

# 2013 University of Tennessee Research and Extension and Tennessee State University Extension Combined Annual Report of Accomplishments and Results

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## I. Report Overview

### 1. Executive Summary

This report consists of the FY 2013 results and accomplishments of the Tennessee Agricultural Research and Extension System. The University of Tennessee Extension and the Tennessee Agricultural Experiment Station (UT AgResearch) comprise the 1862 institution and the Tennessee State University Cooperative Extension Program and the Tennessee State University Institute for Agricultural Research comprise the 1890 institution.

This report represents the combined efforts of the University of Tennessee (UT) Extension, the Tennessee Agricultural Experiment Station (UT AgResearch), Tennessee State University (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 6.4 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 2012, Extension continued its excellence 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 resource development produce substantial returns for Tennessee. Using research, questionnaires, observations and sales records, an estimated impact was \$487 million for FY 2013. It was estimated that for every \$1 in public funds invested in Extension, \$9.81 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 \$341 million. These recurring economic values include increased revenue, increased savings and one time capital purchases associated with four Extension programs: crop variety trials/pest control, forage systems, 4-H camping, and optimizing beef production. Using the United States Department of Defense formula, an estimated 6,836 jobs in Tennessee were created or maintained because of the recurring economic impacts produced by Extension.

The one time, non recurring economic values were estimated at over \$146 million from seven Extension programs. The programs included in this analysis were nutrition education, health literacy, Tennessee Saves, 4-H scholarships, farm financial planning, better beef marketing, and volunteerism.

**Extension's Excellence in Outreach:** UT and TSU Extension professionals and the volunteers they recruited, trained and managed made more than 5.5 million direct contacts through group meetings, on site visits, 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). From 2006-2013, this reporting system has been demonstrated to the administrators of 18 state Extension organizations who regarded it as a national model for Extension accountability.

UT AgResearch data are derived from the annual reports of approximately 140 Ph.D. faculty and specialized staff. This information is collected for each calendar year, then aggregated to reflect collaborative efforts between faculty, and across academic departments and specialty centers.

**Total Actual Amount of professional FTEs/SYs for this State**

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	450.0	53.0	360.0	0.0
Actual	450.0	62.0	337.9	0.0

**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 five 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 2013.

**III. Stakeholder Input**

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

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

**Brief explanation.**

In FY 2013, UT and TSU Extension made 29,403 contacts for needs assessment purposes, with these methods highlighted:

- 345 advisory committee meetings

- 125 focus groups
- 1066 interviews with key informants

Tennessee Extension Agents placed special emphasis on involving youth and other under represented groups in needs assessment activities. Of these needs assessment contacts, 6,480 (22%) were young people under 18 years of age.

One of UT AgResearch's highest priorities is to be continuously engaged with the clientele who rely on our programs. In pursuit of this, the Institute of Agriculture formed three Regional Advisory Councils (RACs) to help guide its programs and priorities. The RACs are organized geographically based upon the Extension regions and the state's grand divisions. They provide a forum to discuss trends and issues in Tennessee with a broadly representative group of our clientele. In addition, we engage with the geographic and topical constituencies through numerous county, department and AgResearch and Education Center advisory groups (based on our ten regional centers).

**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

**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.

**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 2013, Extension conducted 125 different focus groups and 1066 interviews with key informants. Regarding interviews with key informants, 45% 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.

### 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 2013, stakeholder input was used to identify volunteer leaders, identify new audiences, and identify and secure locations for Extension programs. In FY 2013, stakeholder input was used to modify these programs:

- Our **Nursery, Fruit and Vegetable Production** programs were modified to place greater emphasis on plant, pest, and soil diagnostic services. In FY 2013, Tennessee nursery growers realized more than \$1 million in increased revenue or savings as a result of Extension recommendations. Fruit and vegetable production programs stressed proper variety selection.
- The **Center for Profitable Agriculture** conducted Agritourism programs in the areas most requested by farm operators: budgeting, safety, and technical assistance. In 2013, this program was enhanced by using previous surveys of beginning and advanced agritourism operators.
- As a result of stakeholder feedback, UT Extension expanded programming to **Save Our Bees**. The Extension Beemaster program was re-designed in 2013.
- UT Extension Department of Family and Consumer Sciences continued implementation of the statewide **Living Well with Chronic Conditions** program in 2013 based on stakeholder feedback about the health status of Tennessee citizens. Living Well with Chronic Conditions is a 6-week, evidence-based program that teaches people practical skills to live with anxiety, asthma, chronic bronchitis, heart disease, hypertension, multiple sclerosis, and other chronic conditions.
- TSU Extension used stakeholder input to expand its outreach to small and limited resource farmers and producers through its annual Small Farm Expo and Small and Limited Resource Producer Outreach Conference.

