, USDA91, USDA92, USDA102. Samples of the harvest were provided for brewing since grain amaranth is of interest to the microbrewery industry of middle Tennessee as a locally grown grain crop.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #13

1. Outcome Measures

Increase soybean genetic diversity. (Taheri)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Generating new soybean germplasm is necessary for addressing increasing demands for food and feed and adding beneficial traits to the crop. It is also necessary to improve nutritional values in soybeans. Soybean oil has high amounts of saturated fatty acids which are reported to increase cardiovascular diseases. Through mutation, it is possible to change soybean oil content and make it similar to olive oil which is rich in heart healthy fatty acids. Herbicide resistance, reduced allergens and lower phytic acid are other important traits which are in high demand by farmers and consumers.

What has been done

More than 10,000 soybean seeds have been treated with EMS for generating random mutation in soybean genome. About 2000 M1 plants survived the treatment and grew to full maturity. Seeds were harvested from these plants and about 12 seeds were planted from each M1 plant in the second growing season for phenotypic evaluation and DNA extraction. In total we planted more than 20,000 soybean seeds from the 2000 M1 mutants in which 6,500 of these plants survived to maturity. Individual plants were harvested manually and threshed at the end of growing season. Plant yield and seed compositions such as total oil and protein contents, fatty acid and amino acid profiles were measured from each single mutants. The data generated from this germplasm enhancement will be used in fishing out mutations in genes involved in beneficial traits.

Results
Through this project, we have discovered more than 50 mutants which have higher yield compared to the control plants. These results should be validated using a field trial with replicates and proper experimental design at a later stage of the project. We discovered 9 mutants with more than 39% oleic acid content (heat healthy oil) which is considerably higher than 25.4% in parental line. Mutants were also discovered with less than 3% saturated fats (Linolenic acid) which is less than the parental line (7.6%). Mutants with other phenotypic changes were also observed and recorded in this population.

4. Associated Knowledge Areas

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

Outcome #14

1. Outcome Measures

Identify vegetable cultivars suitable for organic management system and to improve efficiency of organic farming by proper allocation of inputs. (Nandwani)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Weeds are a major challenge in agricultural production, particularly in organic agriculture where the use of synthetic herbicides and chemicals are prohibited in weed management and as such, managing weeds is a major economic constraint to the organic vegetable industry.

What has been done
Several types of organic mulches (plastic, wheat straw and pine needles) applied to evaluate effect on weed control in sweetpotato at the TSU organic farm. Weed data on type, density, dry weight, fresh weight collected from replicated trial in summer 2017 growing season.

Results
Significantly higher weed population was recorded in the control treatment (without mulch) over rest of the three mulch treatments essentially because no mulch covering was applied. Dry weight of weeds was fundamentally reduced by the various mulch treatments especially the black plastic and wheat straw mulches.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #15

1. Outcome Measures

Research to better understand the bacterial wilt disease process and the role of individual genes in the disease process. (Dumenyo)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Cucumber and muskmelon are important cucurbit crops. Bacterial wilt disease, caused by the beetle-vectored pathogenic bacterium, Erwinia tracheiphila is one of the most destructive diseases of cucurbits crops. The bacterium and the disease have received little research attention because the bacterium is not easy to manipulate in the laboratory. The disease has also been managed by controlling the insect with insecticides which turn to harm beneficial insects. Pathogen-based management of bacterial wilt disease will require understanding of the pathogen at the fundamental level.

What has been done

We acquired a vector carrying transposase (tnpA) gene for purification of the transposase. The vector was transformed into E. coli and grown for purification of the transposase protein. We PCR-amplified the sacB gene and "cut" the transposon vector to clone the sacB cassette into in an approach to modify the transposon vector. The cassette was ligated into the vector and electroporated into E. coli S17-1. Transformants were selected on antibiotic media.

Results

The purified transposase protein was reconstituted into transposome with PCR-amplified transposon. The transposome was electroporated into electrocompetent E. tracheiphila cells and selected on antibiotic media. There were no colonies recovered that were transformed. The colonies of E. coli S17-1 carrying the putative modified transposon vector were selected and double-patched on sucrose-containing medium. All colonies grew on sucrose suggesting the sacB cassette was not cloned.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #16

1. Outcome Measures

Define the natural enemy complex for the Brown Marmorated Stink Bug (Moore)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #17

1. Outcome Measures

Engineer drought-tolerant bioenergy crops (Cheng)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #18

1. Outcome Measures

Extension Corn Production Programs Increase Total Farm Income

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Challenges facing the row crops industry include understanding and adopting changes in technology, integrated pest management, sustainable agronomic practices and profitability. Corn was planted and harvested on more than 710,000 acres in Tennessee in 2017.

What has been done
Extension agents and area Extension specialists conducted educational programs reaching over 9,700 direct and 7 million indirect contacts during 2017. Best production practices were taught at more than 130 group meetings and over 450 on-farm visits.

Results
Tennessee corn producers increased yield 2,363,854 total bushels by adopting two or more recommended production practices on 366,050 acres, increasing total income by $8.8 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #19

1. Outcome Measures

Extension Soybean Production Programs Increase Total Farm Income

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Challenges facing the row crops industry include understanding and adopting changes in technology, integrated pest management, sustainable agronomic practices and profitability. Soybeans were harvested on more than 1.66 million acres in Tennessee in 2017. Moderate temperatures and plentiful rainfall throughout much of the season created a more uniform yield environment in most counties across the state and there was a final record state average yield of 50 bushels/acre (Jan 2017 NASS quick facts). Soybean prices were mediocre and most

producers received close to $9.50 per bushel for their crop. Projected cash receipts for soybeans in 2017 are more than $788 million.

What has been done
Extension agents and area Extension specialists conducted educational programs reaching over 22,300 direct and 27 million indirect contacts during 2017. Best production practices were taught at more than 180 group meetings and over 770 on-farm visits.

Results
Our evaluation showed that 755 of 1262 (60%) of producers surveyed adopted two or more practices demonstrated in Extension soybean production programs. Soybean producers increased yield by 1,003,866 total bushels by adopting two or more recommended production practices on 629,036 acres, increasing total income by $8.6 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #20

1. Outcome Measures

Extension Wheat Production Programs Increase Total Farm Income

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Challenges facing the row crops industry include understanding and adopting changes in technology, integrated pest management, sustainable agronomic practices and profitability.

What has been done
Updated wheat variety and agronomy information provided producers information on how to efficiently increase wheat production on their farms. Moreover, pest-management information assisted growers in controlling pests with and IPM approach. This information was distributed to producers through 264 direct contacts through direct mail, calls, group meetings, demonstrations, visits to extension offices and visits to farms. Additionally, 134,773 indirect contacts were made through newspaper articles and other outreach activities.

Results
263 of 328 wheat producers gained knowledge of UT recommended agronomic and pest management practices and 145 of 263 producers adopted two or more of those practices. Wheat producers increased yield 77,410 total bushels by adopting two or more recommended production practices on 316,949 acres increasing total income by $367,698.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #21

1. Outcome Measures

Tennessee Row Crop Irrigation (Integrated Research and Extension)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Tennessee Row Crop Producer are interested in maximizing yield with irrigation and having irrigation as insurance against drought. They have to make appropriate choices of when and where to adopt irrigation since the cost is high and varies by site from $1000 to $2000 per acre in a region where rainfall and good water holding soils often provide a majority of the crop's water requirement. Once a decision has been made to install and irrigation system, a major concern is how to best operate that system in the face of unpredictable rainfall patterns. At any irrigation decision point, producers do not know whether to expect a 4 inch rain, a 4 week drought or something in between. Row crop irrigators report substantial yield gains in dry years and sometime yield losses in wet years when irrigation is incorporated into their operations.

What has been done
The concept of Deficit or Reasonable Depletion Irrigation has been introduced, studied and promoted to meet the needs of row crop irrigators in Tennessee. This approach withholds irrigation until a significant soil water depletion develops and then applies irrigation to maintain the desired level of depletion, thus allowing for the capture of rainfall while maintaining a reserve of easily available water in case of drought. Since 2012, irrigation recommendations have been presented at 62 extension workshops to 2609 producers/professionals (10 presentations to 470

individuals in 2017) and at 17 Regional and International Conferences to 575 professionals (9 presentation to 315 professionals in 2017). Extension Agents and Specialist have assisted in facilitating the research center experiments, the on-farm demonstrations, and the extension workshops.

Results

-From 2011 to 2017, row crop irrigation has increased from 70,687 to 198,364 acres according to FSA certified agricultural acreage reports. Presently, irrigation is employed on 7% of the total row crop acreage in Tennessee.

-The average benefit from row crop irrigation in Tennessee is 250 lbs/ac for cotton, 50 bu/ac for corn and 18 bu/ac for soybean based on Research and Education Center plots and producer surveys. The current allocation of irrigation is 25% cotton, 35% corn and 45% soybean. Based on 2017 commodity prices, over $35,000,000 were added to Tennessee's agricultural economy by row crop irrigation.

-Prior to 2012, no established crop consultants or agri-businesses were providing irrigation scheduling services to Tennessee row crop irrigators. As of 2017, there are now 4 irrigation scheduling providers who have contracted with 61 producers on 15,000 acres. There is an unknown multiplier effect on scheduled acres since producers will schedule irrigation on nearby fields that have similar soils, crops and planting dates.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
205	Plant Management Systems

Outcome #22

1. Outcome Measures

Tennessee Extension Leads Variety Test Program for Corn Grain, Silage, and Soybeans

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Tennessee producers need information concerning corn and soybean variety test performance specific to their region so that they can select varieties that will optimize the profitability of their

production systems.

What has been done
The variety test program provides important information on which varieties perform best in Tennessee. Replicated variety tests were conducted on corn grain (86 hybrids; 16 brands), corn silage (11 hybrids, 5 brands), and soybeans (195 varieties; 23 brands) at seven of the UT Research & Education Centers located in the different physiographic regions of Tennessee in 2017. Results from these crop trials were compiled, along with results from the County Standard Tests (CST) and soybean disease variety trials, and published in three peer-reviewed Extension publications. These were distributed electronically as both pdf and mobile-friendly, searchable tables on search.utcrops.com as well as through hard copies (2,250 - corn, 2,250 - soybean, and 300 - silage) distributed to farmers, extension agents, seed industry reps, consultants and other interested clientele.

Results
In 2017, the variety test program provided an estimated $83.38 million in additional revenue to Tennessee producers. These numbers were calculated assuming 88% of producers use the variety test results to select top performing varieties, as indicated by a survey conducted in 2017, yield advantage for top performing varieties compared with average test yields of +11.4 bu/a for corn and +3.9 bu/a for soybeans when averaged over the past three years, and USDA reported Tennessee acreage and commodity prices in 2017. The variety test program has a significant economic impact to Tennessee producers and continues to be a program that is highly valued by producers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

V(H). Planned Program (External Factors)

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Competing Programmatic Challenges

Brief Explanation

• Corn was planted and harvested on more than 710,000 acres in Tennessee in 2017. The 2017 growing season started with a wet spring followed by a growing season that included moderate temperatures and more plentiful rainfall across the state. Farmers reported some of their highest corn yields across most areas of the state. The final state average yield was a record 171 bushels/acre (Jan 2018 NASS Quick stats). Corn prices were low due to the large U.S. crop with producers receiving closer to $3.35 per bushel for their crop on average. Projected cash receipts for 2017 corn grain in Tennessee are estimated at more than $406 million.

• Soybeans were harvested on more than 1.66 million acres in Tennessee in 2017. Moderate temperatures and plentiful rainfall throughout much of the season created a more uniform yield environment in most counties across the state and there was a final record state average yield of 50 bushels/acre (Jan 2018 NASS quick facts). Soybean prices were mediocre and most producers received close to $9.50 per bushel for their

crop. Projected cash receipts for soybeans in 2017 are more than $788 million.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In 2017, the variety test program provided an estimated $83.38 million in additional revenue to Tennessee producers. These numbers were calculated assuming 88% of producers use the variety test results to select top performing varieties, as indicated by a survey conducted in 2017, yield advantage for top performing varieties compared with average test yields of +11.4 bu/a for corn and +3.9 bu/a for soybeans when averaged over the past three years, and USDA reported Tennessee acreage and commodity prices in 2017. The variety test program has a significant economic impact to Tennessee producers and continues to be a program that is highly valued by producers.
In this program, more than 50 soybean mutants were discovered that have higher yield compared to the control plants. These results will be validated using a field trial with replicates and proper experimental design at a later stage of the project.
Grain amaranth varieties were identified that are suitable as an alternative C4 crop for Tennessee producers; alternative markets (i.e. microbrewing) have been identified for the crop.

Key Items of Evaluation

In 2017, the variety test program provided an estimated $83.38 million in additional revenue to Tennessee producers. These numbers were calculated assuming 88% of producers use the variety test results to select top performing varieties, as indicated by a survey conducted in 2017, yield advantage for top performing varieties compared with average test yields of +11.4 bu/a for corn and +3.9 bu/a for soybeans when averaged over the past three years, and USDA reported Tennessee acreage and commodity prices in 2017. The variety test program has a significant economic impact to Tennessee producers and continues to be a program that is highly valued by producers.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Animal Systems

☑ 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
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	2%	0%
205	Plant Management Systems	0%	0%	15%	0%
301	Reproductive Performance of Animals	15%	15%	21%	0%
302	Nutrient Utilization in Animals	0%	0%	16%	21%
303	Genetic Improvement of Animals	10%	10%	0%	22%
304	Animal Genome	0%	0%	0%	29%
305	Animal Physiological Processes	0%	0%	5%	0%
306	Environmental Stress in Animals	0%	0%	1%	0%
307	Animal Management Systems	60%	60%	10%	7%
311	Animal Diseases	15%	15%	8%	7%
312	External Parasites and Pests of Animals	0%	0%	3%	0%
315	Animal Welfare/Well-Being and Protection	0%	0%	15%	0%
402	Engineering Systems and Equipment	0%	0%	0%	0%
603	Market Economics	0%	0%	0%	14%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%	0%	2%	0%
722	Zoonotic Diseases and Parasites Affecting Humans	0%	0%	2%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	44.0	5.0	30.0	8.0
Actual Paid	41.0	0.0	0.0	11.6
Actual Volunteer	6.0	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**
814709	0	0	502832
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
3796328	0	0	502832
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
200000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Livestock sales in Tennessee total over $1 billion annually. Tennessee has 3.5 million acres of forages, 2.1 million head of beef cattle, 210,000 horses and 102,000 goats. Total economic impact of the livestock sector is $5 billion annually in the state. To remain viable in a competitive marketplace, livestock and forage producers must improve their management efficiency, sustainability and productivity. Tennesseans need education in maintaining or improving production efficiency, marketing, product quality and food safety.

In FY 2017, the Master Beef Producer Program was led by a team of University of Tennessee Extension specialists and agents, with the support and involvement of representatives of state agencies, businesses and organizations that have an interest in the state's cattle industry. Master Beef Producer programs were taught by agents that had completed the comprehensive training curriculum. During this training, agents were exposed to each session of the program, and were provided on-screen presentations, speaker notes, evaluation instruments, and instructions about the most effective strategies for teaching this curriculum. Industry professionals, veterinarians, and other local industry leaders were included as a part of the teaching team. The Master Beef Producer Program:

1. Included a series of 12 educational sessions that focus on cow-calf production and issues facing the beef industry. These were conducted at various off-campus locations accessible to Tennessee beef producers. These sessions included hands-on demonstrations, mini-lectures, discussions, question and answer sessions, etc.

2. Enhanced the profitability and competitiveness of cow-calf operations by providing essential, technical information.

3. Provided participants with a beef production reference manual that covered in detail the educational information presented in the sessions.

4. Allowed producers to interact with trained facilitators and encouraged sharing of ideas with other producers.

Goats are an environmentally adaptive specie of livestock, extremely opportunistic and afford the small limited resource landowner(s) an alternative enterprise. The goat provides food security, high quality protein (for human nutrition), biological land enhancement and many 'value-added' products to increase revenue generated on a holistically sustainable rural farm. With the decrease in planted tobacco acreage and income from this traditional crop, the production of goats becomes a natural alternative. Tennessee continues to rank second in meat goats in the U.S. The total number of meat goats in Tennessee on January 1, 2009 was 133,000 head, up 9,000 head from 2008. Milk goats totaled 5,800 head, unchanged from the previous year (TN Farm Facts, February 4, 2009). Meat goat numbers have been significantly increasing within the United States since the early 1990's but goat meat consumption has surpassed

available supply, based on ethnic group statistics. The importation of goat meat (30 pound carcass equivalent) surpassed export in 1994. There is no longer an export value for goat meat; the import value has tripled.

The Tennessee Browsing Academy was extensive four day hands-on training for producers, educators / government agency personnel interested in the biological and environmentally sound practices of vegetative management with small ruminants (specifically goats). This class was taught through lecture and applied practices as the participants learn new techniques.

The most outstanding example of successful outcomes encompassing the work of extension specialists, county extension agents, and clients was the Master Meat Goat Producer Program. This program reached producers, government agencies, meat goat organizations, and 4-H groups.

We conduct applied and basic research in animal health, nutrition, physiology, and genomics to address high priority problems of the livestock industries. We disseminate information gained from these studies to producers, veterinarians, and others associated with the animal industries through outreach programs and publications.

Surveillance of possible disease vectors is maintained throughout the insect season; suspected vectors are tested for appropriate viruses. Risk factor analysis test results are compared between sites where disease risk is high vs. those where disease risk is low. Mastitis susceptible and resistant dairy cows are used to identify potential genes, immune components, and other factors associated with and responsible for mastitis resistance. A series of trials uses pigs to test various feeding regimens and feed additives to determine effects on the number of antibiotic resistant foodborne pathogens occurring in those animals and their environment. Additional studies are detecting the prevalence of antibiotic resistant bacteria associated with cattle and surrounding environments. These studies should help determine strategies to limit such foodborne risks.

Other Activities:
Conduct research on the longitudinal survival and reproductive output of meat goat does.
Conduct research on nutritional requirements for Guinea fowl.
Perform genome mapping of important production qualities in Guinea fowl.
Conduct focus group meetings to collect information from producers and consumers.
Develop and administer surveys to selected producers and consumers.
Identify selected meat goat consumers/ethnic groups/communities.

2. Brief description of the target audience

Producers, veterinarians, and others associated with the animal industry were the target audience for this planned program. Tennessee cattle producers are primarily cow-calf operators, and all of the state's cow-calf operators were in the target audience for this planned program.

Additional target audiences: Dairy and meat goat producers, the national meat goat industry, institutions of meat goat research, ruminant livestock producers, students, public officials, Guinea fowl and poultry industries, small farmers, scientific community.

3. How was eXtension used?

Tennessee Extension personnel were was part of the following eXtension Communities of Practice that informed our work on this planned program:

- Beef Cattle
- Goats
- Horses

- Sheep

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	222431	950	18322	1000

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	17	7	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote awareness of and participation in this planned program.

Year	Actual
2017	8877

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2017	638

Output #3

Output Measure

- Evaluate Alternative Heating Systems for Broiler Houses (Hawkins)

Year	Actual
2017	0

Output #4

Output Measure

- Improve Reproductive Efficiency in Cattle (Rispoli)

Year	Actual
2017	0

Output #5

Output Measure

- Promote Native Grasses in Forage Systems (Keyser)

Year	Actual
2017	0

Output #6

Output Measure

- Improve nutrient utilization in heat-stressed lactating dairy cows (Ruis)

Year	Actual
2017	0

Output #7

Output Measure

- Develop novel methods of measuring temperament in bulls (Kattesh)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Extension Economic Impact: The total economic impact of Extension animal systems programs. (The target is expressed in millions of dollars.)
2	Beef Production and Marketing: Number of beef producers who utilized improved sires, artificial insemination or other genetic improvement methods.
3	Beef Production and Marketing: Number of beef producers who improved marketing methods.
4	Beef Production and Marketing: Number of producers who improved forages for livestock by broadleaf weed control, planting clover, stockpiling fescue or planting warm-season grasses.
5	Beef Production and Marketing: The number of calves managed according to Beef Quality Assurance (BQA) guidelines.
6	Goat Production: Number of goat producers who have implemented practices related to genetic improvement, nutrition, health, reproduction and other information as a result of the Master Goat Program.
7	Develop Diagnostic Devices for Animal/Human Diseases (Eda)
8	Supplement Nutrients for Improved Reproduction (Mulliniks)
9	Research to provide new information on the benefit of a new sire breed option (Savannah) and creep feeding on improving the doe output and economic return for commercial meat goat enterprises. (Browning)
10	Efficiency of feed utilization in poultry through knowledge and implementation of optimum nutrient requirements, especially methionine and cysteine. (Nahashon)
11	Genetic resource information for future and rapid selection of well performing animals and those that can transmit superior economic traits to future generations. (Nahashon)
12	Discovery of modes of action of probiotics and new nutrient sensing pathways leading to establishment of precise nutrient requirements of poultry, especially chickens and guinea fowl. (Nahashon)
13	Research to enhance income for meat goat producers through increased consumer knowledge about goat meat and retailer knowledge of goat meat preferences. (Ekanem)
14	Enhanced producer knowledge of marketing information to expand goat meat sales to existing markets. (Ekanem)
15	Efficacy of fat deposition reduction in poultry through genotyping by sequencing approach for analysis of chicken genome. (Wang)
16	Research intestinal microbiota as alternatives to antibiotic growth promoters for food animals and to combat human obesity (Lin)
17	Address S. aureus as causative agent of mastitis (Dego)
18	Develop Non-Antibiotic Strategies for Dairy Cattle Mastitis (Almeida, Prado, Luther)
19	Conduct basic and applied research in innate immune interferons to develop novel antiviral therapeutics for the livestock industry. (Sang)

20	Increasing Returns for Tennessee Equine Owners through Extension Programs
21	Tennessee Extension Meat Quality, Safety and Marketing Educational Program
22	Master Dairy Producer Program Improves Producers' Knowledge of Milk Quality
23	Making Tennessee Forage Producers More Efficient and Profitable

Outcome #1

1. Outcome Measures

Extension Economic Impact: The total economic impact of Extension animal systems programs. (The target is expressed in millions of dollars.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	109

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Challenges facing the beef cattle industry in Tennessee range from the adoption of very basic management practices to complicated global market drivers that affect input costs. Nutritional, reproductive, genetic, and health management are the general areas that impact profitability most.