#### Brief Explanation of what you learned from your Stakeholders

We continued to implement our State Extension Strategic Plan for 2010-2020. This document, titled Advancing Tennessee, is a guide for identifying emerging issues, redirecting Extension programs, building state action agendas and setting program priorities. Stakeholder input at the local, regional and statewide level is used to monitor and adjust deployment of the strategic plan. To illustrate this important process, consider that stakeholder input was used to modify these programs in FY 2013:

- **Nursery, Fruit and Vegetable Production** - In FY 2013, Tennessee nursery growers realized more than \$1 million in increased revenue or savings as a result of Extension recommendations. Tennessee's commercial fruit and vegetable growers realized more than \$427,000 in increased savings and revenue by following advice from Extension agents and specialists regarding variety selection, management, and marketing.
  - The **Center for Profitable Agriculture** surveyed of 200 agritourism operators, and the findings showed that as a result of Extension programs, sales increased by a combined \$7.5 million in 2013.
  - As a result of stakeholder feedback, UT Extension expanded programming to **Save Our Bees**. More than 100 Tennesseans completed the re-designed course, Extension Beemaster, in 2013. Beekeepers learned how to save honeybee colonies from various catastrophes, including parasitic mites, with an estimated 10,500 bee colonies saved.
  - UT Extension Department of Family and Consumer Sciences continued implementation of the statewide **Living Well with Chronic Conditions** program in 2013 based on stakeholder feedback about the health status of Tennessee citizens. Feedback from the State Extension Advisory Council and program participants indicated great demand for this program. Living Well with Chronic Conditions expanded from 3,200 contacts in 15 counties (2012) to more than 9,000 contacts in 52 counties (2013).

#### IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
8001673	2585223	5494636	0

2. Totaled Actual dollars from Planned Programs Inputs				
Extension			Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
<b>Actual Formula</b>	8001673	2585222	6216291	0
<b>Actual Matching</b>	36670621	2585222	27503402	0
<b>Actual All Other</b>	7484719	0	20409416	0
<b>Total Actual Expended</b>	52157013	5170444	54129109	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
<b>Carryover</b>	0	0	0	0

## V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	4-H Positive Youth Development
2	Agronomic Crop Systems
3	Animal Systems
4	Childhood Obesity
5	Economic Infrastructure and Commerce
6	Environmental and Water Quality Impacts
7	Family Economics
8	Food Safety
9	Forestry, Wildlife, and Fishery Systems
10	Global Food Security and Hunger
11	Health and Safety
12	Horticultural Systems
13	Human Development
14	Sustainable Energy
15	Climate Change

**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	20%	25%	0%	
806	Youth Development	80%	75%	0%	
	<b>Total</b>	100%	100%	0%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	153.0	18.0	0.0	0.0
Actual Paid Professional	144.0	19.9	0.0	0.0
Actual Volunteer	42.0	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
2568538	829857	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
11771270	829857	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**

- **Clubs/Project Groups** - At least 65 Tennessee counties organized over 2,500 4-H clubs where workforce preparation was the major emphasis. Project work was emphasized, and the experiential learning model was used to highlight jobs and careers aligned with 4-H projects. Activity sheets were developed to emphasize practical skills which align with jobs and careers.
- **School Enrichment** - Various school enrichment programs in at least 50 Tennessee counties focused on science, engineering and technology. Youth were exposed to jobs and careers associated with science fields.
- **Mass media** - Mass media was used to inform parents, participants and stakeholders about program opportunities and achievements.
- **Youth from Under-Served and Limited Resource Families:** In 2013, TSU Extension 4-H Youth Development programs placed special emphasis on SET programs in clubs, afterschool settings and other venues to reach youth. The ultimate goal was to increase science literacy among the state's young people. TSU Extension will reach under-served and limited resource youth. TSU Extension professionals made 21,240 direct contacts with under-served minority youth and volunteers made an additional 1,859 contacts.

**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 programs were organized and taught in public schools.

**3. How was eXtension used?**

This 4-H Positive Youth Development Planned Program was enhanced through the service of seven Tennessee Extension personnel on the "For Youth, For Life" and "Military families" 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**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	90383	3150895	51746	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

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



**Number of Peer Reviewed Publications**

<b>2013</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	4	0	4

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of volunteers utilized in delivering this program.

<b>Year</b>	<b>Actual</b>
2013	7828

**Output #2**

**Output Measure**

- Number of exhibits produced.

<b>Year</b>	<b>Actual</b>
2013	247

**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.
12	4-H Energy: Tennessee Youth Gain Science Literacy

**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**

<b>Year</b>	<b>Actual</b>
2013	5196

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	6529

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	4526

**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
2013	9960

#### 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**

<b>Year</b>	<b>Actual</b>
2013	7032

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	6893

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	15649

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	17870

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	14753

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	12910

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	7014

**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

### Outcome #12

#### 1. Outcome Measures

4-H Energy: Tennessee Youth Gain Science Literacy

#### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension

#### 3a. Outcome Type:

Change in Condition Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2013	0

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

##### Issue (Who cares and Why)

The National Science Foundation's (NSF), "Science and Engineering Indicators 2012," 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. Yet, the need for science and engineering graduates in Tennessee and nationwide will continue to grow.

##### What has been done

4-H Energy is a program that stimulates youths' interest in science, while teaching them the science of energy. The program uses fun, hands-on activities as a method of delivery; and is a partnership between Tennessee 4-H and the Tennessee Department of Economic and Community Development, Energy Division. In 2013, 45 counties and 2 4-H Centers conducted this program with 72,116 youth contacts.

##### Results

As a result of this program, 7,847 youth can record data accurately and 6,163 youth can analyze the results of a scientific investigation. In addition, surveys indicated that youth learned to use data to create a graph for presentation to others; use models to explain scientific results; and use

science terms to share scientific results.&#8232;

#### 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)

##### External factors which affected outcomes

- Competing Public priorities

##### Brief Explanation

#### V(I). Planned Program (Evaluation Studies)

##### Evaluation Results

Tennessee 4-H Youth Leadership

Leadership and youth development programs provide many of the developmental pieces needed for youth to succeed in becoming ideal employees, as well as ideal citizens. Research from the Appalachian Regional Commission indicates a growing need for leadership training to ensure young people are prepared to participate in political and civic life. In 2013, 88,892 contacts were made with Tennessee youth in 4-H leadership programs.

4-H leadership programs were evaluated through surveys in the Program Evaluation Network, a database of tested surveys to measure youth life skills. Impacts included:

- 2,710 youth noted that they like to work with others and help them reach their goals.
- 2,385 youth reported using enthusiasm to get a group working.
- 2,590 youth indicated that they felt comfortable being a group leader.
- 2,843 youth reported that they could run a meeting.
- 2,261 said that they give clear directions.

##### Key Items of Evaluation

4-H leadership programs were evaluated through surveys in the Program Evaluation Network, a database of tested surveys to measure youth life skills. Impacts included:

- 2,710 youth noted that they like to work with others and help them reach their goals.
- 2,385 youth reported using enthusiasm to get a group working.
- 2,590 youth indicated that they felt comfortable being a group leader.
- 2,843 youth reported that they could run a meeting.
- 2,261 said that they give clear directions.