What has been done

109 UT Extension Agents and Specialists spent 35,769 hours conducting educational programs that reached 202,802 direct contacts during 2017. Best management practices in beef cattle production were taught at 2,528 group meetings, 2,344 on-site visits and 4,708 walk-in consultations in the local county office. Reach and impact, as measured by direct contacts, remained stable compared to 2016 in all categories reported. Mail, telephone and electronic communications reached 103,308 contacts. These direct methods were reinforced by 3,299 social media posts, 6,337 newspaper articles, 6,683 radio programs and 13 television programs reaching an estimated 8.4 million indirect contacts. Volunteers invested 1,352 hours of their personal time to establish a total of 55,369 direct and indirect contacts.

Results

The total economic impact of UT Extension's beef cattle programming was estimated at more than $109.3 million in savings and additional revenue.
-3,892 beef producers sold 148,975 calves that were managed for improved marketing methods,

according to practices promoted by UT Extension, to increase returns by $10,875,175.
-2,860 beef producers utilized 3,958 bulls (through natural service or artificial insemination) with greater genetic potential to produce 93,964 head of calves to increase returns by $4,698,200.
-1,986 beef producers implemented reproductive management by conducting breeding soundness exams on 14,931 bulls ($74,655,000 increased returns) and pregnancy diagnosis on 47,673 cows/heifers ($19,105,200 increased returns).
Adoption of modern technologies for reproductive management increased from that reported in the previous year. These practices have dramatic impact on the profitability of beef cattle production. Thus, County Agents focused on increasing adoption of those practices and that is evident in the dramatically positive financial impact reported here. In 2017, UT Extension programming for beef cattle production and management continued to enhance the lives and livelihood of Tennessee beef cattle producers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #2

1. Outcome Measures

Beef Production and Marketing: Number of beef producers who utilized improved sires, artificial insemination or other genetic improvement methods.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2956

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals

Outcome #3

1. Outcome Measures

Beef Production and Marketing: Number of beef producers who improved marketing methods.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4003

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #4

1. Outcome Measures

Beef Production and Marketing: Number of producers who improved forages for livestock by broadleaf weed control, planting clover, stockpiling fescue or planting warm-season grasses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4015

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #5

1. Outcome Measures

Beef Production and Marketing: The number of calves managed according to Beef Quality Assurance (BQA) guidelines.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4003

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area

307	Animal Management Systems

Outcome #6

1. Outcome Measures

Goat Production: Number of goat producers who have implemented practices related to genetic improvement, nutrition, health, reproduction and other information as a result of the Master Goat Program.

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	743

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases

Outcome #7

1. Outcome Measures

Develop Diagnostic Devices for Animal/Human Diseases (Eda)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #8

1. Outcome Measures

Supplement Nutrients for Improved Reproduction (Mulliniks)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems

Outcome #9

1. Outcome Measures

Research to provide new information on the benefit of a new sire breed option (Savannah) and creep feeding on improving the doe output and economic return for commercial meat goat enterprises. (Browning)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers need to better assess the ability of breeds to contribute to efficient market kid production under limited inputs. Many producers have made poor breed choices that have led to non-sustainable operations. Creep-feeding in meat goat systems has often been recommended and implemented without sufficient research to support the recommendation.

What has been done

Savanna bucks have been compared to Kiko and Spanish bucks for preweaning progeny performance. Kids born were either creep-fed or not provided creep feed to assess growth and economic outcomes. Presentations and research updates were disseminated to at industry events and academic meetings.

Results
Research outcomes indicated that Savanna sires did not demonstrate an advantage over Kiko or Spanish sires for kid performance. Creep feeding enhanced kid growth, but did not necessarily enhance net economic return. Dissemination of results have allowed 700 new and experienced producers to gain a better understanding of the potential benefits of informed breed selection and creep-feeding for use in commercial meat goat herds.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #10

1. Outcome Measures

Efficiency of feed utilization in poultry through knowledge and implementation of optimum nutrient requirements, especially methionine and cysteine. (Nahashon)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Methionine and lysine are essential amino acids for growth performance of poultry; however, the requirement for the amino acids methionine and cysteine, and lysine for optimum growth performance of the guinea fowl is not known. Lack of optimal dietary amino acid profiles can hamper growth performance and increase cost of poultry production.

What has been done
The methionine and cysteine, and lysine requirement for optimum growth performance of the guinea fowl was evaluated.

Results
The requirement for methionine and cysteine for by the French guinea fowl was determined to be 0.45-0.50% and 0.35%, respectively. Pearl grey guinea fowl females and males demonstrated

optimum growth performance when fed diets containing 1.16% and 0.98-1.22% lysine, respectively. It was determined that these diets should be fed in phases. Genetic resource information for future and rapid selection of well performing animals and those that can transmit superior economic traits to future generations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
304	Animal Genome

Outcome #11

1. Outcome Measures

Genetic resource information for future and rapid selection of well performing animals and those that can transmit superior economic traits to future generations. (Nahashon)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Genetic resource information to aid marker assisted selection for traits of economic importance, such as feed efficiency, and to aid poultry improvement, such as the guinea fowl, is limited. Understanding the nutrient requirements and generating additional genetic resource information to aid breeding will significantly aid poultry production and profitability, especially by small scale farmers willing to raise the bird for commercial purposes.

What has been done
Guinea fowl sequences of the bursa, spleen and bone marrow were generated through de novo sequencing and assembled.

Results
Discovery of modes of action of probiotics and new nutrient sensing pathways leading to establishment of precise nutrient requirements of poultry, especially chickens and guinea fowl. A total of 114.18 GB of bases were generated and 9 assemblies were realized. These sequences will be utilized in generating immune markers for comparative mapping, future selection and genetic improvement of the avian species. 1000 genes were annotated. Transcriptome analysis

of differentially expressed genes in the bursa of the guinea fowl yielded 902 differentially expressed contigs, 64 biological pathways with 35 showing activation and 5 showing suppression. It was also revealed that even at 8 weeks of age, the bursa plays an active role in disease resistance in guinea fowl.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
304	Animal Genome

Outcome #12

1. Outcome Measures

Discovery of modes of action of probiotics and new nutrient sensing pathways leading to establishment of precise nutrient requirements of poultry, especially chickens and guinea fowl. (Nahashon)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The gastrointestinal tract is an enormous surface inhabited by a complex and diverse community of microorganisms known as the intestinal microflora. Some of these microorganisms have been characterized while others have not, yet they might bear beneficial effects on bird performance by enhancing health and nutrient utilization.

What has been done
The 16s rDNA library of chicken and guinea fowl gastrointestinal microbials was constructed, enriched and sequenced, and analyzed.

Results
The microbial profile of chicken and guinea fowl revealed diverse probiotic bacteria whose distribution was correlated with performance characteristics in attempt to improve poultry growth and production performance. Microbial profiles of chicken and guinea fowl revealed phylogenetic diversity of these avian species consisting of almost 150 families. Chicken microbial profiles showed abundance of microbial species compared to guinea fowl. Phylum actinobacteria was more abundant in chickens than guinea fowl.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
304	Animal Genome

Outcome #13

1. Outcome Measures

Research to enhance income for meat goat producers through increased consumer knowledge about goat meat and retailer knowledge of goat meat preferences. (Ekanem)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Goat producers need to meet consumer demand for nutritious alternatives to red meat. Producers need the connections with consumers to satisfy demand for goat meat. Retailers seek opportunities to gain new knowledge about goat meat. Students and researchers desire to learn about goat meat marketing research.

What has been done
Team engaged target audiences in training, focus groups, conferences, expo, field days, meetings, interactive dialogue, seminars, surveys, symposiums, tours and related educational outreach.

Results
More than one-half of study participants (males, aged 51 to 80 years), sold goats at auction markets. Eighty-seven percent of the female producers used the internet in their operations. Results showed that sale of goat meat online increased. About 20 percent of the producers who used the internet to conduct business now sell goats and goat meat online. Almost 42% of participants increased goat meat sale online since they started advertising and marketing goat meat online. Others used online to advertise products, communicate with other farmers, identify competitors, locate auction markets, obtain data on prices, purchase inputs, and maintain inventory.

4. Associated Knowledge Areas

KA Code	Knowledge Area

603 Market Economics

Outcome #14

1. Outcome Measures

Enhanced producer knowledge of marketing information to expand goat meat sales to existing markets. (Ekanem)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Market information is a critical factor for both producers and consumers. Good and timely information about the market and trends in the preferences of consumers allow the producers to track price changes and adjust production decisions accordingly.

What has been done
Project provided producer/consumer education on healthy attributes of goat meat to enhance market connections. Marketing survey, seminars, symposium, visits, meetings, exhibitions, and presentations were used in addressing the nutritional value and benefits of consuming goat meat. Knowledge of such benefits enhances the market value and price paid by consumers for goat meat.

Results
71% of non-white consumed goat meat; whites showed increasing interest in consuming more goat meat. 29% of the consumers indicated that goat meat has now become a part of their regular diet. Consumers were willing to travel long distances and pay top dollars for goat meat from local and hometown producers. About 35% developed good connections; they knew where to purchase goat meat when they need it, especially during holidays. This increased sales for local producers of goat meat. Pre- and post-activity evaluations were used to track progress and modify project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics

Outcome #15

1. **Outcome Measures**

Efficacy of fat deposition reduction in poultry through genotyping by sequencing approach for analysis of chicken genome. (Wang)

2. **Associated Institution Types**

- 1890 Research

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	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
304	Animal Genome

Outcome #16

1. **Outcome Measures**

Research intestinal microbiota as alternatives to antibiotic growth promoters for food animals and to combat human obesity (Lin)

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
302	Nutrient Utilization in Animals
305	Animal Physiological Processes

Outcome #17

1. Outcome Measures

Address S. aureus as causative agent of mastitis (Dego)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
306	Environmental Stress in Animals
311	Animal Diseases

Outcome #18

1. Outcome Measures

Develop Non-Antibiotic Strategies for Dairy Cattle Mastitis (Almeida, Prado, Luther)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
305	Animal Physiological Processes

306	Environmental Stress in Animals
307	Animal Management Systems
311	Animal Diseases

Outcome #19

1. Outcome Measures

Conduct basic and applied research in innate immune interferons to develop novel antiviral therapeutics for the livestock industry. (Sang)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The research will examine a group of antiviral molecules that play a defense role in all livestock species and potentially to develop into an effective measure against viral diseases. Therefore, it is of direct interest to professionals in the area of animal health and production, as well as animal disease workers and livestock farmers who directly care of livestock herds. In addition, the general public should be concerned due to the zoonotic fact of most viral diseases existing in livestock animals, such as flu and Zika.

What has been done

We have determined phylogenic relationship of animal type I and type III innate immune interferons across the genome assemblies of 155 vertebrate species. Compared to humans and mice, which have around 17-20 IFN functional genes, bovine and porcine IFN loci contain about 60 IFN functional genes belonging to nine unconventional IFN subtypes. Based on this molecular identification and phylogenic analyses, we are well-posited in functional characterization of these unconventional IFNs in livestock.

Results

We have cross-species determined the molecular composition of interferon gene families in major livestock species including pigs, cattle and chickens. We further reveal novel molecular features (including double intramolecular Fab domains and novel IFN subtypes) and more than three hundred IFN homologs which are belong to unconventional subtypes other than well-studied typical subtypes of IFN-alpha and IFN-beta. A functional study using porcine interferons as examples is complete. Major results have been disseminated in several journal publications and reported in scientific conferences and symposia.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
311	Animal Diseases

Outcome #20

1. Outcome Measures

Increasing Returns for Tennessee Equine Owners through Extension Programs

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The equine industry has an impressive economic and agricultural impact to the State of Tennessee. Currently, the equine industry contributes $21 million to Tennessee's economy annually, and the state is home to over 112,000 horses, ponies, mules donkeys and burros. With over 41,000 equine operations accounting for nearly 30% of Tennessee's agricultural acreage, UT Equine Extension programs are essential to sustainable agriculture in the State.

What has been done
An integrated, multi-disciplinary extension and applied research program is currently being revitalized to develop and disseminate information regarding equine management, nutrition, economics, environmental impact and health. In 2017, county meetings, field days, on-farm/on-site visits, news articles, publications, personal contacts and an educational website were used to promote adoption of recommended equine management practices. Additionally, the Tennessee Master Horse Program continued this year, providing an unbiased science-based statewide educational program for equine owners, business operators and enthusiasts alike.

Results
The combined economic impact of Extension programs for Tennessee equine owners $518,000.00 in 2017. Individual savings based on management practices are listed below.

-76 equine owners feed 185 equids according to recommended nutritional requirements and management practices, such as adjusting rations based on body condition score and using forage testing to make feeding adjustments, saving $54,000.00 annually.
-69 equine owners follow recommended health practices (including deworming, vaccination, hoof, and dental preventative care) on 202 equids, saving $464,000.00 annually.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #21

1. Outcome Measures

Tennessee Extension Meat Quality, Safety and Marketing Educational Program

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Tennessee livestock producers and meat processors must deliver safe, high quality products to consumers.

What has been done
Extension personnel have designed and participated in educational programs to assist livestock producers, meat processors and consumers to utilize and prepare safe, high quality meat products. Also, information on meat marketing alternatives has been developed. Information has been disseminated via public programs, media outlets and individual consultation.

Results
-Over 350 beef producers and agents learned marketing and processing information through "The End Product" workshop for the Advanced Master Beef Program, grass-fed beef carcass traits, and other beef-related programs.
-Approximately 200 sheep and goat producers gained knowledge of lamb/goat quality assurance and lamb/goat carcass traits and fabrication
-35 consumers participated in a two Home Meat Processing Workshops to increase knowledge and skills related to meat processing, quality, and safety.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
307	Animal Management Systems
603	Market Economics

Outcome #22

1. Outcome Measures

Master Dairy Producer Program Improves Producers' Knowledge of Milk Quality

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dairy production in Tennessee faces one of the primary issues of dairy production across the nation, which is loss of dairy farms. This is a critical issue as it was previously estimated that for each dollar of profit a dairy farm generates an additional $5-7 dollars are generated within the local economy. With an average of roughly 100 cows, a typical Tennessee dairy farm will contribute over a million dollars to the surrounding economy. Some of the main challenges to our farms and their survivability are milk quality, efficiency of production, and cost of production. Grazing and calf management may provide opportunities to address some of this.

What has been done
During 2017, various group meetings, farm visits, directed mail and email, and phone calls were used to reach the state's dairy producers with research-based education. Our major educational effort was the Master Dairy Producer Program.

Results
-More than 100 dairy producers gained knowledge of mastitis, nutrition, and housing from their involvement in the Master Dairy Producer Program. These farm factors contribute directly to the overall productivity of Tennessee's dairy farms.
-57 producers have gained knowledge on measures of milk quality indicators (including somatic cell count, preliminary incubation count, standard plate counts, lab pasteurized counts, etc.)
-57 producers have learned the relationship between somatic cell counts and milk production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #23

1. Outcome Measures

Making Tennessee Forage Producers More Efficient and Profitable

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
More efficient forage production will contribute to improved profitability for Tennessee forage producers.

What has been done
UT Extension conducted forage educational programs reaching over 28,000 direct contacts during 2017. Stockpiling tall fescue and weed control, as well as adding clovers to grass pastures and utilizing warm-season forages were primary educational topics covered. These were taught through approximately 300 group meetings and over 984 on-site visits. These direct contacts were supported by over 100 newspaper articles and 37 radio and TV programs.

Results
On-farm interviews and surveys were used to evaluate these programs. Impacts were:
-Producers planted 39,519 acres with clover for an increased production valued at $988,000.
-Producers planted 28,741 acres with warm-season grasses for an added value of $575,000.
-Producers fed 61,242 cattle with improved hay feed practices, saving $1.5 million.
-Producers stockpiled 17,769 acres of tall fescue, reducing feeding cost by $853,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
302	Nutrient Utilization in Animals
307	Animal Management Systems

V(H). Planned Program (External Factors)

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

The financial impact of Extension animal systems programming fluctuates from year-to-year depending on several factors including commodity prices, public policy, input costs, and land value. Extension animal systems programs continue to enhance the lives and livelihoods of Tennessee farmers.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

New microorganisms were revealed from the gastrointestinal tract of chicken and guinea fowl. These microorganisms will be evaluated for probiotics potential and as alternatives to antibiotics in broiler production. New recommended dietary concentrations of methionine, cysteine and lysine are being utilized and are lower than those previously used by feeding turkey rations to guinea fowl.
Optimizing Animal Production - Extension agents emphasized quality assurance, reproductive management, nutrition, and marketing with Tennessee beef producers, with an economic impact of $109 million. Tennessee horse owners depend on UT Extension's research-based programs for horse health and nutrition. UT Extension taught rotational grazing to increase forage production, vaccinations, dental care, and correct deworming practices. These practices helped 121 horse owners, owning more than 1,000 horses, to save a combined $605,000.

Key Items of Evaluation

Optimizing Animal Production - Extension agents emphasized quality assurance, reproductive management, nutrition, and marketing with Tennessee beef producers, with an economic impact of $109 million. Tennessee horse owners depend on UT Extension's research-based programs for horse health and nutrition. UT Extension taught rotational grazing to increase forage production, vaccinations, dental care, and correct deworming practices. These practices helped 121 horse owners, owning more than 1,000 horses, to save a combined $605,000.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Childhood Obesity

☑ 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
501	New and Improved Food Processing Technologies	0%	0%	0%	0%
502	New and Improved Food Products	0%	0%	0%	34%
701	Nutrient Composition of Food	5%	5%	0%	33%
702	Requirements and Function of Nutrients and Other Food Components	0%	0%	0%	0%
703	Nutrition Education and Behavior	95%	95%	0%	0%
704	Nutrition and Hunger in the Population	0%	0%	0%	33%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%	0%	0%	0%
806	Youth Development	0%	0%	0%	0%
	Total	100%	100%	0%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	75.0	9.0	0.0	6.0
Actual Paid	68.0	0.0	0.0	3.3
Actual Volunteer	10.0	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**
1342927	0	0	142249
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
6257684	0	0	142249
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5986105	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Many Tennesseans suffer from chronic diseases or conditions associated with obesity that could be mitigated with healthier diets and more physical activity. UT and TSU Extension pursued the Childhood Obesity planned program to help Tennesseans manage weight, increase physical activity, improve dietary quality, and ultimately, create healthy futures for Tennessee young people. The following programs weredelivered to Tennesseans in the places they live, work, and play:

- **Tennessee Shapes Up** was a multi-session program focused on eating meals together as a family and eating more fresh fruits and vegetables.
- **Pathweighs to Health** was a multi-session programs that helped participants to manage weight, recognize true hunger, and pursue strength training.
- **Power U** was targeted to young people through schools and afterschool programs. Extension personnel and volunteers taught 10 interactive lessons in nutrition and healthy lifestyles.
- **Healthy Steps** was taught to the state's pre-schoolers. The curriculum emphasized tasting fruits and vegetables and increasing physical activity.
- **Healthy Food Preparation** taught participants how to cook more meals at home and reduce sugar and salt in their diet.
- UT's Tennessee Nutrition and Consumer Education Program (TNCEP) and TSU's Food Nutrition Education Program worked to improve nutrition and health among the state's SNAP recipients and those eligible for SNAP.
- Expanded Food and Nutrition Education Program (EFNEP) was conducted by both UT and TSU Extension to expand nutrition education to the state's low-income families, particularly those with young children.

All UT and TSU Extension obesity prevention programs emphasized the following:

- how to use MyPlate.gov and following Dietary Guidelines.
- how to use the Healthy Plate Method.
- decreasing consumption of high-fat foods like fried foods, bologna, hot dogs, etc.
- increasing consumption of fruits, vegetables and whole-grains.

The TSU Yotuh Active and Media Savvy (YAMS) program was used to facilitate media literacy research and education. The goal of healthier Americans has been addressed through TSU research in novel ways to increase fiber intake for obesity reduction and the identification of naturally occurring compounds for anti-aging properties.

2. Brief description of the target audience

Tennesseans targeted included consumers and youth. Because of the prevalence of obesity in the state, all consumers are potentially members of the target audience. However, the TNCEP and EFNEP programs were targeted to the state's limited resource population. In addition, the TSU Food Nutrition Education Programs were targeted to eligible food stamp recipients.

3. How was eXtension used?

The Childhood Obesity planned program was enhanced through the service of:

- 12 Tennessee Extension personnel on the "Families, Food, and Fitness" CoP.
- two Tennessee Extension personnel on the "A,B,Cs of Omega 3's" CoP.

The "Families Food, and Fitness" CoP continues to make extensive use of social media in Tennessee to promote educational programs and resources related to improving dietary quality and increasing physical activity.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	278948	11208450	249711	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	3	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote program awareness and participation.

Year	Actual
2017	1426

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2017	22547

Output #3

Output Measure

- Number of flavonoids examined for reducing oxidative stress in fibroblast cells.

Year	Actual
2017	0

Output #4

Output Measure

- Number of flavanoids examined for adipocyte differentiate efficiency in fibroblast cells.

Year	Actual
2017	0

Output #5

Output Measure

- Number of focus groups held to determine perceived benefits, value and needs for relationships by probing habits, needs, preferences, values and lifestyles associated with food and media.

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Tennessee Shapes Up: Number of participants who decreased consumption of high-fat foods such as chips, fast food, fried foods, sausage, bacon, bologna, hot dogs, etc.
2	Tennessee Shapes Up: Number of participants who decreased consumption of high-sugar foods and sweetened beverages, such as soft drinks, Kool Aide type beverages, sweetened tea, etc.
3	Tennessee Shapes Up: Number of participants who increased consumption of fruits.
4	Tennessee Shapes Up: Number of participants who increased consumption of vegetables.
5	Tennessee Shapes Up: Number of participants increased consumption of whole grains.
6	Public acceptance of soy fiber fortified breads for increased fiber consumption. (Wu)
7	Establish the fundamental mechanism by which cost-effective, naturally available compounds can promote health and extend lifespan in humans.(Si)

Outcome #1

1. Outcome Measures

Tennessee Shapes Up: Number of participants who decreased consumption of high-fat foods such as chips, fast food, fried foods, sausage, bacon, bologna, hot dogs, etc.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	3730

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #2

1. Outcome Measures

Tennessee Shapes Up: Number of participants who decreased consumption of high-sugar foods and sweetened beverages, such as soft drinks, Kool Aide type beverages, sweetened tea, etc.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	5366

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #3

1. Outcome Measures

Tennessee Shapes Up: Number of participants who increased consumption of fruits.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	5085

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #4

1. **Outcome Measures**

Tennessee Shapes Up: Number of participants who increased consumption of vegetables.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	4987

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #5

1. **Outcome Measures**

Tennessee Shapes Up: Number of participants increased consumption of whole grains.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4531

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #6

1. Outcome Measures

Public acceptance of soy fiber fortified breads for increased fiber consumption. (Wu)

2. Associated Institution Types

- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Due to increasing chronic disease issues, the general public is paying more attention to their diets. Fiber is one important factor in the diet to prevent obesity, diabetes and other chronic diseases. Currently, Americans are consuming 50% less fiber than recommended levels. In Tennessee, soy is a major crop. Soy fiber could be a very good fiber source for making fiber-enriched products. Bread is a common foodstuff worldwide. Once fiber is incorporated into breads, most people can easily increase their daily fiber consumption without changing eating habits.