**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

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	10%	
104	Protect Soil from Harmful Effects of Natural Elements	0%	0%	2%	
111	Conservation and Efficient Use of Water	0%	0%	2%	
112	Watershed Protection and Management	0%	0%	2%	
132	Weather and Climate	0%	0%	1%	
133	Pollution Prevention and Mitigation	0%	0%	1%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	6%	
202	Plant Genetic Resources	0%	0%	12%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	8%	
204	Plant Product Quality and Utility (Preharvest)	0%	0%	1%	
205	Plant Management Systems	50%	85%	12%	
206	Basic Plant Biology	0%	0%	2%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%	0%	16%	
212	Pathogens and Nematodes Affecting Plants	5%	5%	14%	
213	Weeds Affecting Plants	0%	0%	5%	
405	Drainage and Irrigation Systems and Facilities	0%	0%	1%	
511	New and Improved Non-Food Products and Processes	0%	0%	3%	
601	Economics of Agricultural Production and Farm Management	40%	10%	0%	
611	Foreign Policy and Programs	0%	0%	2%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	13.0	2.0	0.0	0.0
Actual Paid Professional	4.1	2.5	68.2	0.0
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
328068	105994	1118049	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1503496	105994	7815373	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
100000	0	4294975	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

The Extension portion of this plan 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 in 2013: 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 highlighted pests and pesticides in a timely manner.

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

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

**Implementation:** On-farm demonstrations were conducted, particularly in the 31 West Tennessee counties, to highlight research-based practices. To the extent possible, integrated research and extension was 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.

UT AgResearch helps agronomic producers in a variety of areas. Producers of corn, soybeans, wheat, and commercial vegetables are challenged each year with high costs of production, relatively low profit margins, and a host of other issues such as plant diseases, weather, and competition from other

countries in world markets. Because farmers often operate with a relatively low profit margin, economic feasibility as well as efficacy of new genetics or technology for pest and disease control is of paramount importance. Farmers need to be aware of the comparative performance of new technologies in order to make appropriate decisions on pest and disease management. Little information exists about the economics of those technologies and systems under differing production conditions. In addition, the economics of systems vary as the combination of system and production environment change, and as relative prices and costs change.

**2. Brief description of the target audience**

The primary audience for this program was Tennessee row crop producers, and the secondary audience were the professionals, business owners/cooperatives, and government officials who serve row crop producers.

**3. How was eXtension used?**

This Agronomic Crop Systems Planned Program was enhanced through the service of three Tennessee Extension personnel and one stakeholder on the "Cotton" CoP and one extension professional and one stakeholder on the "Pesticide Environmental Stewardship" 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**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	25830	331344	1773	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 9



**Patents listed**

1. Seed treatment supplement, foliar spray, or in-furrow granule for control of seedling diseases of agronomic crops (Canaday)
2. Soak Chamber and System to Measure the Seed Density Hydration Profile of Seeds (Harte, Mannam, Worley, Wilkerson, Smith)
3. Novel herbicide resistance gene (Chen, Zhao, Armel)
4. Utilization of Caffeine and Related Xanthine Alkaloids for the Control of Nematodes (Chen, Hwezi)
5. A method for the production of turfgrass sod using a soil-less biodegradable root zone medium (Sorochan, Thoms)
6. Synthetic TAL effectors for targeted gene activation in plants. (Stewart, Liu, Chestnut)
7. ABC transporter ATABC16 increases plant tolerance to abscisic acid and assists in basal resistance against Pseudomonas syringae (Stewart, Peng, Traw, Ji)
8. Genes to increase growth in corn and other monocots (Stewart, Mann, Poovaiah)
9. Expression profiles of CAB1-2-P and PSBR-P in transgenic rice plants (Stewart, Peng, Ye)

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	15	74	89

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of exhibits displayed to promote awareness and participation in this planned program. Not reporting on this Output for this Annual Report

**Output #2**

**Output Measure**

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

Year	Actual
2013	3986

**Output #3**

**Output Measure**

- Research projects to develop irrigation recommendations for cotton and soybeans (Verbree)

Year	Actual
2013	2

**Output #4**

**Output Measure**

- Meta-analysis of Mycorrhizal Impact on Stomatal Conductance (Auge)

<b>Year</b>	<b>Actual</b>
2013	1

**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	Adoption and Abandonment of Precision Farming (Roberts)
5	Automatic Section Control for Planters (Buschermohle)
6	Combatting Pigweed in Cotton and Soybeans (Steckel)
7	Fight Fungal Pathogens of Snap Bean and Soybean (Canaday)
8	Enhance bioactive food components (Kopsell, Armel, Sams, Deyton)
9	Genetically improve soybean yields (Pantalone)
10	Identify a Potentially Serious Corn Pathogen (Bernard)
11	Microbial Community Structure With No-till
12	Appropriate use of Unmanned Aircraft Systems (Freeland)
13	Determining adherence to USGA putting greens standards (Freeland)
14	Develop new cereal varieties (West)
15	Increase soybean yield by double-cropping canola (West)
16	Address Genetic Resistance to Bt Toxins (Jurat-Fuentes)
17	Investigate insect resistance to biopesticides (Jurat-Fuentes)

18	Publicize Kudzu Management (Rhodes)
19	Reduce Phosphorous Pollution, Improve Animal Nutrition (Pantalone)
20	Identify Microbial Community Structure With No-till (Tyler)
21	Attack the Soybean cyst Nematode (Hewezi)

**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
2013	1531

**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**

<b>Year</b>	<b>Actual</b>
2013	667

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

**Issue (Who cares and Why)**

Commercial and private applicators, structural pest control operators, farmers, landscapers and others need training in pesticide safety to ensure Federal and state regulations are followed for public safety.

**What has been done**

Online materials were developed to provide individuals information concerning the PSEP program as well as current pest related issues. Pesticide Safety and Education Training sessions were taught at 17 separate meetings.

**Results**

Well-educated pesticide applicators are better equipped to control pest problems safer and more effectively. Pesticide safety education helps reduce the incidence of pesticide misuse, spills and undesirable damage to non-target organisms.

?587 commercial applicators were trained in various pesticide categories.

?80 private applicators received initial certification via online training.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	1531

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

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

**Outcome #4**

**1. Outcome Measures**

Adoption and Abandonment of Precision Farming (Roberts)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Precision farming (PF) provides information about the spatial variability within a farm field and can improve the efficiency of inputs through variable-rate applications.

**What has been done**

Identifying the factors that influence farmers perceptions of PF as a means to improve the efficiency of nitrogen (N), phosphorus (P) and potassium (K) fertilizer applications can be useful in targeting specific groups of farmers for PF adoption to increase fertilizer efficiency and reduce N, P and K losses to the environment. We used data from a survey of cotton farmers in the southern United States to identify these factors.

**Results**

Results suggest that yield monitoring, precision soil sampling, and on-the-go sensing increased farmers' perception of PF in improving fertilizer efficiency. Farmers who rented a larger portion of the land they farmed thought PF improved the efficiency of N, P and K applications, possibly because they knew less about the spatial variability of rented fields than owned fields before adopting PF, providing more room for improvement in efficiency.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

**Outcome #5**

**1. Outcome Measures**

Automatic Section Control for Planters (Buschermohle)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

A common problem in planting operations is overlapped planted area due to encroachment in point and end rows, during headland turns, and when avoiding obstacles within a field boundary. Swath overlap from input application operations such as planting is determined by factors such as field shape, field obstructions, field size, implement width, direction of the field work tracks, and equipment operator accuracy. Seed expenses in agricultural production have risen 95% in the last decade and continue to rise, due mainly to producers planting relatively more expensive genetically-modified seeds. Thus, farmers are looking for technologies that reduce seed costs and enhance productivity.

**What has been done**

Automatic Section Control (ASC) for planters is a technology that can reduce or eliminate double-planting and therefore, reduce seed costs and improve yields. This analysis used planter overlap data from 52 farm fields in Tennessee to evaluate net returns to Automatic Section Control (ASC) for planters by reducing seed costs and increasing revenue. Potential savings from adopting ASC system for planters were evaluated using this information.

**Results**

Tennessee row crop producers lowered chemical costs and potential losses to the environment by an average of 7% by reducing off-target application errors on 629280 acres with the adoption of automatic section control technology on their sprayers. According to a survey of cotton producers in 2013, approximately 34% of cotton producers in Tennessee have been adopted Automatic Section Control for planters on approximately 82,400 acres. It is estimated that adoption of ASC for planters on these numbers of acres represents a \$870,000 on total savings for these farmers.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
104	Protect Soil from Harmful Effects of Natural Elements
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management



**Outcome #6**

**1. Outcome Measures**

Combatting Pigweed in Cotton and Soybeans (Steckel)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

We have identified glyphosate-resistant Palmer amaranth in 10 counties. Most of these cases are spots of GR Palmer ranging from the size of a car to several acres to in a few cases the whole field.