What has been done

Soluble, insoluble and total dietary fibers were fractionated from soy flour. All fiber fractions were incorporated into bread at various ratios with acceptable sensory qualities. All breads enhanced with soy fiber fractions exhibited attenuated glucose releasing profiles compared to control breads. Breads with 10% fiber content exhibited anti-obesity effects using in vitro 3T3-L1 cells.

Results
The study has revealed that soy dietary fiber could be added into bakery products at a certain percentage (up to 10%) without exhibiting negative impact on product quality. However, reduced pGI and glucose releasing profiles were observed in all breads fortified with fiber, and the soluble fiber-enriched bread exhibited the lowest pGI and glucose releasing profile. This study has provided evidence on significant effect of soluble soy dietary fiber on health benefits reading reduced glucose attenuation and lipid droplet accumulation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
701	Nutrient Composition of Food

Outcome #7

1. Outcome Measures

Establish the fundamental mechanism by which cost-effective, naturally available compounds can promote health and extend lifespan in humans.(Si)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
More and more adults are obese, and have muscle dysfunction, which may contribute to the accelerating of aging processes and decrease of quality of our daily life.

What has been done
Aging-reduced protein expressions in the muscle were reversed by treatment with Cocoa epicatechin. Tissues have been used for RNA sequence and metabolome analysis. One research paper has been prepared and submitted.

Results
Cocoa epicatechin intake affects some aging-related genes expressions. Dietary cocoa intake improves lipids and protein metabolism in mice. Cocoa supplementation improves skeletal muscle function in mice . One peer-review journal article is preparing and will be published in 2018. Two PhD students worked on this project are expected to graduate in May 2018.

4. Associated Knowledge Areas

KA Code	Knowledge Area
704	Nutrition and Hunger in the Population

V(H). Planned Program (External Factors)

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UT and TSU Extension evaluated all Childhood Obesity planned programs through a combination of surveys, observation, and interviews. Our evaluation demonstrated:

• 80% of participants in the Healthy Food Preparation evaluation (532 of 666) now prepare vegetables without salt.
• 69% of participants in the EFNEP evaluation (254 of 269) used food labels to make healthier choices.
• 90% of pre-school teachers in the Healthy Steps evaluation (35 of 39) reported increased physical activity among pre-schoolers in the program. These teachers were from 14 counties.
• 73% of students in the Power U program evaluation (1497 of 2045) increased physical activity.
• 60% of participants in the UT and TSU TNCEP program evaluation (4775 of 7994) increased physical activity.
• 51% of participants in the Tennessee Shapes Up evaluation (993 of 1935) lost a combined 6627 pounds (6.6 pounds on average per person).
Modified breads were developed that could be used to as a tool to increase fiber consumption and help prevent obesity, diabetes and other chronic diseases.

Key Items of Evaluation

UT and TSU Extension evaluated all Childhood Obesity planned programs through a combination of surveys, observation, and interviews. Our evaluation demonstrated:

• 80% of participants in the Healthy Food Preparation evaluation (532 of 666) now prepare vegetables without salt.
• 69% of participants in the EFNEP evaluation (254 of 269) used food labels to make

healthier choices.

- 90% of pre-school teachers in the Healthy Steps evaluation (35 of 39) reported increased physical activity among pre-schoolers in the program. These teachers were from 14 counties.
- 73% of students in the Power U program evaluation (1497 of 2045) increased physical activity.
- 60% of participants in the UT and TSU TNCEP program evaluation (4775 of 7994) increased physical activity.
- 51% of participants in the Tennessee Shapes Up evaluation (993 of 1935) lost a combined 6627 pounds (6.6 pounds on average per person).

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Economic Infrastructure and Commerce

☑ 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
123	Management and Sustainability of Forest Resources	0%	0%	3%	0%
205	Plant Management Systems	0%	0%	8%	0%
601	Economics of Agricultural Production and Farm Management	30%	30%	24%	50%
602	Business Management, Finance, and Taxation	5%	5%	8%	0%
603	Market Economics	5%	5%	3%	50%
604	Marketing and Distribution Practices	30%	30%	0%	0%
605	Natural Resource and Environmental Economics	0%	0%	26%	0%
606	International Trade and Development	5%	5%	3%	0%
607	Consumer Economics	10%	10%	0%	0%
608	Community Resource Planning and Development	15%	15%	9%	0%
609	Economic Theory and Methods	0%	0%	2%	0%
610	Domestic Policy Analysis	0%	0%	6%	0%
903	Communication, Education, and Information Delivery	0%	0%	8%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	32.0	7.0	35.0	2.0
Actual Paid	32.0	0.0	0.0	3.3
Actual Volunteer	5.0	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**
644605	0	0	142249
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
3003688	0	0	142249
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
75000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research analysis includes assessment of market potential, market feasibility studies for new agri-industry ventures, buyer and consumer preferences studies, market segmentation analysis and buyer profiling, analysis of new product acceptance, analysis of marketing alternatives, and analysis of valuation of product attributes. To evaluate the impacts of various policies, management strategies, or economic conditions on a farm's bottom line and financial strength, we are developing a set of representative farms that encompass major segments of agriculture in Tennessee. Methods for evaluating risk include risk-based econometric models, risk-based mathematical programming models, generalized stochastic dominance criteria, dynamic optimization, and subjective probability assessment criteria.

The Extension MANAGE program helped families analyze their total farming business so they can make informed decisions regarding their future. Extension staff trained in farm and financial management help families to:

- review their current financial situation
- capitalize on strengths and reduce weaknesses in the farm business
- develop individualized farm and financial plans
- explore alternatives both on and off the farm
- evaluate capital investment opportunities including land and/or machinery purchases
- analyze likely consequences of changing the scope of enterprises
- determine appropriate production practices

In addition to individualized farm and financial planning assistance, Extension offered hundreds of workshops to help farmers improve their financial situation. For example, workshops were offered in improved marketing, goal-setting, and strategic planning.

Although the MANAGE program did not remove uncertainty of the future, it provided farm families with a clear understanding of their current financial situation and help them evaluate their alternatives for the future. Making informed decisions today may be the best way to prepare for tomorrow's opportunities. The educational program was offered at no cost to participating farm families in all 95 Tennessee counties.

Land is a great source of wealth in the African-American community. In addition to providing economic stability, land ownership is highly correlated to one's social and economic well-being. Many urban residents who desire to return to the land of their origin find themselves confronted by various obstacles in terms of retaining rightful land ownership. In addition to problems they face of landownership retention are efforts to engage in profitable land use development, and operate viable farming enterprises.

Production inputs have changed over the past two decades. As a result of this, there was a reduction in the number of crops produced. In-service training on "Small Farm Outlook" will continue to be conducted to make landowners aware of resources that are available to them for land retention and crop production. The training will provide information on ways to keep land through estate planning, lessening their property, and legal issues for seniors (the aging population).

Leadership development workshops were focused on leadership, healthy self-esteem, positive risk-taking, achieving goals, ethical decision making, public speaking and responsible citizenship. Extension personnel also led, trained, recruited and coordinated more volunteers.

2. Brief description of the target audience

- Limited-resource and small farmers
- Farmers transitioning from tobacco to other crops
- Policy-makers at the state, federal, and municipal level
- Businesses looking to expand or relocate to Tennessee

3. How was eXtension used?

Tennessee Extension personnel annually address hundreds of Frequently Asked Questions through eXtension, including questions about economic infrastructure and commerce.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	105864	2010350	10533	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	14	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote program awareness and participation.

Year	Actual
2017	96

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2017	195

Output #3

Output Measure

- Perform economic analyses of various industries and agricultural practices (Jensen)

Year	Actual
2017	0

Output #4

Output Measure

- Promote local food production and consumption (Hellwinckel)

Year	Actual
2017	0

Output #5

Output Measure

- Provide forward looking economic analysis for Tennessee (English)

Year	Actual
2017	0

Output #6

Output Measure

- Evaluate economic resilience of agriculture and water use efficiency (Clark, Lambert)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Land Ownership Information Program: Number of African-American landowners who increased their knowledge of property rights and responsibilities.
2	Land Ownership Information Program: Number of African-American landowners who developed farm management plans.
3	Land Ownership Information Program: Number of African-American landowners who developed estate plans to reduce the financial and legal risks farm family businesses face as they transition between generations.
4	Farm Financial Analysis and Planning: Number of farm families and rural business operators who implemented partial budgeting decisions (examples include sell calves now or later and evaluating equitable leasing arrangements)
5	Farm Financial Analysis and Planning: Number of farm families who developed whole farm plans to improve their farm financial performance.
6	Tennessee Extension Leadership Development: Small businesses or non-profits developed by limited resource leaders.
7	Assess the Local Food System/the Knoxville Foodshed (Hellwinckel)
8	Promote the growth of the Tennessee viticulture industry by determining the impact of production designations (eco-labeling and other certifications) on consumer perception, preference and willingness to pay. (Kar)
9	Evaluate bioenergy economics (Yu, Jensen, Lambert, English)
10	Enhancing Tennessee Small-scale Fruit and Vegetable Farms' Ability to Manage Marketing and Financial Risks
11	Advance the sustainability of small farm enterprises through assessment of income risks and the role of diversification strategies among small farms in Tennessee and the United States.(Khanal)

Outcome #1

1. Outcome Measures

Land Ownership Information Program: Number of African-American landowners who increased their knowledge of property rights and responsibilities.

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #2

1. Outcome Measures

Land Ownership Information Program: Number of African-American landowners who developed farm management plans.

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #3

1. Outcome Measures

Land Ownership Information Program: Number of African-American landowners who developed estate plans to reduce the financial and legal risks farm family businesses face as they transition between generations.

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

Farm Financial Analysis and Planning: Number of farm families and rural business operators who implemented partial budgeting decisions (examples include sell calves now or later and evaluating equitable leasing arrangements)

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	322

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #5

1. Outcome Measures

Farm Financial Analysis and Planning: Number of farm families who developed whole farm plans to improve their farm financial performance.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	106

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #6

1. Outcome Measures

Tennessee Extension Leadership Development: Small businesses or non-profits developed by limited resource leaders.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Assess the Local Food System/the Knoxville Foodshed (Hellwinckel)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
601	Economics of Agricultural Production and Farm Management
603	Market Economics
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics
607	Consumer Economics

Outcome #8

1. Outcome Measures

Promote the growth of the Tennessee viticulture industry by determining the impact of production designations (eco-labeling and other certifications) on consumer perception, preference and willingness to pay. (Kar)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
While the American Viticultural Areas (AVA) designation has been extensively utilized by wineries internationally and domestically, it is relatively underutilized in Tennessee. Despite its establishment in 1984, the wine production activities in this area remain largely underdeveloped. As a comparison, the Outer Bank Plain AVA, established in 2007, has been credited to substantially increase the profile of wineries in New Jersey. This raises the question if similar success can be replicated in Tennessee, and other areas in the US where there exists the potential for growth in wine production.

What has been done

A literature review has been performed. The findings from the literature review have been condensed into a consumer survey, which is the primary instrument for data collection in this study. IRB clearance was gained and data collection was completed. The data consist of 1000 American wine drinkers. Preliminary econometric analyses were conducted, specifically, with a Willingness to Pay Space model.

Results
Of main interest is the effect of origin labeling. The use of an AVA designation does not raise consumers? willingness to pay for the product on average; it implies that at the mean level, consumers are not affected with the use of AVA label. The positive willingness to pay observed on the label ?Product of USA? suggest that labeling the wine with the Country of Origin label may elicit a higher willingness to pay; further undercutting the perceived use of AVA.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics

Outcome #9

1. Outcome Measures

Evaluate bioenergy economics (Yu, Jensen, Lambert, English)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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

601	Economics of Agricultural Production and Farm Management
603	Market Economics
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis

Outcome #10

1. Outcome Measures

Enhancing Tennessee Small-scale Fruit and Vegetable Farms' Ability to Manage Marketing and Financial Risks

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small-scale producers may only use direct-to-consumer outlets, given their limited ability to satisfy a large demand and meet requirements imposed by intermediate market outlets. These conditions present specific challenges, opportunities, and distinctive financial and marketing risks that may need to be managed in unique ways. For instance, farmers selling produce through farmers markets face a set of uncontrollable events that will influence not only prices received but sales volume.

What has been done
A total of 146 Tennessee fruit and vegetable producers with gross sales of less than $50,000 per year received training through five workshops on how to adapt available educational materials (e.g., Veggie Compass Whole Farm Profit Management, farmers markets price reports, enterprise budgets) to their specific operation conditions and how to use these materials to price products, determine sale volumes, calculate and track expenses, and evaluate farm profitability.

Results
Of the 146 producers who attended 2017 training events:
-84% indicated they gained new knowledge of managing marketing and financial risks.
-69% took steps to better manage marketing and financial risk.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #11

1. Outcome Measures

Advance the sustainability of small farm enterprises through assessment of income risks and the role of diversification strategies among small farms in Tennessee and the United States.(Khanal)

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small farms are unable to keep pace with agricultural advancements requiring high initial costs, so they carry uncertainty about future survival if they continue to follow conventional commodity production routes. Most small-sized agricultural farms face increasing pressure to increase the profitability and viability of their farming business. For most small farms, the only way to stay in business is to diversify and increase their incomes, either through new alternatives on the farm or from off-farm employment by allocating production assets and resources among different on-farm and off-farm income-generating activities. This is an important issue because sustainability of small farms rests on these strategic diversification activities to mitigate income variability at both farm and household levels.

What has been done
Using secondary data, we compared socio-economic and demographic characteristics, diversification, and economic and financial attributes of the farms in Tennessee in comparison to regional and national average. We also examined the participation decision on specific agricultural diversification such as organic farming, factors influencing such diversification and impact on economic performance of farm households using national-level secondary data set and appropriate econometric methods. To examine factors influencing diversification, financial constraints and conditions and impact on economic well-being specific to Tennessee farmers, information has been collected from primary survey of farms in Tennessee. Responses have been collected and being entered for preliminary analysis

Results
Based on our analysis and comparison of Tennessee farmers, we found that Tennessee farmers are lacking in leveraging assets for their proper utilization. The findings were synthesized and prepared as posters aimed at target groups and stakeholders. These findings also guided the preparation of proposals to seek additional grants for further research. Findings from secondary

data from national level also resulted conference paper for annual meetings of Agricultural and Applied Economics Association and publishable papers. Additionally, sources and utilization of funds by farm households and their financing mechanism and constraints are under study

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

V(H). Planned Program (External Factors)

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

We conducted an evaluation of our Extension direct marketing programs with the following impacts:
-Through Extension programming in 2017, 537 participants reported gaining direct marketing knowledge or skills to increase sales revenue, reduce costs, prevent losses, increase payroll or make one-time capital purchases.
-One year following educational programming, 1,442 participants reported implementing new or improved direct farm marketing practices or procedures generating $472,800 in increased sales.
-The following success story was submitted by a producer who participated in three Growing Digital workshops: Advanced Social Media, Video Content Creation and Marketing, and E-commerce Options.
"The workshops provided digital strategies that were used to enhance our social media platforms and create a digital library of engaging videos marketing 19 wineries in East Tennessee. In the first six months following the workshop, we increased our Facebook Likes on our wine trail page by over 2,000, had over 60,000 video views with 17,000 minutes of view time. These same videos have been used to create a You Tube Video Library. Using these same strategies we enhanced our digital event marketing on social media with our most successful event garnering a reach of over 1.3M. Our two most successful events had over 10,000 attendees; remarkable given one of these was a first time event. These workshops provided valuable information on digital marketing, gave participants the opportunity to do hands-on training, and significantly enhanced the digital presence and reach of our wineries and wine trails."

Key Items of Evaluation

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V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Environmental and Water Quality Impacts

☑ 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	0%	0%	7%	0%
102	Soil, Plant, Water, Nutrient Relationships	20%	20%	18%	10%
111	Conservation and Efficient Use of Water	0%	0%	12%	0%
112	Watershed Protection and Management	80%	80%	23%	30%
131	Alternative Uses of Land	0%	0%	3%	0%
132	Weather and Climate	0%	0%	1%	10%
133	Pollution Prevention and Mitigation	0%	0%	3%	20%
135	Aquatic and Terrestrial Wildlife	0%	0%	3%	10%
136	Conservation of Biological Diversity	0%	0%	0%	0%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	8%	0%
205	Plant Management Systems	0%	0%	0%	10%
212	Pathogens and Nematodes Affecting Plants	0%	0%	3%	0%
215	Biological Control of Pests Affecting Plants	0%	0%	2%	0%
216	Integrated Pest Management Systems	0%	0%	0%	0%
402	Engineering Systems and Equipment	0%	0%	0%	0%
403	Waste Disposal, Recycling, and Reuse	0%	0%	13%	10%
404	Instrumentation and Control Systems	0%	0%	0%	0%
601	Economics of Agricultural Production and Farm Management	0%	0%	2%	0%
605	Natural Resource and Environmental Economics	0%	0%	2%	0%
721	Insects and Other Pests Affecting Humans	0%	0%	0%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	5.0	1.0	35.0	12.0
Actual Paid	16.0	0.0	0.0	10.0

Actual Volunteer	2.0	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**
313349	0	0	433362
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1460126	0	0	433362
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
50000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We are developing economic and policy data by accessing existing sources, generating data from computer models, and surveying market participants. This data is analyzed using appropriate statistical and econometric methods. Watershed scale model assessments are conducted utilizing field-level estimates of alternative management practices (AMPs). Changes in water quality in impaired watersheds resulting from the evaluation of AMPs are measured. The cost of meeting different water quality standards at different points within a watershed and the potential impact of different environmental policies on Tennessee's agriculture are evaluated. A model used to project land use change estimates the probability of land development of individual parcels as a function of parcel-level attributes.

Soil research is fundamental to our environmental program.The erosion, sediment transport, and contaminant transport capabilities of the RUSLE2 soil erosion model continue to be refined as the model's use increases nationally and around the world. Soil samples are thoroughly characterized in terms of elemental composition, particle size, mineralogy, and other soil chemical and flow characteristics using standard techniques. New methods for decreasing the expense of measuring soil properties by agricultural producers and fellow researchers are developed.

As new waste treatment approaches are introduced, we provide research-based evaluation of appropriate technologies for Tennessee. Background information on the water quality is collected in various watershed areas, including one where baseline environmental data is being used to evaluate the impact of a dairy production unit on the area.

Research to enhance the protection of watersheds, understand sources of contamination, preserving aquatic ecosystems.

2. Brief description of the target audience

This is currently a research-only targeted program, so the target audience is weighted toward basic/applied research clients i.e. agricultural producers, environmental scientists, environmental regulatory agencies.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	136	280	20	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	1	8	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of arbuscular mycorrhizal fungi that enhance biomass productivity by cellulosic herbaceous perennials in fly ash-amended soils.

Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Leverage the Stormwater Management Center (Buchanan, Ludwig, Tyner, Yoder)

Year	Actual
2017	0

Output #3

Output Measure

- Relate community health and resilience to gas wells (Lambert)

Year	Actual
2017	0

Output #4

Output Measure

- Analyze long-term effects of disturbance on soil-dwelling organisms (Bernard)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased sustainable biomass production strategies by cellulosic herbaceous perennials in fly ash-amended soil to allow cleanup of toxic materials in the waste product while using the biomass as biofuel feedstock. (Dzantor)
2	Develop practical systems for organic forage production (Butler)
3	Help municipalities evaluate land use and development and related tax structures (Cho)
4	Optimize non-chemical methods of soil disinfestation (Butler)
5	Research to reduce the impact of pharmaceuticals and personal care products in surface water in rural and urbanizing watersheds. (Dennis)
6	Farmers and homeowners will be educated on the impact of pharmaceuticals and personal care products in surface water and the proper ways to dispose of these chemicals (Dennis)
7	Develop a greater understanding of the mechanisms of the studied emerging contaminants for the scientific community to expedite the decision making process in terms of protecting environmental health. (Rakshit)
8	Improve mechanistic understanding of microbial processing of soil decay and its long-term responses to climate warming. (J Li)
9	Research to influence change in understanding of proper management of riparian landscapes. (Sutton)
10	Use biodiversity of aquatic flies to assess environmental resilience (Moulton)
11	Couple chemical fingerprinting with microbial genetic markers for stream sediment source tracing (Essington)
12	Document the role of viruses in shaping soil bacterial community diversity and impacting biogeochemical cycling (Radosevich)
13	Crop Nutrient Stewardship Impacts (Integrated Research and Extension)
14	Extension Programming for Water Quality: Sustainable Residential Landscapes for Tennessee

Outcome #1

1. Outcome Measures

Increased sustainable biomass production strategies by cellulosic herbaceous perennials in fly ash-amended soil to allow cleanup of toxic materials in the waste product while using the biomass as biofuel feedstock. (Dzantor)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Coal-based electricity generation utilities are concerned about increasing accumulations of coal fly ash (CFA) and other coal combustion byproducts and threats posed to human and environmental health. Of course, the public cares and is concerned about land, water and sediment degradation caused by the catastrophic CFA spills that have become eerily patterned triennial events in Kingston, Tennessee, 2008, WE Power Spill in Wisconsin 2011 and Duke Energy spill, North Carolina, 2014. While catastrophic coal ash spills grab national and international headlines, dangerous pollutants have been quietly seeping into drinking water supplies and streams across the nation from hundreds of improperly lined and unmonitored coal ash dumps, exposing people and wildlife to toxic and cancer-causing substances.

What has been done

Currently, catastrophic ash spill are cleaned up by removal and storage in landfills, invariably with undesirable intrusions into the environment at a later stage. The goal of this research is find ways to use CFA as beneficial soil amendment to produce bioenergy feedstock. This is expected to consume large amount of the byproduct with simultaneous cleanup of soil, sediments and air.

Results

Our results strongly suggest that a combination of CFA and poultry litter can indeed produce desired goals of simultaneous cleaning up pollution while obtaining bioenergy feedstock. Results with soil inoculation with arbuscular mycorrhiza further showed that one isolate, named Rhizophagus clarus can modulate toxic effects of CFA to allow growth and biomass production of switchgrass.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
205	Plant Management Systems
403	Waste Disposal, Recycling, and Reuse

Outcome #2

1. Outcome Measures

Develop practical systems for organic forage production (Butler)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
721	Insects and Other Pests Affecting Humans

Outcome #3

1. Outcome Measures

Help municipalities evaluate land use and development and related tax structures (Cho)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment

Outcome #4

1. Outcome Measures

Optimize non-chemical methods of soil disinfestation (Butler)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017	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
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment

Outcome #5

1. Outcome Measures

Research to reduce the impact of pharmaceuticals and personal care products in surface water in rural and urbanizing watersheds. (Dennis)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Incidence of pharmaceuticals and personal care products is becoming a complex environmental issue. Little is known about the potential health effects to humans or aquatic organisms exposed to the trace levels of these chemical when present in surface water. Humans are primarily responsible for the pathway of pharmaceuticals to surface water, partly through excretion and disposal of unwanted medications to sewers and trash. Farm animals also contribute to some extent, through their excretion of veterinary medicines, and the use of animal manure as soil amendment. Unfortunately, municipal wastewater treatment plants and septic systems are not

engineered to remove these non-biodegradable products and non-metabolized drugs by humans and farm animals. Consequently, minute concentrations of Pharmaceuticals and Personal Care Products have been detected in surface water. Since the safety and health of the environment is directly affected by the disposal of unused pharmaceuticals, consumers need to be aware as well as understand how to ensure the safe disposal of pharmaceuticals and personal care products.

What has been done
Stream water sampling for pharmaceuticals and personal care products and water quality parameters were taken during a span of Spring, Summer and Fall in urban, urbanizing and rural watersheds in Middle Tennessee. In each season, water samples were collected weekly for 6 consecutive weeks and analyzed using GC-MS. Solid phase extraction (SPE) was used to separate compounds in the samples. Differences in pharmaceuticals and personal care products detected in the rivers in response to seasonal variation was tested at $p < 0.05$. Using forum such as our College of Agriculture field day in July 2017, 20 farmers and homeowners were educated on the impact of pharmaceuticals and personal care products in surface water and the proper ways to dispose of these chemicals.

Results
Pharmaceutical most frequently detected were those containing the active ingredients used for the control of type 2 diabetes (thiazolindine); anti-inflammatory and anti-fibrotic effect (methyl palmitate); steroid derivatives (pregnanes); antibiotic (trimethoprim) and insect repellent (deet) were detected in all the 3 rivers sampled. Similarly the personal care products most frequently detected in the three rivers included the active ingredients found in perfumes, antiperspirants, skin conditioners and shampoos

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

Outcome #6

1. Outcome Measures

Farmers and homeowners will be educated on the impact of pharmaceuticals and personal care products in surface water and the proper ways to dispose of these chemicals (Dennis)

2. Associated Institution Types

- 1862 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Low-level concentrations of pharmaceuticals and personal care products have been detected in fresh water resources throughout the U.S. The pharmaceuticals detected in our study included those used for treatment of chronic alcoholism, antibiotic drug, and drug used for anti-inflammatory conditions and drugs used for the control of type 2 diabetes. However, little is known about the potential health effects to humans or aquatic organisms exposed to the trace levels of these chemicals when present in surface water. As such there is a dire need of societal awareness on proper disposal of these chemicals especially among homeowners and agricultural producers.

What has been done
Advancing efforts to mitigate this problem, we developed an extension fact sheet detailing the proper disposal of unused pharmaceuticals and personal care products. Additionally, the project was engaged in a drug take back event held in Nashville Tennessee (Davidson County), in fall 2017.

Results
The drug take back program was a means of disposing of unused Rx drugs by consumers. Factsheet impact is far reaching and goes beyond the targeted stakeholders (farmers and homeowners); it has enhanced the reduction of the quantities of Rx drugs entering our nation's waterways or the drugs being stockpiled in homes awaiting misuse or abuse.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

Outcome #7

1. Outcome Measures

Develop a greater understanding of the mechanisms of the studied emerging contaminants for the scientific community to expedite the decision making process in terms of protecting environmental health. (Rakshit)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Environmental science professionals and agencies can gain in-depth insight into the fate of emerging contaminants under various laboratory simulated environmental conditions to predict

their bioavailability in the environment. In addition, the scientific community will benefit from the knowledge gained through understanding of the environmental systems and can further deliver it to stakeholders to strengthen their awareness about emerging contaminants, thereby protecting the public health.

What has been done
Tungstate adsorption on hematite has been investigated using macroscopic and spectroscopic experiments. Competitive sorption mechanism of W (VI) and P on hematite has been investigated. Tylosin antibiotic sorption on montmorrilonite has been investigated as well.

Results
Tylosin antibiotic indicated different exchange behavior on Na-and Ca saturated clay. In situ ATR-FTIR data on Tylosin sorption corroborated the X-Ray diffraction and macroscopic data in that the tylosin sorbed principally as an exchange complex on Na saturated clay. However, for Ca saturated clay, stronger surface interaction was evident.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation

Outcome #8

1. Outcome Measures

Improve mechanistic understanding of microbial processing of soil decay and its long-term responses to climate warming. (J Li)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil harbors the largest organic carbon pool in the terrestrial biosphere, with a total of more than 1500 Gt in the top meter globally. Annual soil CO2 efflux is about six times of that from fossil fuel burning. Microbial communities are the primary drivers of soil organic carbon mineralization and respiratory C loss to atmosphere. Because both climate warming and nitrogen (N) fertilization can accelerate soil CO2 efflux to atmosphere, investigation of microbial transformation of soil organic C under both climate warming and N fertilization becomes a research priority.

What has been done
Meta-analysis statistical modeling method was employed to examine how N fertilization influenced soil microbial biomass and extracellular enzyme activities as well as soil carbon and nitrogen stocks. The results were published in a peer-review journal paper. In addition to microbial and soil measurements, all data were analyzed and incorporated into a manuscript to be submitted to a peer-review journal.

Results
Results indicate that warming and N fertilization could alter microbial preference for different substrates over different time scales, but these effects are likely moderated in bioenergy croplands. Nitrogen fertilization and warming increased cumulative soil respiration by 4.2% and 16.4%, respectively ($p < 0.05$). Warming also significantly enhanced microbial biomass C and specific soil respiration (i.e. respiration per unit of microbial biomass), indicating decreased microbial growth efficiency. The less-pronounced N fertilization effects relative to warming effects are likely due to substantial N uptake from soil and accumulation in switchgrass biomass.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

Outcome #9

1. Outcome Measures

Research to influence change in understanding of proper management of riparian landscapes. (Sutton)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The quality of aquatic resources is a topic that concerns of every living organism. A variety of anthropogenic land uses, including urbanization, mining, and agriculture threaten the quality of water resources throughout Tennessee. Land mitigation via restoration represents a viable option for conservation of landscapes and water quality. However, riparian areas represent habitats that tend to be overlooked and are difficult to restore once they are degraded. Many stream-dwelling organisms, including the eastern hellbender (Cryptobranchus alleganiensis) can be used as biological indicators to gauge the quality of water body along with effectiveness of restoration efforts. Often, conservation efforts need to consider multiple spatial scales for effective

management and conservation of rare and sensitive species. This is especially true for aquatic species that may be threatened by multiple stressors at disparate spatial scales.

What has been done
We have collaborated with a variety of state-level organizations, including the Tennessee Department of Environmental Conservation, Tennessee Wildlife Resources Agency, and the Nashville Zoo to acquire and develop an extensive occurrence database for the Eastern Hellbender (Cryptobranchus alleganiensis) throughout Tennessee. These occurrences have been used to develop a preliminary habitat model for the state. The process of reviewing the draft habitat model has begun and preliminary results have been presented at two regional conferences. We have completed sampling based on the habitat model and have sampled over 300 sites throughout TN for C. alleganiensis presence. In addition to the original habitat suitability model, we have evaluated site occupancy of C. alleganiensis and have accounted for errors in detection among seasonal-repeated sample sites.

Results
Results indicate that Eastern Hellbenders are primarily regulated to habitats that have a very low anthropogenic footprint. Our research indicates that streams in middle Tennessee face the greatest threats from anthropogenic disturbances, which include agricultural and urban disturbances. Optimal aquatic habitats appear to be those not yet impacted by agricultural and forestry practices, suggesting that greater measures must be taken to make anthropogenic land-uses more compatible with biodiversity conservation. We are now evaluating the preliminary habitat model and will use the results from the eDNA analysis to develop a C. alleganiensis landscape occupancy model. In addition to our landscape model efforts, we have also completed microhabitat sampling for larval, sub-adult, and adult C. alleganiensis at three sites in east Tennessee and found that microhabitat requirements are different for adult, juvenile, and larval C. alleganiensis.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife

Outcome #10

1. Outcome Measures

Use biodiversity of aquatic flies to assess environmental resilience (Moulton)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
403	Waste Disposal, Recycling, and Reuse

Outcome #11

1. Outcome Measures

Couple chemical fingerprinting with microbial genetic markers for stream sediment source tracing (Essington)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
201	Plant Genome, Genetics, and Genetic Mechanisms

Outcome #12

1. Outcome Measures

Document the role of viruses in shaping soil bacterial community diversity and impacting biogeochemical cycling (Radosevich)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
212	Pathogens and Nematodes Affecting Plants

Outcome #13

1. Outcome Measures

Crop Nutrient Stewardship Impacts (Integrated Research and Extension)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With low crop prices, increasing prices of nitrogen and phosphorus fertilizers, and the contribution of production agriculture to diminished water quality in the Mississippi River Basin, fertility practices need to be reevaluated to better benefit our producers and the environment. Increasing the use of sustainable resource management practices will enable the world to meet present needs while continuously improving future generation's ability to meet their own needs. This can be done not only by lessening our environmental impacts, improving human health, and improving the economic and social well-being of Tennessee's communities, but also by increasing productivity to meet current as well as future food, fuel, and fiber demands.

What has been done
An integrated, multi-disciplinary research, education, and outreach program has been established to develop and disseminate information pertaining to crop fertility practices and associated economic and environmental impacts. We promoted the adoption of profitable and environmentally-conscious resource management practices through presentations at field days, county, and/or on-farm demonstrations, newly-developed publications and/or mass media articles, and on-site visits.

Results
Our Crop Nutrient Stewardship educational efforts in 2017 resulted in the following impacts:

-1565 producers assessed nutrient needs by conducting soil sampling on approximately 715,000 acres, potentially reducing fertilizer costs by $15.70/ac and 6500 tons of excess phosphorus pentoxide from potentially moving offsite and causing environmental degradation.
-969 producers utilized UT fertility recommendations on approximately 150,000 acres, resulting in a potential reduction in phosphorus pentoxide fertilizer costs of $15.40/ac as well as almost 12,000 tons of phosphorus pentoxide that could move offsite and have negative environmental consequences.

4. Associated Knowledge Areas

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

Outcome #14

1. Outcome Measures

Extension Programming for Water Quality: Sustainable Residential Landscapes for Tennessee

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Residential landscapes may also impact Tennessee's natural capital. Over 12% of Tennessee lands are developed for urban and suburban uses, which are linked to water quality degradation, soil quality degradation, and impacts to outdoor recreation and fisheries. Since 2004, there has been a 36% increase in stream impairments due to urbanization. Tennesseans need information on sustainable landscaping practices in order to maintain high property values and sustainability of natural capitol in communities.

What has been done
UT Extension continues to maintain a focused workgroup of state and county personnel that develop and disseminate programs for citizens, neighborhoods, and communities. In 2017, 4207 direct contacts were made on the specific topic of sustainable residential landscapes.

Results
As a result of the sustainable residential landscaping program, in 2017:
-1466 consumers implemented water--wise gardening practices to conserve and protect water quality.
-1477 consumers applied fewer fertilizers and pesticides due to a better understanding of landscape best management practices.
-1513 consumers used the results of their soil test to properly amend their soil.
-4047 consumers learned how to conserve and protect water quality in the landscape.
-2167 residents implemented conservation landscaping practices.
-2827 residents implemented recommended plant selections.
-1725 residents implemented sustainable stewardship practices.

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

V(H). Planned Program (External Factors)

- Public Policy changes
- Competing Public priorities

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research resulted in an increase in knowledge gained on pharmaceuticals and personal care products in water ecosystems by homeowners and apartment residents; increased adoption of proper pharmaceutical and personal care product disposal; increased awareness of pharmaceuticals and personal care products in the environment; decrease in surface water contamination by pharmaceuticals and personal care products.
Evaluation techniques include a before-after opinion survey where we speak with the general public before they hear details of our research and then survey the same stakeholders to observe if our study results change their opinions regarding the conservation and management of this species.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Family Economics

☑ 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
801	Individual and Family Resource Management	100%	100%	0%	0%
	Total	100%	100%	0%	0%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	12.0	2.0	0.0	0.0
Actual Paid	10.0	0.0	0.0	0.0
Actual Volunteer	2.0	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**
205915	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
959511	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
100000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension supported more than 10 regional and local social marketing campaigns organized by UT and TSU Extension and supported by coalitions of volunteers across Tennessee. The Tennessee toolkit for savings lesson plans and activities for teaching financial and savings education was used in schools, workplaces, community centers and other locations to teach youth and adults. Extension maintained a partnership with national Extension "Financial Security in Later Life" initiative and with the "America Saves" national organization and other national and state partners with the TN Jumpstart Coalition. Extension hosted bi-annual partnership training conferences to strengthen the capacity of educators to teach

financial and savings education. Extension deployed its On My Own curriculum and youth TN Saves in over 100 financial education simulations annually throughout the state to reach 30,000 youth with savings and financial education. Additional classes, newsletters, news releases and community events were conducted for adult audiences.

2. Brief description of the target audience

Youth and adults were targeted for this program. UT Extension has been a national leader in creating, testing and validating family economic programs for reaching different target audiences, such as youth ages 9-18, young adults, coalition members and consumers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	54677	894049	61694	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote program awareness and participation.

Year	Actual
2017	150

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2017	359

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	TN Saves: Number of participants who estimated their retirement income needs.
2	TN Saves: Number of participants identified ways to reduce debt.
3	TN Saves: Number of participants who set financial or retirement goals.
4	Youth Financial Education Simulation: Number of participants who felt more strongly that they needed to get a good education.
5	TN Saves: Number of participants who followed a spending plan.
6	TN Saves: Number of participants who initiated or increased savings.
7	TN Saves: Number of participants who reduced debt.
8	TN Saves: Statewide economic impact from reduced debt, increased savings and increased investment. (This outcome target is expressed in millions of dollars.)

Outcome #1

1. **Outcome Measures**

TN Saves: Number of participants who estimated their retirement income needs.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	82

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #2

1. **Outcome Measures**

TN Saves: Number of participants identified ways to reduce debt.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	76

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #3

1. Outcome Measures

TN Saves: Number of participants who set financial or retirement goals.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2663

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #4

1. Outcome Measures

Youth Financial Education Simulation: Number of participants who felt more strongly that they needed to get a good education.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	6614

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #5

1. Outcome Measures

TN Saves: Number of participants who followed a spending plan.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	3766

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #6

1. Outcome Measures

TN Saves: Number of participants who initiated or increased savings.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	511

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #7

1. Outcome Measures

TN Saves: Number of participants who reduced debt.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	76

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #8

1. Outcome Measures

TN Saves: Statewide economic impact from reduced debt, increased savings and increased investment. (This outcome target is expressed in millions of dollars.)

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1525859

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

V(H). Planned Program (External Factors)

- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UT and TSU Educational Programs created a great amount of awareness among adults and youth in Tennessee regarding their personal finances. The Youth Financial Education program helped 1462 youth and adults save an average of $985 which amounts to economic impact of $1,440,070. TN Saves program helped 76 individuals reduce their debt by an average of $403. This amounted to a total economic impact of $30,628 in the state. The program also helped 177 people increase or started savings by an average of $403. The total impact of these savings accounted for over $55,161.

Key Items of Evaluation

The total economic impact of reduced debt, savings and other education on savings was estimated to be over $ 1.5 million in the state.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Food Safety

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	2%	0%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	2%	0%
212	Diseases and Nematodes Affecting Plants	0%	0%	12%	0%
302	Nutrient Utilization in Animals	0%	0%	5%	0%
306	Environmental Stress in Animals	0%	0%	3%	0%
311	Animal Diseases	0%	0%	12%	0%
501	New and Improved Food Processing Technologies	0%	0%	13%	25%
502	New and Improved Food Products	0%	0%	5%	0%
503	Quality Maintenance in Storing and Marketing Food Products	10%	10%	3%	0%
504	Home and Commercial Food Service	10%	10%	0%	0%
511	New and Improved Non-Food Products and Processes	0%	0%	8%	0%
701	Nutrient Composition of Food	0%	0%	8%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	40%	40%	25%	75%
722	Zoonotic Diseases and Parasites Affecting Humans	0%	0%	2%	0%
903	Communication, Education, and Information Delivery	40%	40%	0%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	9.0	1.0	35.0	8.0
Actual Paid	12.0	0.0	0.0	6.6
Actual Volunteer	2.0	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**
232774	0	0	284497
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1084665	0	0	284497
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
140061	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

In the **Safe Food for Tennessee** initiative, UT and TSU Extension taught lessons in homes, schools, community centers, churches, and other accessible locations to consumers. The lessons in "Cook's Corner" and "Safe Food for You" were designed to change attitudes, skills and behaviors in regards to safe food handling practices. Youth participants received food safety education using Fight BAC and other curricula through their school classroom, community center, after-school program, or other locations to reach youth. Direct methods (group meetings, classes, demonstrations, and on-site visits) and indirect methods (newsletters, TV media programs, web sites, newspaper articles and radio programs) emphasized safe food practices:

- using a thermometer to check the internal temperature of food.
- using a thermometer to check the internal temperature of the refrigerator.

We conduct applied and basic research in food-borne risks and nutrition to address high priority issues for consumers of food products. We disseminate information gained from these studies to food industries and consumers through outreach programs, including workshops and educational events at the county level, and through a variety of publications.

Studies are underway on how non-thermal processing (high pressure, ultrasound, solvents) affect the functional properties of proteins for food and non-food applications. Supercritical carbon dioxide will be used to produce biopolymers encapsulation systems for flavors and nutraceuticals and to modify functional properties of proteins.

Research projects in food safety are multi-pronged in their objectives. A major thrust is characterization of the antimicrobial activity of novel natural (i.e., plant-, animal- or microbial-based) compounds and better targeting through controlled-delivery encapsulation systems and incorporation into nanofibers and packaging films. Encapsulation strategies include micelles, liposomes, chitosans, supercritical carbon dioxide, high pressure homogenization and ultrasound. Novel molecular biology strategies are used to identify stress mechanisms in bacteria that allow them to resist interventions.

Research will also characterize, analyze, and identify pathogenic profiles and patterns of pathogenic microorganisms in fresh produce and farm environments and deliver educational programs to producers and consumers on hygienic agricultural and food handling practices that are needed to improve fresh produce safety. In addition, the program will reduce antibiotic-resistant bacteria in fresh produce and the farm environment; change the behaviors of consumers and farmers to produce safer fresh produce handling practices and judicious use of antibiotics; and train competitive students with relevant skills for employment opportunities in food safety.

Research to develop new methods to identify and reduce contaminants in the food supply.

2. Brief description of the target audience

- Consumers
- Employees of Child Care Centers
- SNAP and WIC clients
- Food producers

3. How was eXtension used?

Four Tennessee Extension personnel served on the Food Safety Community of Practice, including the leader, a specialist in the UT Extension Department of Family and Consumer Sciences.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8966	4724374	1658	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	2	3	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote safe food handling practices.

Year	Actual
2017	45

Output #2

Output Measure

- Number of research-based publications distributed by Extension to educate producers,

processors, and consumers.

Year	Actual
2017	180

Output #3

Output Measure

- Control A. acidoterrestris bacterium in pasteurized fruit juices (Golden)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Safe Food Handling for Consumers: Number of consumers who more often washed their hands with soap and warm running water before preparing food.
2	Safe Food Handling for Consumers: Number of consumers who now separate raw, cooked, and ready-to-eat foods while storing and preparing.
3	Safe Food Handling for Consumers: Number of consumers who now use a thermometer to check the internal temperature of food.
4	Safe Food Handling for Consumers: Number of consumers who canned vegetables following a tested recipe.
5	Inactivate viral pathogens (D'Souza, Davidson)
6	Prevent, rather than responding to, food-borne illness (Buchanan, Critzer, Wszelaki, Lockwood)
7	Target leading foodborne human pathogen C. jejuni (Lin)
8	Research to develop an Immunochemical Fingerprint Analysis method to be specific and sensitive and applicable as a diagnostic assay to identify and differentiate Salmonella isolates from various sources of food contamination. (Chen)
9	Research to develop process innovations and innovative manufacturing technologies providing high quality, novel or modified, healthy products with improved safety profiles using state-of-the-art optical technologies for aflatoxin removal from foods. (Patras)
10	Investigate cell cytotoxicity, cell viability and cytokine analysis using murine macrophage cell line to assess the activity of treated aflatoxins. (Patras)
11	Research to provide logical corridors to mitigate antibiotic-resistance in the Tennessee food system. (Kilonzo Nthenge)
12	Development of science based information on judicious use of antibiotics for agricultural commodity producers. (Kilonzo Nthenge)
13	Produce gluten-free food ingredient from sorghum proteins (Dia)
14	Safe Food Handling for Consumers: Tennessee Youth Food Science Educational Program

Outcome #1

1. Outcome Measures

Safe Food Handling for Consumers: Number of consumers who more often washed their hands with soap and warm running water before preparing food.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	169

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Safe Food Handling for Consumers: Number of consumers who now separate raw, cooked, and ready-to-eat foods while storing and preparing.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	136

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #3

1. Outcome Measures

Safe Food Handling for Consumers: Number of consumers who now use a thermometer to check the internal temperature of food.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2641

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area

503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service

Outcome #4

1. Outcome Measures

Safe Food Handling for Consumers: Number of consumers who canned vegetables following a tested recipe.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	789

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Inactivate viral pathogens (D'Souza, Davidson)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Prevent, rather than responding to, food-borne illness (Buchanan, Critzer, Wszelaki, Lockwood)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many Tennessee fruit and vegetable producers use surface water for irrigation. From a food safety perspective, surface water is inherently more risky. There are many opportunities for open waterbodies to become pathogen contaminated. In response to recent disease outbreaks from contaminated produce, the U.S. FDA has promulgated rules that demand the testing of irrigation water for human pathogens. When pathogens are detected, mitigation must be provided before that water can be applied to crops that could be consumed raw or marginally processed. Chlorine, peroxyacetic acid, and ultraviolet light are well-known water disinfectants. However, there is little information about how to apply these technologies to irrigation water. Each of these disinfectants have limitations.