**What has been done**

We have been able to see a high level of grower and consultant adoption of our research findings. In a survey of cotton growers and consultants, 60% of the growers and 100% of the consultants made changes in their weed control programs based on information from UT research.

**Results**

They estimated the value per acre of these changes at \$40 per acre on the 590,000 acres of cotton for a total of \$23.6 million impact. At a middle TN grain conference, 96% of the respondents indicated they made changes in their weed control programs based on this research and resulting recommendations.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
104	Protect Soil from Harmful Effects of Natural Elements
205	Plant Management Systems
213	Weeds Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #7**

**1. Outcome Measures**

Fight Fungal Pathogens of Snap Bean and Soybean (Canaday)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

In terms of acreage, snap bean is the leading vegetable crop in Tennessee; and seedling diseases are the principal reason for yield reduction and loss of grower profits. Soybean is one of the leading agronomic crops in Tennessee. The Production Committee of the United Soybean Board (USB) has recognized the impact of soybean seedling diseases on both soybean yield and quality. Surveys conducted by the USB have indicated that seedling diseases had the greatest impact on soybean yield of all disease pests other than soybean cyst nematode.

**What has been done**

The soilborne fungal pathogens attacking the seedlings of both crops are the same. The field and laboratory experiments conducted at the WTREC in 2013 sought to improve the control of this seedling disease complex.

**Results**

While the soybean field experiments failed to identify a method to reduce soybean seedling diseases, the snap bean experiments identified an experimental seed treatment supplement that reduced the incidence of snap bean seedling diseases by over 30% and increased snap bean yield by over 60%. A provisional patent application was submitted for this seed treatment supplement.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #8**

**1. Outcome Measures**

Enhance bioactive food components (Kopsell, Armel, Sams, Deyton)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Increasing concentrations of nutritionally important bioactive food components in specialty crops.

**What has been done**

Identified the influence of genotype on concentrations of nutritionally important bioactive food components in specialty crops.

**Results**

Demonstrated the ability to successfully select cultivars with higher propensity for accumulating greater concentrations of nutritionally important food components.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)

## **Outcome #9**

### **1. Outcome Measures**

Genetically improve soybean yields (Pantalone)

### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

More than half of all gains in USA agricultural production have been through genetic improvement. Genetic improvement of soybeans is vital to sustaining the economic livelihood of farmers in Tennessee and the Mid-South region.

#### **What has been done**

Soybean varieties developed by our program and released by UT AgResearch were produced over an estimated 28,000 acres during the past three years (2011-2013).

#### **Results**

During this three-year time period, Tennessee state soybean production averaged an outstanding 39.3 Bu/A coupled with an excellent \$13.25 soybean commodity price average. Thus 28,000 acres x 39.3 Bu/A x \$13.25/Bu provided more than \$14.5 million impact in direct revenue to the farmers who grew our new UT AgResearch varieties. The exceptional yield of the new Ellis soybean that we released this year will provide further increases in revenue to Tennessee soybean producers. (Pantalone)

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
601	Economics of Agricultural Production and Farm Management

**Outcome #10**

**1. Outcome Measures**

Identify a Potentially Serious Corn Pathogen (Bernard)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

Recognition and publication of the description of a new genus and species of cyst nematode, *Vittatidera zeaphila*, makes it possible for growers, extension agents, and ag scientists to identify this potentially serious pathogen of corn in the mid-South.

**Results**

Scientists are already testing available corn lines for sources of resistance. (Bernard)

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #11**

**1. Outcome Measures**

Microbial Community Structure With No-till

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

It has generally been thought that no-till systems result in higher fungal populations compared to tilled systems.

**What has been done**

We evaluated populations on a long-term cotton experiment with tillage and legume and grass cover crop combinations.