What has been done

Recent research conducted by the UTIA's AgResearch has shown that passing irrigation water through an ultraviolet light (UV) reactor may be the most cost effective means of providing disinfection. UV light can reduce the pathogen load (using E coli as an indicator of pathogens) below the 126 CFU per 100 mL limit set by the U.S. FDA. Based on this research, an interdisciplinary team of Tennessee Extension Specialists from Biosystems Engineering, Food Science and Technology, and Plant Science are developing educational programming to teach producers how to implement an on-farm irrigation-water disinfection system utilizing UV light. This program is new, only recently has this Extension team received the USDA-NIFA funding to develop and deliver the educational materials. This grant also includes funding to design and construct a mobile demonstration unit that will allow Extension educators to conduct on-farm training.

Results

-34 of 89 fruit and/or vegetable producers completed a self-evaluation of Good Agricultural Practices on their farm.
-8 of 55 fruit and/or vegetable producers completed a food safety plan for their farm.
-178 fruit and vegetable producers adopted good agricultural practices (GAPs) on 3199 acres to improve food safety and enhance marketing opportunities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Target leading foodborne human pathogen C. jejuni (Lin)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
311	Animal Diseases
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #8

1. Outcome Measures

Research to develop an Immunochemical Fingerprint Analysis method to be specific and sensitive and applicable as a diagnostic assay to identify and differentiate Salmonella isolates from various sources of food contamination. (Chen)

2. Associated Institution Types

● 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Salmonella is one of the most important foodborne pathogens. Every year, Salmonella is estimated to cause one million illnesses in the United States. To reduce the incidence of illnesses caused by Salmonella, advanced detection technology is needed to provide reliable and efficient identification of Salmonella from contaminated foods.

What has been done
This project has developed a process of identification and subtyping of Salmonella using Immunochemical Fingerprint Analysis (IFA) profiles generated from the antigenic fragments probed by a panel of monoclonal antibodies. The IFA protocols have been used to establish a database of the fingerprint profiles of Salmonella isolates.

Results
The establishment of IFA database allowed the comparison of fingerprint profiles of different Salmonella serovars. We have also compared the binding kinetic parameters among Salmonella enterica serovars using the same monoclonal antibodies. The results showed that there were five distinct patterns in binding kinetics among serovars; however, the binding kinetics analysis does not necessarily correspond to serotypes. This project presented the potential of using anti-flagellar monoclonal antibodies as recognition elements in the subtyping and rapid detection of Salmonella.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #9

1. Outcome Measures

Research to develop process innovations and innovative manufacturing technologies providing high quality, novel or modified, healthy products with improved safety profiles using state-of-the-art optical technologies for aflatoxin removal from foods. (Patras)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mycotoxins are fungal metabolites commonly occurring in food, which pose a health risk (i.e. cancer) to the consumer. Aflatoxins are a group of potent mycotoxins with mutagenic, carcinogenic, teratogenic, hepatotoxic, and immunosuppressive properties and are of significance due to their occurrence and adversative effects on animal and human health. Maximum levels for major mycotoxins allowed in food have been established worldwide. But still, persistence of mycotoxins or their metabolites is a major safety concern world-wide especially in developing countries. The persistence of aflatoxins (AFB1, AFG1, AFB2 and AFG2), patulin and their metabolites in agricultural products is a major safety concern due to their high resistance to current methods.

What has been done
Efficacy of a medium pressure lamp to reduce aflatoxins in pure water and milk was studied. Experiments were conducted using a collimated beam system operating between 200 to 320 nm. Known concentrations of aflatoxins were spiked in water or milk and irradiated. Degradation of the molecules was monitored by LC-MS/MS.

Results
UV irradiation significantly reduced aflatoxins in pure water and milk. Irradiation doses up to 0-4.88 J.cm-2 reduced AFB1 content by 98.25% in water and 22% in milk. No chromatographic peak unique to the UV-treated samples was observed for AFB1-8,9 epoxide. None of the by-products formed were cytotoxic to liver cells.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies

Outcome #10

1. Outcome Measures

Investigate cell cytotoxicity, cell viability and cytokine analysis using murine macrophage cell line to assess the activity of treated aflatoxins. (Patras)

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Research to provide logical corridors to mitigate antibiotic-resistance in the Tennessee food system. (Kilonzo Nthenge)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Antibiotic-resistant infections burden families and communities due to lost wages and health care costs. The total economic burden placed on the U.S. economy by antibiotic-resistant infections has been estimated to be as high as $20 billion in health care costs and $35 billion a year in lost productivity.

What has been done
The aim of this study was to gain an understanding in microbiological profile of produce and food safety practices in small-scale produce farms. A leafy, soil, and chicken feed from small farms were collected for microbial analysis. Biochemical tests, standard methods and Polymerase Chain Reaction were used for microbial analysis.

Results
Our results indicate that fresh produce from small farms harbor antibiotic-resistant bacteria and could position consumers at greater risk for foodborne illnesses. Food safety education and written food safety plans are important steps toward minimizing the risk of produce contamination on small produce farms. There is a need to review poultry management practices to minimize the occurrence of ESBL-producing E. coli on farms and poultry meat. Produce harbored diverse bacterial communities which was dominated by Escherichia coli (29.7%), followed by Serratia liquefacians (13%), Klebsiella pneumoniae (11.4%), Proteus mirabilis (10.8%), Pantoea spp (8.1%), among others. Salmonella (2.7%) and Shigella (0.5%) were also isolated from the produce. Antimicrobial resistance was highest for erythromycin (22.3%), followed by ampicillin (19.6%), streptomycin (12.8%), and amoxicillin (10.3%). Salmonella isolates also exhibited drug resistance to streptomycin (60%), erythromycin and ampicillin (40%), amoxicillin, and kanamycin (20%). ESBL-producing E. coli from soil, chicken manure, and feed carried blaCTX-M, blaTEM, and blaSHV genes.

4. Associated Knowledge Areas

KA Code	Knowledge Area

712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #12

1. Outcome Measures

Development of science based information on judicious use of antibiotics for agricultural commodity producers. (Kilonzo Nthenge)

2. Associated Institution Types

- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Antimicrobial resistance is a well-recognized problem with profound implications for global health. Implementation of Best Management Practices (BMPs) and antimicrobial stewardship programs for animal production systems will slow the spread of antimicrobial resistance.

What has been done
Train-the-trainer workshop. Preventing microbial contamination in an integrated approach, the extension agents and farmers were trained to understand their role in mitigation of antimicrobial resistance. During the workshop, farmers were asked if they had written food safety plans, kept records for the farm, and whether they used composted manure to fertilize produce (if practiced mixed farming).

Results
According to our results, only few growers had written food safety plans(9%), kept farm records (33%), or used composted animal manure to fertilize produce(29%). Antimicrobial stewardship education and timely messages are critically needed to persuade farmers to take appropriate actions to reduce antibiotic resistance in animal production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #13

1. Outcome Measures

Produce gluten-free food ingredient from sorghum proteins (Dia)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
502	New and Improved Food Products

Outcome #14

1. Outcome Measures

Safe Food Handling for Consumers: Tennessee Youth Food Science Educational Program

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth are food producers and consumers. Expanded food media has encouraged youth to be more active in food selection/preparation and food industry as a career. Training is needed in proper handling and preparation to assure a safe and high quality food product.

What has been done

Extension personnel conducted educational programs to train youth and extension agents in meat selection, meat preparation, food safety, sensory attributes and food processing principles. In 2017, approximately 25,000 Tennessee youth enrolled in the 4-H Food Science project.

Results

-Approximately 550 youth were directly impacted through the Outdoor Meat Cookery, Meat Judging, Dairy Product Judging, Food Science project competitions and Academic Conference educational programs
-288 youth gained knowledge in meat selection, preparation and safety by participating in the 4-H Outdoor Meat Cookery program
-Approximately 250 youth learned to identify meat retail cuts, evaluate meat cutability and quality

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service

V(H). Planned Program (External Factors)

- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UT and TSU Extension had a robust food safety education program that educated thousands of adults and youth on "preserving food at home" and "safe food handling

practices" at home through a variety of workshops. A program evaluation was conducted of selected workshops. After the workshops, the following impacts were shown:

- 184 of 196 refrigerate or freeze perishable foods within two hours.
- 86 of 93 participants surveyed made a positive change in the attitude about cooking food to a safe internal temperature.
- 54 of 59 participants surveyed made a positive change in their attitude about how they thaw food.
- 46 of 51 participants surveyed made a positive change in their attitude about cleaning surfaces, utensils and equipment to prevent cross-contamination.
- 70 of 75 participants surveyed made a positive change in their attitude about eating/drinking foods from unsafe sources.
- 73 of 93 participants surveyed made a positive change in their attitude about keeping the temperature in the refrigerator at 40 degrees F or below.

In 2017, UT and TSU Extension also conducted a program evaluation of our fruit and vegetable education programs for producers. This evaluation showed that 225 fruit and vegetable producers adopted good agricultural practices (GAPs) on 3,717 acres to both improve food safety and enhance marketing opportunities.
This project developed a method for rapid identification and subtyping of Salmonella that is beneficial for food producers/processors and food testing laboratories. Interested industrial partners have inquired about the opportunity to utilize this new technology development.

Other research also suggests that UV irradiation can be used as an effective technique for the reduction of aflatoxins. This technique will be further used to treat food surfaces (i.e. nuts, corn) and milk (treated with 365 nm optical source).
Results indicate that fresh produce from small farms harbor antibiotic resistant bacteria and could position consumers at greater risk for foodborne illnesses. As a result of workshop on judicious use of antimicrobials in agriculture 25 farmers are now part of educated community ready to accept policy changes aimed at mitigating antimicrobial resistance

Key Items of Evaluation

UT and TSU Extension had a robust food safety education program that educated thousands of adults and youth on "preserving food at home" and "safe food handling practices" at home through a variety of workshops. A program evaluation was conducted of selected workshops. After the workshops, the following impacts were shown:

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V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Forestry, Wildlife, and Fishery Systems

☑ 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
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	0%	37%
112	Watershed Protection and Management	0%	0%	7%	0%
123	Management and Sustainability of Forest Resources	75%	75%	15%	25%
124	Urban Forestry	0%	0%	7%	0%
125	Agroforestry	10%	10%	0%	38%
131	Alternative Uses of Land	0%	0%	0%	0%
133	Pollution Prevention and Mitigation	0%	0%	7%	0%
135	Aquatic and Terrestrial Wildlife	10%	10%	12%	0%
136	Conservation of Biological Diversity	0%	0%	11%	0%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	4%	0%
206	Basic Plant Biology	0%	0%	2%	0%
211	Insects, Mites, and Other Arthropods Affecting Plants	0%	0%	4%	0%
213	Weeds Affecting Plants	0%	0%	4%	0%
215	Biological Control of Pests Affecting Plants	0%	0%	7%	0%
311	Animal Diseases	0%	0%	7%	0%
312	External Parasites and Pests of Animals	0%	0%	4%	0%
603	Market Economics	0%	0%	0%	0%
605	Natural Resource and Environmental Economics	5%	5%	0%	0%
608	Community Resource Planning and Development	0%	0%	7%	0%
721	Insects and Other Pests Affecting Humans	0%	0%	2%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	9.0	2.0	40.0	5.0
Actual Paid	7.0	0.0	0.0	6.7

Actual Volunteer	1.0	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**
143245	0	0	291114
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
667486	0	0	291114
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
50000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Natural Resource Management has become increasingly complicated within environmental, social, resource and personal contexts. UT and TSU Extension provided landowners with educational assistance to understand alternatives, decide their goals and successfully pursue them. Programs within private forest landowner contexts included: (1) improve the profitability of forest ownership (marketing), (2) improve management of the forest resource and (3) understand the ecology of forest development and succession. Tennessee's private landowners own more than 11 million forested acres. Our programs included curriculum-based program of forest and wildlife short courses for landowners, education programs for county forestry associations, and demonstration of forest practices on state forests, wildlife management areas, UT research and education centers, private lands and forest-industry lands. Cooperative partners included the Tennessee Department of Agriculture, Forestry Division, Tennessee Wildlife Resources Agency, various industries, non-profit organizations and the Tennessee Forestry Association. UT and TSU Extension continued one-on-one contacts with forest landowners throughout the year and used mass media and newsletters to inform the general public on issues and educational opportunities related to natural resources. Both UT and TSU Extension provided leadership for conducting programs that targeted limited resource landowners with TSU providing specialist leadership for this effort.

For Tennessee's forestry sector, UT AgResearch continues biological control of Hemlock Woolly Adelgid by known predators and new species and release technologies.We evaluate methods of increasing seedling success, and techniques for improving reforestation.We exploit genetic variation in nursery and field characteristics of native hardwood and coniferous forest tree species.We try novel strategies to address exotic forest tree pests and corresponding forest restoration. We establish collections of woody plants, including species and cultivars, and plants having potential commercial value as forest species or for landscape development, from which materials may be obtained for breeding/propagation.

For wood products manufacturing, we characterize key parameters associated with the formation of durable, high-performance composite materials, and establish new statistical methods to advance intelligent manufacturing practices. We explore new methods to produce carbon fibers from low-quality raw materials and are developing a process for bonding plastic or polymer to lignocellulosic fibers (using ultrasonic vibration) as a replacement for toxic wood preservatives.

We identify approaches and services to landowners that would enable them to realize a wide range of landownership benefits while fostering stewardship and sustainability of private forest lands in Tennessee. Both qualitative (e.g., personal interviews and focus groups) and quantitative (e.g., survey responses) data are collected and analyzed to better understand landowners understanding of management.

Although manipulative studies of tree seedlings and saplings are cost effective and quick, recent

research has shown that they may not allow for valid predictions on mature trees. Therefore, direct experiments on large trees or forested catchments have been developed. Experiments are being conducted on local forest research sites developed by the Department of Energy (DOE). Each are large-scale, multi-year, multi-investigator experiments.

UT AgResearch wildlife and fisheries research evaluates and quantifies the effects of deer on agricultural production and identifies associated land-use patterns and biological and ecological factors that could be used for reducing that impact.We monitor target avian species and relate specific population parameters to factors affecting forest health and sustainability, and develop new forest management prescriptions that promote sustainability.We develop prediction methods and evaluate selected aquatic species in existing and new production systems adapted to Tennessee's climate and geography.

2. Brief description of the target audience

The target audiences for this program were forest landowners, the professionals and volunteers who served them, as well as those who enjoy the state's wildlife resources.

3. How was eXtension used?

This Forestry, Wildlife, and Fisheries planned program was enhanced through the service of:
• one Tennessee Extension professional on the "Climates, Forests, and Woodlands" CoP.
• one Tennessee Extension professional on the "Extension Wildfire Information Network" CoP.
• one Tennessee Extension professional on the "Feral Hogs" CoP.
• one Tennessee Extension professional on the "Wildlife Damage Management" CoP.
Tennessee Extension personnel shared implementation strategies and research results with their CoP colleagues.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	16069	153317	4650	120

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	8	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Protect walnut from the walnut twig beetle (Taylor)

Year	Actual
2017	0

Output #2

Output Measure

- Number of logger preferences examined in emerging forest products industries.

Year	Actual
2017	0

Output #3

Output Measure

- Develop mobile apps for IPM (Fulcher, Windham, Hale)

Year	Actual
2017	0

Output #4

Output Measure

- Investigate importance of wildlife to plants (Kwit)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Forest Landowner Education: Number of landowners who now understand the ecology of forest development and succession (using forest management plans or contacting a professional forester.)
2	Assess Biomass Feedstock Availability (Hodges, Young)
3	Address Thousand Cankers Disease on black walnut (Grant, Lambdin, Hadziabdic, Windham)
4	Suppress Emerald Ash Borer (Grant, Wiggins)
5	Establish shortleaf pine (Clatterbuck)
6	Deploy predatory beetles against Hemlock Woolly Adelgid (Lambdin, Grant, Parkman, Wiggins)
7	Protect amphibians from ranavirus (Gray)
8	Research to determine long term site improvement for biofuels production in intercropping systems through increased nutrient pools. (Haile)
9	Optimum switchgrass/pine intercropping combination to enhance soil carbon sequestration and minimize greenhouse gas production. (Haile)
10	Biomass mapping models to help plan a continuous supply of traditional forest products, and help generate revenue, and protect and restore supporting services in the forests in Tennessee. (Pokharel)
11	Optimize oak savannah restoration (Keyser, Kwit)
12	Address tick-borne disease in the Southeast (Hickling)
13	Use of remote sensing and GIS technologies to produce enhanced monitoring tools for forestry production in the Southern US. (Akumu)
14	Forest Landowner Education: Number of landowners who improved profitability (marketing) of their forest ownership.
15	Tennessee Master Logger Program
16	Improved Railroad Bridge Timbers
17	Sustainable Forestry versus Diameter Limit Cutting
18	Bottomland Hardwood Restoration Demonstration

Outcome #1

1. Outcome Measures

Forest Landowner Education: Number of landowners who now understand the ecology of forest development and succession (using forest management plans or contacting a professional forester.)

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Assess Biomass Feedstock Availability (Hodges, Young)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
123	Management and Sustainability of Forest Resources
125	Agroforestry
131	Alternative Uses of Land
603	Market Economics
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Address Thousand Cankers Disease on black walnut (Grant, Lambdin, Hadziabdic, Windham)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
123	Management and Sustainability of Forest Resources
125	Agroforestry
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #4

1. Outcome Measures

Suppress Emerald Ash Borer (Grant, Wiggins)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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

123	Management and Sustainability of Forest Resources
125	Agroforestry
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

Establish shortleaf pine (Clatterbuck)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
123	Management and Sustainability of Forest Resources
125	Agroforestry
605	Natural Resource and Environmental Economics

Outcome #6

1. Outcome Measures

Deploy predatory beetles against Hemlock Woolly Adelgid (Lambdin, Grant, Parkman, Wiggins)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
123	Management and Sustainability of Forest Resources
605	Natural Resource and Environmental Economics

Outcome #7

1. Outcome Measures

Protect amphibians from ranavirus (Gray)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
312	External Parasites and Pests of Animals

Outcome #8

1. Outcome Measures

Research to determine long term site improvement for biofuels production in intercropping systems through increased nutrient pools. (Haile)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

As biofuel production increases, so will the demand for forests and other agricultural biomass in providing sources of biomass feedstock. The real challenge and opportunity, however, lies on how agricultural and forestry efforts can be integrated to meet future renewable energy demand. For a long-term improvement and sustainability of biofuel production systems, bioenergy feedstock production has to be integrated with existing agricultural production systems, available land, resources, economic systems, and community practice. Information on the ability of an agroforestry system of loblolly pine and switchgrass to produce biomass feedstock in flood prone sites will advance the limited knowledge in this area. This study analyzes the agronomic, economic and ecological viability of intercropping of switchgrass and Loblolly pine. The findings from this study will have potential to transform the monoculture pattern of cultivation.

What has been done

We continued to assess and compare the performance of agroforestry ecosystems services against monoculture systems based on land use and production yield by carbon pool and preparing soil samples for quality measurement analysis.

Results

Analysis of two years soil organic carbon (SOC) trend shows that intercropping has overall higher stock of SOC. The study was conducted for five different soil profiles up to 1m depth and total SOC stored at the depth below 50cm can be intact for 20-30 years. The qualitative aspects of SOC will be further analyzed by isotope analysis of SOC stored at different depths.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Optimum switchgrass/pine intercropping combination to enhance soil carbon sequestration and minimize greenhouse gas production. (Haile)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Low-carbon systems are key for long-term improvement and environmental sustainability of bioenergy feedstock production. Intercropping systems such as agroforestry, that combine energy crops and trees, has the potential to enhance soil carbon sequestration and minimize greenhouse gas release from the system. They may also produce much of the needed biomass for sustainable biofuel production in the near future, yet only few studies have been conducted regarding its overall performance in this regard. This study examines best management practices of integrating agroforestry systems of loblolly pine and switchgrass to enhance soil carbon sequestration and minimize greenhouse gas production.

What has been done
We have been preparing soil samples collected from agroforestry feedstock systems that combines energy crops and trees and monoculture systems of energy crops and tree plantations for further stable carbon isotope analysis. Soil carbon content was determined in the lab for profile samples to assess and compare the three systems.

Results
Preliminary results shows that agroforestry systems of loblolly pine and switchgrass has potential to enhance the total soil carbon accumulation and reduce greenhouse gas production. The result showed that the SOC concentration at the top soil (0-10cm) was higher as compared to lower depth in all treatments. Intercropping of switchgrass and loblolly pine noted higher concentration of SOC at every depths expect 50-100 cm. The SOC concentration decreases with depth but subsequently increased with time. Further carbon quality analysis is needed to determine which components of the agroforestry system (tree or grass) is the source of the different carbon fraction in the soil and the respective nature and longevity of soil carbon in the system.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Biomass mapping models to help plan a continuous supply of traditional forest products, and help generate revenue, and protect and restore supporting services in the forests in Tennessee. (Pokharel)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The perspectives regarding forests and forestry practices have changed the emphasis from traditional timber production to multiple-value forest management. To satisfy the multiple objectives of forest management, timely and accurate information of forest conditions, at multiple scales and resolutions is required. With the advancement of computer and remote sensing technology, there is an opportunity to leverage geographically extensive data to develop predictive models of forest attributes. This offers synergistic benefits with field-based data collection to reduce cost, increase accuracy, and provide new opportunities in forest resources management and utilization through mapping of forest biomass across the state of Tennessee.

What has been done

A suite of predictor variables and their derivatives from remote sensing images, i.e. Landsat 5, Digital Elevation Model, were used to develop predictive map of biomass for the entire state of Tennessee. Five thousand regression-trees were generated from the fitting data set through a boot-strapped sampling procedure (selecting cases and predictor variables for each tree at random) using ?randomForest? package in the R statistical computing platform. The model was used to generate a continuous gridded layer of predictive raster map with 30-meter resolution.

Results

The biomass map produced can be used to generate available woody biomass at user specified proximities from the selected point of interest on the ground. The tool not only helps to plan a continuous supply of traditional forest products, e.g. timber and pulp, and new bioproducts such as biomass from the forest, but also helps to generate revenue and improve the quality of forests in the State of Tennessee. High resolution maps are important to generate business opportunities to utilize huge stock of unused biomass without compromising the ecological, economic and social values of Tennessee?s valuable forests. Furthermore, it addresses one of the important milestones from the Agriculture Act 2014, Energy Independence and Security Act 2007 and the Energy Policy Act 2005 to increase production of cellulosic biofuel that not only guarantees national energy security, but also enhances economic development to local communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
123	Management and Sustainability of Forest Resources

Outcome #11

1. Outcome Measures

Optimize oak savannah restoration (Keyser, Kwit)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
123	Management and Sustainability of Forest Resources
125	Agroforestry
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #12

1. Outcome Measures

Address tick-borne disease in the Southeast (Hickling)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
312	External Parasites and Pests of Animals
721	Insects and Other Pests Affecting Humans

Outcome #13

1. Outcome Measures

Use of remote sensing and GIS technologies to produce enhanced monitoring tools for forestry production in the Southern US. (Akumu)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Several stakeholders such as government agencies, land management companies, forest logging companies are continuously seeking updated softwood forest distribution maps in the Southern US for monitoring and forest management activities such as harvesting, pruning, forest fire management and conservation.

What has been done
The classification and mapping of southern yellow pines have been performed. Analyses of vegetation extent, quality and validation are ongoing. Furthermore, several satellite datasets have also be gathered to develop techniques that will be used to improve the detection of southern yellow pine stands on the landscape

Results
The project has generated spatio-temporal distribution maps for southern yellow pine stands in Tennessee for the years 1999, 2009 and 2016. Validation and accuracy assessments of the generated maps are ongoing

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
125	Agroforestry

Outcome #14

1. Outcome Measures

Forest Landowner Education: Number of landowners who improved profitability (marketing) of their forest ownership.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	24

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
125	Agroforestry

Outcome #15

1. Outcome Measures

Tennessee Master Logger Program

2. Associated Institution Types

● 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Training of loggers in Best Management Practices (BMPs) is necessary in providing a non-regulatory approach to protecting water quality during forest harvesting operations in concordance with the Clean Water Act. The educational program is a cooperative effort between UT Extension, Tennessee Department of Agriculture Forestry Division (TDA), and the Tennessee Forestry Association.

What has been done
-13 continuing education logger workshops with 318 participants (loggers, foresters, landowners) were held in 2017 (8 hours each, 2,500+ contact hours).
-2 logger workshops of 5 days each for 30 participants (loggers) were held in 2017 (36 hours of instruction, 1,000+ contact hours).
-Statewide BMP survey of 213 harvest sites was completed in 2017 (funded through a grant with TDA.

Results
-Each participant increased their knowledge on BMPs to protect water quality during harvesting operations during the one-day continuing education workshop. Approximately 50% of the trained logging work force in Tennessee attended the workshops (requirement to maintain Master Logger designation is to attend one continuing education workshop every two years).
-Based on Master Logger class surveys (highly variable to characterize each logging operation), each logger is estimated to harvest 500 acres per year, averaging 3,000 board feet per acre (partial harvests included), and with an estimated average timber value of $1,000 per acre.
-The Tennessee Master Logger educational program has reached more than 1,200 loggers and 300 forestry professionals since 1983 or about 90 percent of the state logging workforce.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #16

1. Outcome Measures

Improved Railroad Bridge Timbers

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Railroad bridge timbers are a critical component of the railroad infrastructure. They are expensive to manufacture and even more expensive to replace, given the associated bridge downtime. Unfortunately, bridge timbers which are large in dimension - are very difficult to penetrate with preservative chemicals, and thus will often fail due to rot in a relatively short time. More effective preservative treatments are needed for bridge timbers.

What has been done
UT Extension has participated in the development of a supplemental preservative treatment for railroad bridge timbers. Work has included showing no negative strength impacts and a financial impact analysis.

Results
Three bridge tie manufacturers are now using the technology for at least five different customers, including three Class 1 railroads. Potential savings associated with the technology have been estimated at $300 million per Class 1 railroad.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
605	Natural Resource and Environmental Economics

Outcome #17

1. Outcome Measures

Sustainable Forestry versus Diameter Limit Cutting

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
U.S. Forest Service Data continues to reveal that although the amount of forestland in Tennessee and the wood volume contained within is increasing, the quality of wood is declining. A primary reason is the continued indiscriminate and destructive harvesting practice of diameter limit cutting (DLC). DLC leads to forest degradation and affects timber and lumber sale revenue.

What has been done
To address the issue, a three-year program was initiated whereby forest logging demonstration sites were developed depicting sustainable harvesting versus diameter limit cutting. 2017 represents the first year of the program and two field days and eight evening presentations were delivered. In total, 341 landowners were reached through these events. A Formal Extension publication was also created to support the program.

Mercker, D. C. 2016. Sustainable Forestry versus Diameter Limit Cutting. University of Tennessee Extension. PB1848.

Results
Surveys of event attendees indicate:
-98% have a better understanding of DLC and claim they are now more aware of the negative effects.
-94% are more likely to utilize the services of a professional forester and indicated they will share the information with other landowners.
-95% felt the field demonstration was beneficial for better understanding of DLC.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #18

1. Outcome Measures

Bottomland Hardwood Restoration Demonstration

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Throughout the 1940 - 1970's, vast amounts of bottomland hardwoods were cleared for the purpose of row crop agriculture. Productivity suffered due to continual flooding. Since then, efforts have focused on replanting these sites to restore the bottomland hardwood ecosystem.

What has been done
During 2004, a UT Extension forester established a 120 acre bottomland tree planting, including 51,000 seedlings of 14 different species. The stand has developed to the point that field days were needed to convey results. During 2017, three field days were held.

Results
31 professional foresters and natural resource managers attended the events.Surveys of the participants indicate 94% of participants:
-are willing to adopt the practices.
-felt the event was worth attending and that forests would be better managed.
-are willing to share the knowledge gained, and would like to attend another similar event.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

V(H). Planned Program (External Factors)

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research indicates the intercropping of switchgrass and Loblolly pine have potential to be the substitute of the mono-cropping system of cultivation in the southeastern USA. This system of cultivation may provide many ecological and economic solutions to small farm owners. Findings from this research verify that long term benefits are inevitable for this system.

Mapping tools not only help to plan a continuous supply of traditional forest products, e.g. timber and pulp, and new bioproducts such as biomass from the forest, but also helps to generate revenue and improve the quality of forests in the State of Tennessee. High resolution maps are important to generate business opportunities to utilize huge stock of unused biomass without compromising the ecological, economic and social values of Tennessee's valuable forests.
Evaluation of Extension forest landowner education programs demonstrated the following in 2017:
-105 forest landowners are members in a local County Forestry Association representing 35,000 forest acres.
-30 forest landowners indicated a willingness to adopt recommended practices presented from the County Forestry Association educational programs.
-118 landowners became aware of the educational modules available from the National Learning Center for Private Forest and Rangeland Owners.
-24 landowners improved profitability (marketing) of forest ownership.
-73 landowners now understand the ecology of forest development process (planning) by contacting a professional forester or developing a forest management plan for 7,090 forested acres.

Key Items of Evaluation

Evaluation of Extension forest landowner education programs demonstrated the following in 2017:
-105 forest landowners are members in a local County Forestry Association representing 35,000 forest acres.
-30 forest landowners indicated a willingness to adopt recommended practices presented from the County Forestry Association educational programs.
-118 landowners became aware of the educational modules available from the National Learning Center for Private Forest and Rangeland Owners.

-24 landowners improved profitability (marketing) of forest ownership.
-73 landowners now understand the ecology of forest development process (planning) by contacting a professional forester or developing a forest management plan for 7,090 forested acres.

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Health and Safety

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment	5%	5%	0%	0%
511	New and Improved Non-Food Products and Processes	5%	5%	0%	0%
724	Healthy Lifestyle	70%	70%	0%	0%
805	Community Institutions, Health, and Social Services	20%	20%	0%	0%
	Total	100%	100%	0%	0%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	20.0	1.0	0.0	0.0
Actual Paid	18.0	0.0	0.0	0.0
Actual Volunteer	3.0	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**
358114	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1668715	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
150000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Dining with Diabetes was a three-session course offered throughout the state. This course was taught by Extension Family and Consumer Sciences Agents who coordinated with local health officials to

target people with diabetes and/or their caregivers.

Arthritis Self-Help was delivered in six sessions. Each session was two-hours in length. Participants were provided with the book, The Arthritis Helpbook, written by Kate Lorig and James Fries. This evidence-based program was designed to increase the self-confidence of participants to manage their arthritis. It was delivered by Extension, in partnership with the Tennessee Chapter of the Arthritis Foundation, the Tennessee Department of Health's Arthritis Control Program, and the University of Tennessee Medical Center's Department of Family Medicine. Specific efficacy-enhancing strategies used in this program include:

- Contracting: Weekly contracting helps participants master something new.
- Feedback: Opportunity is provided to report and record progress and explore different behaviors.
- Modeling: People learn more and try harder when they are motivated by people whom they perceive to be like themselves. Program participants and the trainer serve as models. The course has an emphasis on modeling.
- Reinterpreting Symptoms and Changing Beliefs: People are pretty rational. They act based on beliefs. If people believe arthritis is a wear and tear disease, then they may not think they can exercise. If they think that nothing can be done for their arthritis, they are probably right. Throughout this program, there is a great emphasis on changing such beliefs.
- Persuasion: By seeing others in the class contract and succeed, even the most reluctant participant will often choose to take part. It is hard not to go along with others. The facilitator urges participants to do a little more than they are doing now, such as walking four blocks instead of two.

Living Well with Chronic Conditions targeted citizens living with chronic health issues such as asthma, arthritis, and heart disease. Extension helped these individuals to manage their pain and engage in daily activities.

2. Brief description of the target audience

The target audience was inclusive of consumers and limited resource individuals and families. The Dining with Diabetes program targeted individuals with this chronic disease and the caregivers, health professionals and volunteers who serve them.

3. How was eXtension used?

- In 2017, Tennessee Extension professionals served on the Home Energy Community of Practice.
- In 2017, Tennessee Extension professionals served on the Creating Healthy Communities Community of Practice.
- Tennessee Extension personnel annually address hundreds of Frequently Asked Questions through eXtension, including health and safety questions.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	111236	11711022	41458	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	11	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits built and displayed to promote program awareness and participation.

Year	Actual
2017	912

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2017	133500

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Arthritis Self-Help Course: Number of participants surveyed who have less pain from their arthritis.
2	Arthritis Self-Help Course: Number of participants surveyed who take fewer medications for their arthritis pain.
3	Dining with Diabetes: Number of participants surveyed who reduced weight.
4	Dining with Diabetes: Number of participants surveyed who eat at least five servings of fruits and vegetables each day.
5	Dining with Diabetes: Number of participants surveyed who use spices and other seasonings to cut back on fat, sugar, and salt.
6	Living Well with Chronic Conditions: Number of participants controlling their anger and frustration caused by their condition by using positive thinking techniques six months after completing the program.
7	Living Well with Chronic Conditions: Number of participants making healthy food decisions six months after completing the program.
8	Living with Chronic Conditions: Number of participants who have had fewer doctor visits and/or emergency room visits six months after completing the program.
9	Healthy Decisions for Tennessee Youth
10	Walk Across Tennessee: Choices for Better Health

Outcome #1

1. **Outcome Measures**

Arthritis Self-Help Course: Number of participants surveyed who have less pain from their arthritis.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	305

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

Outcome #2

1. **Outcome Measures**

Arthritis Self-Help Course: Number of participants surveyed who take fewer medications for their arthritis pain.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	31

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

Outcome #3

1. Outcome Measures

Dining with Diabetes: Number of participants surveyed who reduced weight.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Dining with Diabetes: Number of participants surveyed who eat at least five servings of fruits and vegetables each day.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	335

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

Outcome #5

1. Outcome Measures

Dining with Diabetes: Number of participants surveyed who use spices and other seasonings to cut back on fat, sugar, and salt.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	335

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

Outcome #6

1. Outcome Measures

Living Well with Chronic Conditions: Number of participants controlling their anger and frustration caused by their condition by using positive thinking techniques six months after completing the program.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	328

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

Outcome #7

1. Outcome Measures

Living Well with Chronic Conditions: Number of participants making healthy food decisions six months after completing the program.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

Outcome #8

1. Outcome Measures

Living with Chronic Conditions: Number of participants who have had fewer doctor visits and/or emergency room visits six months after completing the program.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	60

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

Outcome #9

1. Outcome Measures

Healthy Decisions for Tennessee Youth

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth face tremendous risk from abuse of alcohol, tobacco, and other drugs. Alcohol has negative effects on judgement, reflexes, respiration, and heart action (Whitney & Rolfes, 2011). According to the Centers for Disease Control and Prevention (CDC), 6.7% of middle school youth and 23.3% of high school students currently use tobacco products, including cigarettes, cigars, hookahs, smokeless tobacco, electric cigarettes, and other tobacco products (2015). Prescription drugs that are abused by young people include stimulants that cause the heart rate to increase, raise the body's temperature to dangerous highs, and cause seizures. Research has demonstrated that almost all youth ages 12-14 are at risk for trying a substance due to peer pressure or it being the norm in their communities.

What has been done

4-H Health Rocks! is a healthy living program targeting youth substance abuse prevention with 10 hours of instruction. An annual 4-H Health Rocks professional development conference educated Extension 4-H Agents on all aspects of the drug abuse problem in Tennessee as well as program accountability and implementation. In turn, the Extension 4-H Agents partnered with schools, non-profit organizations, and public agencies to implement the program in their communities. In 2016-2017, the program reached 15,523 youth in 18 counties.

Results

Youth in this program developed attitudes toward a healthy lifestyle, improved skills in managing stress, and built assets for productive living. Annually, the program is evaluated with a retrospective post-then-pre survey of a group of randomly selected youth participants. From 2014-2017, 1,492 youth completed surveys, and the Tennessee program has demonstrated the following:

-5% increase in the number of youth who now understand that illegal drug use causes psychotic behavior.

-7% increase in the number of youth who understand that illegal drug use affects relationships with family and friends.

-2% increase in the number of youth who now have long-term goals in life.

-3% increase in the number of youth who report they would help other youth to stay away from alcohol and other drugs.
-4% increase in the number of youth who report they are able to say no if offered cigarettes.

The following are representative written comments from youth participants:
-"I like Health Rocks, it's fun and educational." Bradley County 5th Grader
-"I thought it was very informative and helpful. It taught me a lesson about drugs, and I will never do drugs!" Dyer County 6th Grader
-"Health Rocks was very helpful for me. I learned new stuff, and it was a fun experience." McNairy County 6th Grader
-"It helped me stay away from drugs and alcohol." Robertson County 7th Grader
-"Health Rocks taught me not to do drugs." Grainger County 7th Grader

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

Outcome #10

1. Outcome Measures

Walk Across Tennessee: Choices for Better Health

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The prevalence of obesity has been increasing over the past two decades throughout the United States especially in southern states. Regular physical activity has several health benefits, including: control weight, reduces risk of several health conditions (e.g., type 2 diabetes, high blood pressure), improves mood, boosts energy, and improves sleep quality. However, only 39% of Tennessee adults reported meeting the recommended levels for physical activity.

What has been done
Walk Across TN is a group-walking program that is offered by UT Extension. The objectives of Walk Across TN are: 1) to decrease the overweight and obesity trend in the state, and 2) to help Tennessean improve their physical and emotional health, and manage chronic diseases. This program was offered in 54 Tennessee counties and 5,750,790 indirect contacts (exhibits,

newspaper articles, publications, radio programs, and social media) have been made about the program and the importance of physical activity.

Results
Overall, 30,769 participants walked 965,923 miles in the Walk Across Tennessee Program. Participants reported that:

-95% (19,324 of 20,303) increased their exercise routine during Walk Across Tennessee Program.
-28% (5,732 of 20,205) will continue to exercise after the Walk Across Tennessee Program.
-94% (16,475 of 17,445) can better control their chronic disease as a result of participating in the program.

Six-month follow-up
-13% (643 of 4,823) lowered their blood sugar levels.
-87% (4,065 of 4,670) decreased their blood pressure six months after completing the program.
-76% (3,063 of 4,025) decreased their cholesterol levels six months after completing the program.
-82% (4,895 of 5,948) feel their overall health has improved by maintaining an exercise program
-51% (1,578 of 3,111) maintained their walking/exercise routine.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

V(H). Planned Program (External Factors)

- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Breast cancer is the most common cancer and the second most common cause of death among women in Tennessee. The Tennessee Breast and Cervical Screening Program offers clinical breast exams, mammograms, Pap tests and pelvic exams through county health departments to eligible women. However, many eligible women do not use these screening services. There is a need to improve breast and cervical cancer screening by educating women about the available screening programs, as well as the importance of screening. A total of 26 counties conducted several events / activities, focused on breast cancer, cervical cancer, or both breast cancer and cervical cancer. In each county, TEAM UP events were planned and implemented through county partnerships. Activities were held in a number of community settings: from schools, to healthcare facilities, to churches, and worksites. Counties reported 2,942 direct contacts, and 355,274 indirect contacts (exhibits, newspaper article, publications, radio programs, and social media), reaching county residents with information on the importance of breast and cervical cancer screening.

A total of 809 women completed a survey and reported that:

- 94% (796 of 844) understand that cancer screening and early detection can save their life.
- 94% (796 of 844) know what cancer screenings they need according to their age and gender.
- 90% (732 of 809) feel confident they can reduce their personal risk factors that increase their chances of developing a specific cancer.
- 90% (718 of 795) plan to get age and gender appropriate cancer screenings.

Key Items of Evaluation

Breast cancer is the most common cancer and the second most common cause of death among women in Tennessee. The Tennessee Breast and Cervical Screening Program offers clinical breast exams, mammograms, Pap tests and pelvic exams through county health departments to eligible women. However, many eligible women do not use these screening services. There is a need to improve breast and cervical cancer screening by educating women about the available screening programs, as well as the importance of screening. A total of 26 counties conducted several events / activities, focused on breast cancer, cervical cancer, or both breast cancer and cervical cancer. In each county, TEAM UP events were planned and implemented through county partnerships. Activities were held in a number of community settings: from schools, to healthcare facilities, to churches, and worksites. Counties reported 2,942 direct contacts, and 355,274 indirect contacts (exhibits, newspaper article, publications, radio programs, and social media), reaching county residents with information on the importance of breast and cervical cancer screening.
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V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Horticultural Systems

☑ 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
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	5%	0%
111	Conservation and Efficient Use of Water	0%	0%	10%	0%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	10%	0%
205	Plant Management Systems	12%	12%	19%	12%
211	Insects, Mites, and Other Arthropods Affecting Plants	45%	45%	0%	45%
212	Pathogens and Nematodes Affecting Plants	11%	11%	30%	11%
213	Weeds Affecting Plants	0%	0%	0%	0%
215	Biological Control of Pests Affecting Plants	0%	0%	2%	0%
216	Integrated Pest Management Systems	10%	10%	4%	10%
601	Economics of Agricultural Production and Farm Management	22%	22%	0%	22%
607	Consumer Economics	0%	0%	0%	0%
702	Requirements and Function of Nutrients and Other Food Components	0%	0%	10%	0%
721	Insects and Other Pests Affecting Humans	0%	0%	10%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	36.0	5.0	25.0	10.0
Actual Paid	29.0	0.0	0.0	14.9
Actual Volunteer	4.0	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**
581935	0	0	645081
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2711663	0	0	645081
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
100000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

To develop and maintain attractive landscapes and productive home gardens, consumers need knowledge and skills in proper fertilization, plant selection, planting techniques and pest management. UT and TSU Extension responded to these needs in FY 2017 through extensive residential and consumer horticulture programs in all 95 counties of the state as well as UT Gardens. UT and TSU Extension recruited and managed volunteers, such as Master Gardeners, to provide community garden and landscape programs that improved the quality of life.
In Tennessee, commercial horticulture is quite diverse and encompasses production of ornamental plants, turfgrass as well as fruits and vegetables and commercial landscape management. Extension programming focused on these aspects to strengthen the state's commercial horticulture industry:

- Implementation of best management practices to monitor pesticide, fertilizer and water usage.
- Evaluation of plant varieties, plant quality coupled with marketing and management to increase sales and maximize profits.
- Diversification of fruit and vegetable production systems through the use of high-density plantings, organic/sustainable production methods, integrated pest management, season extension techniques and Good Agricultural Practices (GAPs).

Variety evaluation of several different vegetable crops will be conducted to determine suitability to climate, soils and cultural practices for state producers. Yields, quality and market potential will be evaluated to assess potential production by growers seeking additional crops or alternative crops. Crops suitable for greenhouse production in farmers tobacco transplant greenhouses will be evaluated for profitability and product quality with respect to local and state markets.

UT AgResearch efforts determine the effectiveness of various control technologies, develop new genetic cultivars of plants from in-house breeding programs or, in some cases, find naturally resistant populations of plants by searching the southeast U.S. (i.e. for anthracnose resistant dogwoods).

Research is conducted at selected Research and Education Centers across Tennessee, and at several farmer-cooperator locations in key areas of horticultural production in Tennessee. Substantial investments have just been made in construction and renovation of greenhouse facilities on campus and at certain Research and Education Centers. These will be utilized extensively in the conduct of our research.

Research conducted at TSU will:

Identify new pesticide, biopesticide, and treatment methodologies for container and field-grown nursery stock to manage disease and insect problems.
Determine the lowest effective rates for synthetic petroleum-based pesticides and develop new reduced rate insecticide / biopesticide combinations.
Identify new biopesticides that can substitute for synthetic petroleum-based pesticides and reduce worker exposure risk and environmental impact.
Release phorid-decapitating flies in Tennessee to provide imported fire ant biological control.
Provide extension training and literature to producers on imported fire ant and Japanese beetle management and train students in pest management and research techniques.

Provide data to support new treatments in the Domestic Japanese Beetle Harmonization Plan and the Federal Imported Fire Ant Quarantine, as well as data to support new insecticide label amendments. Conduct assessment of current and future energy use by greenhouse and nursery businesses. Identify alternative energy sources for the greenhouse and nursery industry.

2. Brief description of the target audience

- Farmers/producers who have traditional livestock and tobacco operations, but are looking to improve income through the Green Industry.
- Master Gardeners who volunteer to provide community service through horticulture.
- Business owners who need research-based information to start, maintain or expand their greenhouse, landscaping, or nursery business.

- Regulatory agencies (e.g., U.S. Environmental Protection Agency, USDA-APHIS, Tennessee Department of Agriculture).
- Agrochemical manufacturers

3. How was eXtension used?

Information on control of Imported Fire Ant was disseminated via webinars and other postings on eXtension.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	121818	24457787	119644	110

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	14	26	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Horticultural workshops and conferences.

Year	Actual
2017	7275

Output #2

Output Measure

- Number of exhibits displayed to teach best practices in horticultural systems.

Year	Actual
2017	223

Output #3

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2017	427095

Output #4

Output Measure

- Factsheets about alternative methods to control disease and insects in nursery production.

Year	Actual
2017	0

Output #5

Output Measure

- Develop Drought- and Temperature-Tolerant Grapes (Cheng)

Year	Actual
2017	0

Output #6

Output Measure

- Employ Nematodes for Biological Pest Control (An)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Consumer Horticulture: Number of consumers who applied fewer fertilizers and pesticides due to a better understanding of landscape best management practices.
2	Consumer Horticulture: Number of consumers who learned about plant selection and proper planting to save money and time in the landscape.
3	New trap designs and strategies for Ambrosia beetle available to growers. (Addesso)
4	Assess and Reintroduce Pityopsis ruthii (Trigiano, Wadl)
5	Enhance Gentic diversity in dogwood cultivars (Windham, Windham, Trigiano, Wadl)
6	Control Downy Mildew (Lamour, Trigiano)
7	Enhance Greenhouse Production (Deyton, Sams)
8	Develop Molecular Markers for Horticultural Traits (Trigiano, Ownley, Wadl)
9	Use Genetics Against Phytophthora Blight (Lamour)
10	Improved understanding of pest management treatment options and reduced-risk pest control options by end-user nursery growers. (Oliver)
11	Development of new treatment options, reduced costs, lower environmental pesticide inputs, or reduced risk from lower rates or new chemistries with less acute toxicity. (Oliver)
12	Research to develop changes to quarantine guidelines for Japanese beetle and imported fire ant. (Oliver)
13	Determine the current labor use by small Tennessee farmers and the degree of off-farm employment by small farmer. (Tegegne)
14	Development of Best Management Practices for labor use by small farmers in Tennessee. (Tegegne)
15	Enhancing sustainable plant health through identification and characterization of microbes with bioactivity against diverse fungal diseases, insects and environmental stress for use as microbial pesticides for pathogens, and in improving plant growth. (Mmbaga)
16	Enhance nursery production efficiency through readily-adopted chemical, biorational and cultural techniques to reduce soil-borne disease. (Baysal-Gurel)
17	Decrease ground and surface water contamination in nursery production through identification of new nursery crop production practices to reduce the use of synthetic pesticides. (Witcher)
18	Develop Bioactive Natural Products for Plant Protection (Gwinn, Chen, Ownley, Bernard)
19	Address Viruses of Grapevine (Hajimorad)

20	Extension Provides Nursery, Greenhouse, and Landscaping Tour
21	Extension Enhances Commercial Fruit and Vegetable Production in Tennessee
22	Extension Provides Turfgrass Education Programs for Homeowners
23	Plant Disease and Insect Management for Tennessee's Green Industry

Outcome #1

1. Outcome Measures

Consumer Horticulture: Number of consumers who applied fewer fertilizers and pesticides due to a better understanding of landscape best management practices.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1467

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. **Outcome Measures**

   Consumer Horticulture: Number of consumers who learned about plant selection and proper planting to save money and time in the landscape.

2. **Associated Institution Types**

   - 1862 Extension
   - 1890 Extension

3a. **Outcome Type:**

   Change in Knowledge Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	5189

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #3

1. **Outcome Measures**

   New trap designs and strategies for Ambrosia beetle available to growers. (Addesso)

2. **Associated Institution Types**

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Ambrosia beetles are serious pests of trees and shrubs in nursery production. The beetles tunnel into the bark and excavate galleries which can girdle the tree and kill it. The beetles feed on symbiotic fungus they inoculate into the bark tissue which can cause diseases in some plants.

What has been done
Several fungicide products were tested as preventative and curative treatments for Phytopthora and evaluated for prevention of ambrosia beetle attacks. Two potential ethanolic compounds were run in trials as repellents.

Results
Fungicides applied before and after flooding events provided variable suppression of ambrosia beetles in flood stressed trees. None of the products prevented attacks entirely. Two ethanolic compounds were evaluated in lab and field experiments alone and in combination to repel ambrosia beetles. These compounds successfully reduced the number of ambrosia beetle attacks on cut tree branches and whole trees when applied as sprays and lures. The compounds evaporate quickly, so future work will require formulation of slow-release methods.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #4

1. Outcome Measures

Assess and Reintroduce Pityopsis ruthii (Trigiano, Wadl)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #5

1. Outcome Measures

Enhance Gentic diversity in dogwood cultivars (Windham, Windham, Trigiano, Wadl)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
212	Pathogens and Nematodes Affecting Plants

Outcome #6

1. Outcome Measures

Control Downy Mildew (Lamour, Trigiano)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

Outcome #7

1. Outcome Measures

Enhance Greenhouse Production (Deyton, Sams)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
607	Consumer Economics

Outcome #8

1. Outcome Measures

Develop Molecular Markers for Horticultural Traits (Trigiano, Ownley, Wadl)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #9

1. Outcome Measures

Use Genetics Against Phytophthora Blight (Lamour)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

Outcome #10

1. Outcome Measures

Improved understanding of pest management treatment options and reduced-risk pest control options by end-user nursery growers. (Oliver)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Ornamental nurseries grow a more diverse mixture of plant genera and species than typical of other monoculture farming systems like traditional row crops. Consequently, nursery producers must deal with multiple pest and disease issues at any given time. In addition, a large number of non-indigenous species have been introduced into the U.S. and the invasive nature of many of these species and the costly quarantine programs often associated with them pose a constant challenge to nursery operations. With the complexity of pest issues in nursery agroecosystems, it is important to provide producers and stakeholders with current research information to maximize their knowledge on successful, sustainable, and profitable control tactics via workshops and field days, educational materials like factsheets, and other outlets like webinars and one-on-one training.

What has been done

Field and laboratory research was performed to address key management issues for ambrosia beetles, flatheaded borer, imported fire ant (IFA), and Japanese beetle (JB). Research included neonicotinoid alternatives for flathead borer and Japanese beetle, systemic fungicide development for ambrosia beetles, temperature effects on the efficacy of JB treatments, injection techniques to improve IFA treatments, and evaluation of a new polymer formulation of bifenthrin to enhance soil penetration for improvement of IFA treatments.

Results

Information on efficacious treatments were communicated at grower workshops and online grower training. Nursery producers participating in the online training have reported thousands of dollars in savings from knowledge gained, changed practices, and improved quality of product

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #11

1. Outcome Measures

Development of new treatment options, reduced costs, lower environmental pesticide inputs, or reduced risk from lower rates or new chemistries with less acute toxicity. (Oliver)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Numerous insect pests in nurseries require frequent insecticide treatments to reduce levels of plant damage or to meet mandatory quarantine requirements. Examples include trunk damaging borers like ambrosia beetle and flatheaded borers, which can destroy the marketability of a tree, and cryptic quarantine pests that are easily transported in nursery plant soils like Japanese beetle larvae and imported fire ants. The development of new product alternatives, especially reduced-risk treatments, and better treatment methodologies, is important for protecting agricultural workers, the environment, and ensuring treatments remain viable and available to agricultural producers.

What has been done

Field and laboratory tests were completed. Tests included fall- and spring-applied neonicotinoid and anthranilic diamide treatments for flatheaded borer, effects of weeds and cover crops at eliminating or reducing the need for flatheaded borer insecticide treatments, systemic fungicides like pyraclostrobin for management of ambrosia beetles, timing and temperature effects on bifenthrin and chlorpyrifos Japanese Beetle Harmonization Plan (JBHP) treatments, anthranilic diamide alternatives for JBHP, improvement of imported fire ant (IFA) root ball drench treatments with injections, effects of compost on IFA and JB treatments, new JB container treatments, and methods to infest container plants more effectively with JB for research trials.

Results

Findings include: 1) vegetation in nursery crops does reduce the need for insecticide treatments, 2) half the labeled rate of imidacloprid provided equivalent control of flatheaded borers, 3) some systemic fungicides reduced ambrosia beetle attacks on various tree species, but more work will be needed before treatments can be recommended, 4) spring dip timings of bifenthrin and chlorpyrifos were the most effective for JB management, but fall timings work if larvae are left exposed to the soil treatments until spring, 5) Signal Green dye injected into root balls could be used to predict concentrations of bifenthrin, 6) container drenches of regular and polymer bifenthrin were equivalently effective on JB at rates tested as were new biocontrol treatments.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #12

1. Outcome Measures

Research to develop changes to quarantine guidelines for Japanese beetle and imported fire ant. (Oliver)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Imported fire ants (IFA) and Japanese beetle (JB) populations continue to spread into new areas in the United States. Both of these pests require expensive certification treatments involving to ensure insects are not shipped to new areas. Management of these pests has been particularly challenging in Tennessee because our nursery industry has the most field-grown acres in the nation. Most of the current IFA and JB quarantine protocols for field-grown nurseries are expensive, rely extensively on one of only three active ingredients, and have potential worker exposure issues from repeated site reentries or post-treated plant handling. More options are needed with lower cost, reduced-risk to farm labor, and greater efficacy to ensure these pests are not shipped to new areas.

What has been done

Research was performed to address specific concerns with JB and IFA quarantines. We completed a second successful year of testing anthranilic diamides against early instar JB as a new potential alternative treatment to the current imidacloprid and thiamethoxam neonicotinoid pre-harvest JB Harmonization Plan (JBHP) treatment. Studies to determine temperature effects on JBHP treatments and compost effects on JB and IFA quarantine treatments also were performed, as well as JB evaluations of a new polymer bifenthrin product in container substrates. Data from IFA and JB tests were shared with USDA-APHIS-PPQ, National Plant Board, and Tennessee Department of Agriculture to facilitate JB and IFA regulation changes.

Results

At the present time, no changes have been made to current JB and IFA quarantines. However, the second year evaluation of anthranilic diamides established rates that were adequate to meet JBHP requirements, which would provide the first neonicotinoid rotational alternative. Our previous chlorpyrifos IFA drench research allowed nursery producers to change from 6 consecutive drenches to 2 drenches, which reduced costs by two-thirds, reduced worker exposure via fewer applications, and reduced environmental contamination.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #13

1. Outcome Measures

Determine the current labor use by small Tennessee farmers and the degree of off-farm employment by small farmer. (Tegegne)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Labor is an important input in agriculture in general, and in small farms in particular. The issue becomes critical in light of the growing ageing population of farmers.

What has been done
Data on characteristics of the farm operators and their spouses was acquired and maintained.

Results
Students acquired experiential learning opportunity in the research process by assisting on the project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #14

1. Outcome Measures

Development of Best Management Practices for labor use by small farmers in Tennessee. (Tegegne)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
It is important to realize that agricultural activities are seasonal and labor supply is influenced by this seasonality. Thus it is necessary to focus on efficient use of labor during the peak season.

What has been done
A mail survey was used to collect data for determining economic efficiency of the farm operations.

Results
Results show that some operations are economically more efficient than others. The result would be made available to other small farmers as well as policy makers. The farmers could adopt the results with appropriate modification and the policy makers could use it as input in developing strategies to enhance economic viability of small farms.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #15

1. Outcome Measures

Enhancing sustainable plant health through identification and characterization of microbes with bioactivity against diverse fungal diseases, insects and environmental stress for use as microbial pesticides for pathogens, and in improving plant growth. (Mmbaga)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Diseases caused by fungi have detrimental effects on agricultural productivity and reduce crop yields. The use of chemical pesticides to control such diseases is a common practice, but there is increasing concern over toxicity hazards from accidental exposures to the users and environmental contamination. It is important to develop alternative products that are effective and safer to the users and the environment. Microbial pesticides are deemed safer and more precise and may provide alternative products to chemical pesticides.

What has been done
Isolation of microorganisms and evaluation of their effect on diverse fungal pathogens have been completed. Identification of microbial isolates has been initiated but is not complete. Evaluations of the microbial isolates for biological activity in suppressing fungal pathogens were performed in

the lab and some have been confirmed in greenhouse and field environments, this action is continuous and is being repeated.

Results
Of 197 microorganisms isolated from healthy plants, six organisms suppressed growth of fungal pathogens in the lab; several isolates are known to be pathogens but they did not express their pathogenicity on plants from which they were isolated. Evaluation of their pathogenicity is continuous and evaluation of isolates known to be pathogens has not been completed. A question remains whether non-pathogenic isolates suppressed the pathogenic ones from expressing their pathogenicity. The role of the non-pathogenic microbes in suppressing disease development from the pathogenic fungi is being evaluated.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #16

1. Outcome Measures

Enhance nursery production efficiency through readily-adopted chemical, biorational and cultural techniques to reduce soil-borne disease. (Baysal-Gurel)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil-borne diseases can be a major limitation to field production of woody ornamentals, particularly for propagation ground bed systems. Based on nursery inspections and disease samples received at the TSU Nursery Research Center, soil-borne pathogens were documented as most economically important pathogens. Soil-borne diseases are often difficult to control, and cannot be managed solely through the use of crop rotations, improved disease resistant varieties, and chemical control. Therefore, providing improved, efficacious, cost-effective, sustainable and environmentally friendly recommendations for soil-borne disease management to the nursery industry is very important.

What has been done
Chemical and biorational products were evaluated for ability to control Phytophthora root rot of dogwood, hydrangea, Phytophthora aerial blight of annual vinca and Rhizoctonia root rot of Viburnum. Based on the outcome of the pathogenicity study from 2016 research results, selected biofumigation cover crops in the Brassicaceae family were evaluated for their ability in controlling

soilborne diseases in greenhouse and farm trials.

Results
Fungicides were identified that produced significant reductions in Phytophthora root rot and significant increases in root dry weight. Fungicide were also identified to control Phytophthora aerial blight. These findings are of significant interest to nursery producers and were communicated via new fact sheets and presentations. Additionally, potential biofumigant crops were identified to control soilborne diseases. These crops are undergoing additional testing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #17

1. Outcome Measures

Decrease ground and surface water contamination in nursery production through identification of new nursery crop production practices to reduce the use of synthetic pesticides. (Witcher)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Weed pests are a continuous problem in woody ornamental crop production and propagation. Synthetic herbicides can be used to control/prevent weeds, yet some crops are sensitive to herbicides. Also, reducing the frequency of herbicide applications minimizes potential crop damage and result in higher quality crops. Mulches and cover crops have potential to control weeds while reducing herbicide use and reducing production costs for growers.

What has been done
Several mulching materials and pre-emerge herbicides were applied to container-grown tree seedlings (several crop species) and evaluated for effects on crop growth and weed prevention. In a second study, cover crops (various species) were sown in the fall to determine if planting date affected cover crop establishment and weed control in field grown nursery crops.

Results
In a mulching study, compressed pine pellet mulch provided excellent control of several weed species, with similar control compared with most of the herbicide treatments. Crop plant growth

was similar between non-treated and mulched tree seedlings. In a cover crop study, winter rye and crimson clover provided the most effective weed control, particularly when planted later in the fall. Mulches have potential for use in crop propagation where herbicides cannot be used, while winter cover crops may be used to reduce herbicide applications in field grown nursery stock.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #18

1. Outcome Measures

Develop Bioactive Natural Products for Plant Protection (Gwinn, Chen, Ownley, Bernard)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #19

1. Outcome Measures

Address Viruses of Grapevine (Hajimorad)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #20

1. Outcome Measures

Extension Provides Nursery, Greenhouse, and Landscaping Tour

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sustainable agriculture remains relevant, as it promotes environmental stewardship, a profitable farm income, and prosperous farm families and communities. Keeping sustainable agriculture in the forefront, however, requires quality planning and instruction.

What has been done
UT Extension conducted a Nursery, Greenhouse and Landscaping Tour for 39 nursery growers, landscapers, and Extension agents from 18 counties. All participants were from the Eastern Region of Tennessee. The tour was a three-day tour, and featured innovative nurseries in Georgia and South Carolina.

Results
Our evaluation showed the following impacts:
-100% of participants increased their knowledge of improved marketing practices, new and innovative plant materials, and new production technologies.
-Nursery growers reported an average economic impact of over $6,250 per operation. Total estimated economic impact was $166,725.
-100% of participants agreed that the educational tour was beneficial, and they would recommend it to other nursery producers and landscapers

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #21

1. Outcome Measures

Extension Enhances Commercial Fruit and Vegetable Production in Tennessee

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Challenges facing the commercial fruit and vegetable industry include implementing food safety practices, integrated pest management, organic and sustainable cultural practices, season extension, and profitability.

What has been done
UT Extension programming in fruit and vegetable production resulted in nearly 24,000 direct contacts during 2017. Best production and management practices were taught at 363 group meetings and 918 on-site visits. Over 500 social media outlets, radio programs, TV stories, newspaper articles and other publications reaching 3,639,683 stakeholders supported the direct contacts.

Results
The total economic impact of Extension's commercial fruit and vegetable horticulture programming was estimated at $804,422 in increased savings, increased income, and one-time capital purchases by adopting good agricultural practices (GAPs), season extension or organic production practices. Other impacts included:

-178 fruit and vegetable producers adopted good agricultural practices (GAPs) on 3,199 acres to improve food safety and enhance marketing opportunities.
-12 farm families successfully diversified into fruit and vegetable production and marketing.
-28 fruit and vegetable producers adopted organic and/or sustainable production practices on their farm.
-27 fruit and/or vegetable producers adopted a season extension practice: row covers, high tunnels, greenhouses and/or colored plastic mulches.
-57 fruit and/or vegetable producers adopted IPM.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #22

1. Outcome Measures

Extension Provides Turfgrass Education Programs for Homeowners

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many Tennessee homeowners enjoy working in and managing their lawns and landscapes. According to a survey of the TN Turfgrass Industry led by University of Tennessee Institute of Agriculture faculty in the Department of Agricultural and Resource Economics and the Department of Plant Sciences, the industry contributed > $5 billion to the state's economy and provided > 46,000 full and part-time jobs in 2013. Homeowners throughout TN accounted for an estimated $4.4 billion or nearly 79% of this total.

What has been done
County Extension professionals in 11 counties reported that 930 home lawn insect, disease and weed samples were submitted for identification and management recommendations. In addition, the UT Soil, Plant and Pest Center received >660 home lawn soil samples from the 11 counties for nutrient testing. Several resources developed in 2017 by the state UT Extension Turfgrass Specialist to support efforts of county Extension professionals responsible for delivering lawn programs and answering clientele questions regarding turfgrasses.

Results
-1099 homeowners living in one of the 11 reporting counties dethatched, aerated or applied an appropriate pesticide to the home lawn according to recommendations by county Extension professionals.
-300 homeowners established new turfgrass species and varieties, and 1100 homeowners in the 11 counties mowed, fertilized or irrigated the lawn based on Extension guidelines.
-130 participants of the West Tennessee Summer Celebration Lawn & Garden Open House attending a presentation regarding the selection, establishment, maintenance and renovation of turfgrasses in shade indicated that they would either adjust their overall lawn care program to better accommodate turfgrasses, plant improved and shade-tolerant species and varieties, or naturalize shaded, erosion-prone areas of their landscapes.

4. Associated Knowledge Areas

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

205 Plant Management Systems

Outcome #23

1. Outcome Measures

Plant Disease and Insect Management for Tennessee's Green Industry

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Plant diseases and insects cause millions of dollars of damage to turfgrass and ornamental plants in residential and commercial landscapes, nurseries and greenhouses in Tennessee each year. A key to pest management is the identification of the target pest or disease so that appropriate management strategies can be implemented. Emphasis in many educational processes has been placed on identifying pests and diseases and reliable sources of information for green industry professionals and Master Gardeners.

What has been done
UT Extension conducted educational programs in consumer and commercial horticulture. Pest and disease identification and management practices were taught by Extension educators at group meetings and site visits. These Extension personnel reached 72,903 direct contacts in 60 counties during 2017.

Results
Educational activities across the state were evaluated to determine the following commercial and consumer horticulture impacts:
-432 landscape and nursery participants increased their knowledge of fire ant management.
-766 green industry personnel adopted an integrated pest management approach to insect, mite and disease control in turfgrass and/or ornamentals.
-741 green industry personnel increased business profitability and sustainability through improved insect, mite and disease control in turfgrass and/or ornamental plants.
-1,339 green industry personnel learned to correctly identify pest insects, mites and diseases of turfgrass and/or ornamental plants.
-9 nursery producers implemented recommended, research-based practices that reduced fertilizer use 19%, pesticide use 23.33%, pesticide frequency 22.67%, water use 36% and/or implemented other best management practices resulting in a total estimated savings of $22,500 on a total of 845 acres.
-As a result of Extension Programs, 14 nursery producers have improved plant quality and/or sales resulting in a 30.5% increase in profitability estimated at $76,050.

-255 landscape and grounds management professionals implemented integrated pest management, proper fertilization, species selection, and/or other best management practices resulting in reduced plant mortality and improved environmental impact in 10,559 job sites.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

V(H). Planned Program (External Factors)

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

New Imported Fire Ant drench protocol has provided a major labor cost reduction on hundreds of thousands of treated nursery plants and reduced farm worker pesticide exposure. This one impact is likely saving the U.S. nursery industry hundreds of thousands of dollars every year.
Newly developed treatments for flatheaded borer management programs are providing up growers to 3-years of post-treatment control and have saved growers hundreds of dollars per acre per year in tree losses prevented.
In 2017, we conducted an evaluation of Extension residential and consumer horticulture programs, including our Tennessee Extension Master Gardener Program (TEMG). Evaluation results showed:
-218,746 direct contacts including group meetings and demonstrations (106,415), office visits (12,776), on-site visits (10,864) as well as phone calls and emails (88,691), were made by Tennessee Extension agents, as well as state and area specialists and TEMG volunteers in the area of residential and consumer horticulture in 2017. Additionally, 13 million indirect contacts were made through print, television, radio, social media and other methods.
-10,289 residents received information on home fruit and vegetable production.
-3815 consumers learned how to properly take a soil test and interpret the results.
-4233 consumers learned how to apply landscape fertilizers and pesticides safely.
-4047 consumers learned how to conserve and protect water quality in the landscape.
-5251 consumers learned about plant selection and proper planting to save money and time in the landscape.
-TEMG volunteers contribute substantially to the overall education and outreach capacity of Tennessee Extension is found in the efforts and impacts of TEMG volunteers. In 2017, there were 2,496 volunteers reporting service hours, with 594 of those participating in intern training consisting of 40 hours of education in a broad range of horticultural topics. Together, these volunteers donated 184,640 hours of service to Tennessee in 2017 that is valued at $4,091,621.51.
To provide insight into the impact of these service hours across Tennessee:

-TEMGs managed 111 landscape and ornamental gardens to demonstrate sustainable practices.
-TEMGs managed 57 food gardens that contributed 158,142 pounds of produce to local citizens and communities.
-TEMGs participated in or led 210 fairs, festivals, garden shows or events that reached 295,461 residents.
-TEMGs taught or conducted 446 educational presentations that delivered information to 55,573 residents.
-TEMGs led or participated in 87 camps, garden clubs or agriculture events that reached 19,069 TN youth.

Key Items of Evaluation

In 2017, we conducted an evaluation of Extension residential and consumer horticulture programs, including our Tennessee Extension Master Gardener Program (TEMG). Evaluation results showed:
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V(A). Planned Program (Summary)

Program # 12

1. Name of the Planned Program

Human Development

☑ 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
802	Human Development and Family Well-Being	100%	100%	0%	0%
	Total	100%	100%	0%	0%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	17.0	2.0	0.0	0.0
Actual Paid	14.0	0.0	0.0	0.0
Actual Volunteer	2.0	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**
286491	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1334972	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
200000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This program involved professionals, parents, child care providers, older adults, and community leaders. The target audiences were child care providers, adolescents, and parents who are divorced or incarcerated, court-ordered parents and relatives as caregivers. The following methods were used to help the target audience gain awareness: displays, exhibits, community events, newspaper articles, radio programs, TV shows and newsletters. In addition, fact sheets and resource lists for parents, teachers and professionals were created and disseminated. Extension Family and Consumer Sciences Agents in over 60 of Tennessee's 95 counties offered the four-hour class Parenting Apart: Effective Co-Parenting, an

information and skills-based program that utilizes lecture, class discussion, videos, and handouts to inform parents about the potential effects of divorce on their children and provides them with strategies for minimizing those effects.

In 2017, the TSU Extension Family and Community Health programs continued to teach "Healthy Aging" for the mind, body and spirit. The ultimate goal is to increase knowledge and education relating to healthy aging. Tennessee is getting older. Various assessments have shown that the percentage of Tennessee's population over the age of 65 will grow to 20% by 2025 (up from about 12% at the beginning of the 21st Century). TSU Extension produced and distributed resource materials and educational programs on a variety of topics for interested individuals, caregivers, and professionals. Various methods were employed, including inter-generational connections.

2. Brief description of the target audience

The target audiences for this planned program were Tennessee child care providers, parents, and adolescents. While all parents of infants and young children were targeted for literacy programs, parents seeking a divorce were especially targeted for parenting instruction because of the added demands of co-parenting. Tennessee child care providers working full-time are required to have 18 hours and child care center directors are required to have 24 hours of instruction annually. Tennessee parents seeking a divorce are directed by the courts to a four-hour co-parenting class. In many communities in the state, Extension continues to be the only provider of this instruction.

3. How was eXtension used?

In 2017, Tennessee personnel served on three eXtension Communities of Practice in implementing this program: Parenting, Child Care, and Family Caregiving. eXtension resources were used to inform and improve Extension human development programs in Tennessee.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	49824	3944746	26376	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	3	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote program awareness and participation.

Year	Actual
2017	83

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2017	522

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Child Care/Parenting: Number of parents and childcare providers who report using suggested guidance techniques more often.
2	Child Care/Parenting: Number of parents and child care providers who report putting down or blaming their child less.
3	Child Care/Parenting: Number of parents and child care providers who report talking, singing and playing more with their children than before the program.
4	Divorcing Parents: Number of parents who plan to decrease exposure of their children to parental conflict.
5	Caregiving Education: Number of caregivers who report the Extension program helped them to minimize stress.

Outcome #1

1. **Outcome Measures**

Child Care/Parenting: Number of parents and childcare providers who report using suggested guidance techniques more often.

2. **Associated Institution Types**

- 1862 Extension

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2017	318

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)

What has been done

Results

4. **Associated Knowledge Areas**

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #2

1. **Outcome Measures**

Child Care/Parenting: Number of parents and child care providers who report putting down or blaming their child less.

2. **Associated Institution Types**

- 1862 Extension

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. **Quantitative Outcome**

Year	Actual

2017	355

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #3

1. Outcome Measures

Child Care/Parenting: Number of parents and child care providers who report talking, singing and playing more with their children than before the program.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	236

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #4

1. Outcome Measures

Divorcing Parents: Number of parents who plan to decrease exposure of their children to parental conflict.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1514

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #5

1. Outcome Measures

Caregiving Education: Number of caregivers who report the Extension program helped them to minimize stress.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017 1321

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

V(H). Planned Program (External Factors)

- Other (N/A)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UT Extension After-school Programming
The Tennessee Department of Education holds schools accountable for the success of their students based on standardized test scores and grades. Over 45% of schools in Tennessee have been "failing" the annual Tennessee School Report Card which assesses school system objectives. Since 2014, UT Extension has secured over $2.5 million dollars for quality after-school programming from the Tennessee Department of Education and USDA to help schools receiving a "failing grade" as determined by the Tennessee School Report Card program. In 2017 we operated nine after-school programs across the state serving 710 children. The curricula focuses on Reading, Science, Math, Technology, Health, Homework, Socialization and Leadership. The program targets children/youth who are struggling academically and emotionally. Program evaluation demonstrated:

- Consistently, 51% of our students below the proficient level in both math and/or reading, increase their overall grade point average in those two subjects by one full letter grade by the end of the school year. State average for other state funded after-school programs is 39%.
- Consistently, 42% of our students below the proficient level in both math and/or reading, increase their standardized test scores to the proficient level or above in either math, reading or both. State average for other state funded after-school programs is 35%.
- Consistently, by teacher and parent report, our students who have had office referrals on a regular basis upon entering our after-school programs, have reduced their office referrals by over 77% while in the program.
- The self-esteem scales we use have shown that children in our programs increase their self-perception of their own self-esteem by a significant level.

Key Items of Evaluation

UT Extension After-school Programming
The Tennessee Department of Education holds schools accountable for the success of their students based on standardized test scores and grades. Over 45% of schools in Tennessee have been "failing" the annual Tennessee School Report Card which assesses school system objectives. Since 2014, UT Extension has secured over $2.5 million dollars for quality after-school programming from the Tennessee Department of Education and USDA to help schools receiving a "failing grade" as determined by the Tennessee School Report Card program. In 2017 we operated nine after-school programs across the state serving 710 children. The curricula focuses on Reading, Science, Math, Technology, Health, Homework, Socialization and Leadership. The program targets children/youth who are struggling academically and emotionally. Program evaluation demonstrated:

- Consistently, 51% of our students below the proficient level in both math and/or reading, increase their overall grade point average in those two subjects by one full letter grade by the end of the school year. State average for other state funded after-school programs is 39%.
- Consistently, 42% of our students below the proficient level in both math and/or reading, increase their standardized test scores to the proficient level or above in either math, reading or both. State average for other state funded after-school programs is 35%.
- Consistently, by teacher and parent report, our students who have had office referrals on a regular basis upon entering our after-school programs, have reduced their office referrals by over 77% while in the program.
- The self-esteem scales we use have shown that children in our programs increase their self-perception of their own self-esteem by a significant level.

V(A). Planned Program (Summary)

Program # 13

1. Name of the Planned Program

Sustainable Energy

☑ 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
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	9%	12%
121	Management of Range Resources	0%	0%	6%	0%
132	Weather and Climate	0%	0%	0%	22%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	12%	22%
202	Plant Genetic Resources	0%	0%	0%	0%
204	Plant Product Quality and Utility (Preharvest)	0%	0%	6%	0%
205	Plant Management Systems	0%	0%	6%	22%
212	Pathogens and Nematodes Affecting Plants	0%	0%	0%	0%
215	Biological Control of Pests Affecting Plants	0%	0%	0%	0%
402	Engineering Systems and Equipment	0%	0%	12%	0%
404	Instrumentation and Control Systems	0%	0%	3%	0%
511	New and Improved Non-Food Products and Processes	0%	0%	45%	0%
512	Quality Maintenance in Storing and Marketing Non-Food Products	80%	80%	1%	0%
601	Economics of Agricultural Production and Farm Management	0%	0%	0%	22%
603	Market Economics	10%	10%	0%	0%
605	Natural Resource and Environmental Economics	10%	10%	0%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	5.0	1.0	60.0	7.0
Actual Paid	5.0	0.0	0.0	10.1
Actual Volunteer	1.0	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**
89528	0	0	436670
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
417178	0	0	436670
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Disseminate research findings to the scientific community, stakeholders, agricultural, environmental, life science industries. Recruit and train students, incorporating research training into teaching and extension curricula.

Our economic research is developing national ethanol, biodiesel, electric, and bioproduct demand quantities and incorporating them into an existing dynamic agricultural sector econometric simulation model (POLYSYS). Regional feedstock supply curves necessary to meet national bioenergy and bioproduct demand quantities are being estimated by modifying POLYSYS to include cellulosic feedstock in addition to existing agricultural grain and oilseed crops. Regional bioenergy and bioproduct supply curves are being developed using regional feedstock supply curves, representative transportation costs, and representative costs for each feedstock-technology-product combination considered. A national expansion curve for the bioenergy and bioproduct industry is being estimated. Key indicators of agricultural sector performance including net farm income, agricultural prices, and government cost in meeting national bioenergy and bioproduct demand quantities are being evaluated.

As part of our engineering research, we are documenting drying rates and methods for corn stover, and quantifying the distribution and quality of the above ground biomass.For existing biomass densification systems, we areidentifying relations between particle size, biomass type, final density, compression pressures and energy, and other engineering factors. We are determining optimum particle sizes based on a balance between expended energy, final density, and integrity of compressed pellet or wafer. We are using these optimum particle sizes to identify or invent technologies to achieve the size based on theoretical cutting lengths due to feed speed, cutter speed, and other engineering factors. We are applying the developed technologies in laboratory-scale granulation tests to verify sizes using laser, image analyzer, sieve, and manual methods. We are comparing the developed methods in particle size reduction to existing technologies.

In terms of downstream processing, we are conducting fundamental studies on the fractionation of various free fatty acid (FFA) mixtures to test whether the mathematical modeling approach used by us for rapeseed oil is more widely applicable.Additionally, the food safety of the purified FFA products is being assessed. We will then complete the cost analysis of this fractionation process using results predicted by the mathematical model using chemical plant design software. A bench-scale continuous reactor is being assembled and we will attempt to maintain the same productivity (moles of product per time per mass of enzyme) as achieved for batch-mode experiments from previous experiments.We are also attempting the further development of microemulsion-based protein extraction as a rapid low-cost and scalable means of selectively isolating and purifying proteins of interest from aqueous media.

2. Brief description of the target audience

This planned program is targeted to Tennessee farmers. Secondary audiences include consumers of

both basic and applied research and the general public.

3. How was eXtension used?

eXtension was not used in this program.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4578	3992	525	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research-based publications distributed as part of Extension biofuels programs.

Year	Actual
2017	54

Output #2

Output Measure

- Number of underrepresented students trained in bioenergy and climate change research

Year	Actual
2017	0

Output #3

Output Measure

- Develop bio-based agricultural mulches (Hayes)

Year	Actual
2017	0

Output #4

Output Measure

- Increase control of thermal properties of lignin polymers (Chmely)

Year	Actual
2017	0

Output #5

Output Measure

- Produce platform chemicals from hemicellulose (Chmely)

Year	Actual
2017	0

Output #6

Output Measure

- Determine Environmental Fate of Cellulose Nanocrystals (Radosevich)

Year	Actual
2017	0

Output #7

Output Measure

- Provide Process Analytics for Bio-based Products (Young)

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Address Switchgrass Pathogens and Diseases (Ownley, Zale, Gwinn, Windham)
2	Improve Switchgrass Logistics and Handling (Womac)
3	Develop Lignin-Based Biorefinery Coproducts (Bozell)
4	Use Insects to Help with Biofuel Production (Jurat-Fuentes, Klingeman, Oppert)
5	Deploy Switchgrass Extractives as Bioactive Compounds (Canaday, Gwinn, Labbe, Ownley)
6	Improved understanding of mechanisms of biofuel crop responses to agricultural practices and climate change. (Hui)
7	Improved process-based ecosystem models to forecast biofuel productivity and greenhouse gas emission under future climate conditions. (Hui)
8	Document the growth performance, environmental conditions, and agronomy practices for alternative biomass production in the Southeast. (Illukpitiya)
9	Determine the economic benefits, factors that inhibit adaptation, and cost of short rotation woody biomass crops for bioenergy production. (Illukpitiya)
10	Research to provide insight into factors responsible for regulating stress tolerance traits that are inherited via seeds or genome imprinting in stock plants. (Zhou)
11	Stabilize Bio-oil by Deoxygenation (Chmely)
12	Improve Switchgrass Germination, Yield, and Yield Persistence (Bhandari, Allen)
13	Build and Install the First Synthetic Chloroplast Genome (Liu, Stewart)
14	Using biotechnology to improve biomass traits and properties of bioenergy feedstocks. (Ondzighi-Assoume)

Outcome #1

1. Outcome Measures

Address Switchgrass Pathogens and Diseases (Ownley, Zale, Gwinn, Windham)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #2

1. Outcome Measures

Improve Switchgrass Logistics and Handling (Womac)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
603	Market Economics

Outcome #3

1. Outcome Measures

Develop Lignin-Based Biorefinery Coproducts (Bozell)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017	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
511	New and Improved Non-Food Products and Processes
603	Market Economics
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Use Insects to Help with Biofuel Production (Jurat-Fuentes, Klingeman, Oppert)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
511	New and Improved Non-Food Products and Processes

Outcome #5

1. Outcome Measures

Deploy Switchgrass Extractives as Bioactive Compounds (Canaday, Gwinn, Labbe, Ownley)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
215	Biological Control of Pests Affecting Plants
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management

Outcome #6

1. Outcome Measures

Improved understanding of mechanisms of biofuel crop responses to agricultural practices and climate change. (Hui)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project improves our understanding how biofuel crops respond to biochar and nutrient applications and climate change.

What has been done
A new biochar field experiment was initiated. We considered three biochar levels, and two N applications, and implemented the design in the switchgrass field. Leaf photosynthesis was measured. We also worked on the effects of precipitation on switchgrass data and wrote manuscripts for publication. Part of the results have been presented at the 2017 ESA meeting.

Results
The precipitation treatments significantly affected soil, microbial and root respiration in switchgrass soils. Soil microbial respiration contributed more to soil respiration than root respiration. Across all precipitation treatments, soil respiration was significantly influenced by soil moisture, soil temperature, and aboveground biomass. Our results suggest that precipitation regulates the response of soil respiration to soil temperature, and information generated in this study is useful for model simulation of soil respiration in switchgrass fields under precipitation changes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
205	Plant Management Systems

Outcome #7

1. Outcome Measures

Improved process-based ecosystem models to forecast biofuel productivity and greenhouse gas emission under future climate conditions. (Hui)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project improves our understanding how biofuel crops respond to climate change and agricultural practices.

What has been done
We continued our modeling study using the process-based model (DNDC). As the nitrogen availability and soil moisture are two main factors controlling soil N2O emission, we simulated how different nitrogen application levels and precipitation intensity and pattern (dry-wet cycles) influence soil N2O emission. The results has been presented as a poster at the 2017 AGU meeting.

Results
Very frequent dry-wet cycles tended to increase soil N2O emission while long drought-wet cycles had lower soil N2O emission, but the timing of N fertilization and precipitation also played an important role in the magnitude of pulse response and annual budget of N2O emission. Annual soil N2O emission could be described as a function of soil nitrogen application and annual precipitation amount. Our results demonstrate that not only the intensity and pattern of precipitation greatly influence soil N2O emission, but also the timing of rainfall and N fertilization may play an important role in soil N2O pulse responses and annual N2O emission in cornfields.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
205	Plant Management Systems

Outcome #8

1. Outcome Measures

Document the growth performance, environmental conditions, and agronomy practices for alternative biomass production in the Southeast. (Illukpitiya)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers have concerns over net return from growing and marketing feedstock and the economic benefits to their operation. In terms of production of short rotation woody biomass, producers are wanting to know the economic benefits of new production methods including capital and operational costs and potential economic returns. Producers also need information to compare economic benefits of the potential investment.

What has been done
Economic feasibility of producing sweetgum for pellet market, Monti Carlo risk analysis of range of potential income, sensitivity analysis on how yield, price and production costs affect net profit for growers. Investment costs for small, medium and large scale pelletization plant.

Results
Sweetgum is a competitive short rotation woody biomass for pellet production. Comparatively higher dry matter yield of sweetgum is an economic advantage for growers. Monti Carlo simulation results shows potential risk however the economic risk is low. Producers have an option to enhance profit by investing for on-site pellet plants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #9

1. Outcome Measures

Determine the economic benefits, factors that inhibit adaptation, and cost of short rotation woody biomass crops for bioenergy production. (Illukpitiya)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small-scale on-farm bioenergy production is relatively new for farmers. Information on reliable crop varieties, field operations and management are essential to attract growers for energy crop farming. This information is needed for long term investment decisions.

What has been done
Evaluate bioenergy feedstock, growth performance, fertilizer responses, harvesting, yield and response to environmental conditions (freezing and snow damage), oil quality analysis, quantification of economic risk of production. Performed small plot trials at locations in Middle and West Tennessee.

Results
There are superior plants with high yield that can be adopted in the region. Some species (carinata and crambe) are susceptible to freezing and snow kill hence need further field trials to identify appropriate planting date and management. Yield of industrial rapeseed is low compared to canola. The risk analysis shows that net return is sensitive yield, market price and unit costs of production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #10

1. Outcome Measures

Research to provide insight into factors responsible for regulating stress tolerance traits that are inherited via seeds or genome imprinting in stock plants. (Zhou)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The understanding if and how tillers and seeds of perennial herbs utilize the inheritable epigenetics mechanisms to adapt to environmental stress is an important issue for breeders and growers as they choose a smart way to propagate better adapted plants under certain circumstances. Tillers deriving directly from the parent plants should be able to carry on all the mitotically transmitted information which includes the stress-induced DNA methylation patterns (also named intra-generational epigenetics). Many of the stress-activated changes in genome are reset during the gametogenesis process.

What has been done
Drought treatments were applied to Panicum hallii seedlings and leaf tissues were harvested. After brief processing, ChIP-Seq sequencing and genome mapping were completed on these samples.

Results
Identification of genomic region sets and regulatory elements enriched in drought treated leaves using Chip-Seq assay. Generate data for constructing the functional networks of drought-induced proteome regulation. Trained graduate and undergraduate students.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms

Outcome #11

1. Outcome Measures

Stabilize Bio-oil by Deoxygenation (Chmely)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
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

Improve Switchgrass Germination, Yield, and Yield Persistence (Bhandari, Allen)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
205	Plant Management Systems
605	Natural Resource and Environmental Economics

Outcome #13

1. Outcome Measures

Build and Install the First Synthetic Chloroplast Genome (Liu, Stewart)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017	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
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
511	New and Improved Non-Food Products and Processes

Outcome #14

1. Outcome Measures

Using biotechnology to improve biomass traits and properties of bioenergy feedstocks. (Ondzighi-Assoume)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The main concerns of making liquid fuels used by consumers are the combination of rising oil prices, exhaustion of crude oil reserves, energy insecurity, and environmental pollution. These concerns can be addressed with biofuels used as the replacement for petroleum-based fuels in transportation. Switchgrass is considered as an excellent bioenergy feedstock due to its high biomass yield, wide climatic adaptation, as well as its low energy input for production. Using switchgrass for biofuels necessitates the development of genetic manipulation strategies to produce improved cultivars with better biomass quantity and quality.

What has been done
Development and optimization of efficient cell culture systems from calli of switchgrass Alamo and Performer. These cell lines are capable of genetic transformation. Evaluation of the transformation techniques on these two varieties.

Results
(1) Development and establishment of efficient cell culture systems capable of genetic transformation. (2) Testing for regeneration and optimizing the rate of the regeneration of modified switchgrass Alamo and Performer. (3) In process of making CRISPR-Cas constructs to edit cell wall genes for switchgrass. These results represent an essential improvement regarding the genetic transformation along with regeneration of recalcitrance switchgrass.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Enhancing Bio-energy Education in Tennessee
Fuel prices are volatile which can adversely affect national, regional, and local economies. In addition, the combustion of fossil fuels produces chemical compounds and gases that have a negative effect on the environment. Utilizing production agriculture to produce crops for fuel without taking food crops out of production can help create greater energy independence and mitigate these environmental issues. TSU Extension used a series of mobile and/or hands-on demonstrations involving 184 youth and 17 teachers. Based on evaluation results of student respondents:

- 89% had increased knowledge of bio-energy feedstocks,
- 89% had increased knowledge of how ethanol was produced
- 91% had increased knowledge of how bio-diesel was produced
- 43% had increased interest in seeking a career in agriculture or bio-energy

Based on evaluation results of teacher respondents:

- 100% had increased knowledge of bio-energy feedstocks
- 88% had increased knowledge of how ethanol was produced
- 100% had increased knowledge of how bio-diesel was produced
- 88% had increased interest in engaging students with a bio-energy activity

Key Items of Evaluation

Enhancing Bio-energy Education in Tennessee
Fuel prices are volatile which can adversely affect national, regional, and local economies. In addition, the combustion of fossil fuels produces chemical compounds and gases that have a negative effect on the environment. Utilizing production agriculture to produce crops for fuel without taking food crops out of production can help create greater energy independence and mitigate these environmental issues. TSU Extension used a series of mobile and/or hands-on demonstrations involving 184 youth and 17 teachers. Based on evaluation results of student respondents:

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Based on evaluation results of teacher respondents:

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- 88% had increased knowledge of how ethanol was produced
- 100% had increased knowledge of how bio-diesel was produced
- 88% had increased interest in engaging students with a bio-energy activity

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
8617	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
5490	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.