**Results**

On the silt loam soil studied, the bacterial populations in all treatments were not dominated by fungi but by bacteria indicating a better microbial community structure as a result of no-tillage. (Tyler)

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #12**

**1. Outcome Measures**

Appropriate use of Unmanned Aircraft Systems (Freeland)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Spurred by the FAA's congressional mandate to fully integrate Unmanned Aircraft Systems (UASs) into the nation's airspace, a significant number of bills, particularly in state legislatures, have been introduced in an attempt to regulate UAS use. Although geared toward privacy protection and law enforcement, some laws may adversely affect agriculture because they create legal uncertainty and/or they sweepingly ban or highly curtail local UAS operations.

**What has been done**

Our project examined the nature of the current debate surrounding the UAS within the U.S., analyzes the impact on agriculture from the legislation considered, discusses policy options to ameliorate the controversy, and describes the factors that will likely determine UAS operations within the U.S. The information was obtained from government documents, academic research, industry studies, nonprofit organizations, and media reports. An analysis was done using these data on how UAS legislation may affect precision agriculture.

**Results**

Possible solutions have been proposed: 1) Reducing the legal uncertainty regarding UASs, 2) Adopting an industry Code of Conduct and Safe Practices, and 3) Producing a consensus on UAS regulations among diverse groups through an open discussion of how to balance UAS operations with safeguards on privacy and property rights. The economic potential of the UAS, particularly in agriculture, combined with the lobbying power of the UAS industry, strongly suggest that policy will eventually be developed that will allow the use of this technology for precision agriculture in U.S. airspace.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
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204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

### **Outcome #13**

#### **1. Outcome Measures**

Determining adherence to USGA putting greens standards (Freeland)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Action Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

We need to discover conformity (or lack thereof) to the design specifications of putting greens.

##### **What has been done**

A study with Ohio State introduced a nonintrusive survey protocol that combines ground-penetrating radar (GPR) and real-time kinematic (RTK) positioning. A case study was used to examine a putting green designed using the USGA specifications. The protocol created "as-built" subsurface maps.

##### **Results**

The protocol non-intrusively identified the tile slope and spacing. It also determined the depth and thickness of the root-zone mixture and gravel. The green adhered to the tile spacing specification, but failed to meet specifications as to tile slope and root-zone mixture depth. These findings suggest that this protocol supplies a relatively inexpensive method to determine adherence to USGA greens standards. Generated maps highlighted conformity (or lack thereof) to the design specifications.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
405	Drainage and Irrigation Systems and Facilities



- 511 New and Improved Non-Food Products and Processes
- 601 Economics of Agricultural Production and Farm Management

**Outcome #14**

**1. Outcome Measures**

Develop new cereal varieties (West)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

We are developing new cereal varieties that increase grain yield.

**Results**

New wheat variety Charlie produced 6 bushels/acre more than the average of 44 varieties in the Tennessee State Wheat Variety trial in 2012 and 2013. If this variety replaced an average variety on one-fourth of the wheat acres in Tennessee it would add 800,000 bushels of production and 4.8 million dollars of income for Tennessee's farmers.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
601	Economics of Agricultural Production and Farm Management

**Outcome #15**

**1. Outcome Measures**

Increase soybean yield by double-cropping canola (West)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Need for higher yields of soybeans.

**What has been done**

Double-cropping canola followed by soybean could increase soybean yields 3 bushels/acre compared to the traditional wheat-soybean double crop sequence.

**Results**

This would add approximately \$36/acre in income for Tennessee's soybean 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

## **Outcome #16**

### **1. Outcome Measures**

Address Genetic Resistance to Bt Toxins (Jurat-Fuentes)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

Transgenic Bt corn represents >70% of the corn grown in the US, yet resistance has been reported for populations of armyworms in Puerto Rico. This is the first reported case of resistance resulting in field crop failures and withdrawal of the Bt crop. The resistance mechanism involved, its potential spread to mainland US, and the potential for cross-resistance in these armyworms are critical issues.

#### **What has been done**

We generated a population of armyworms that we keep under constant selection with transgenic corn.

#### **Results**

Using this population we identified a gene that is down-regulated in resistant armyworms, and this down-regulation is linked to resistance to Bt corn, which should allow us to develop efficient monitoring tools. Using these insects we also determined that there is cross-resistance to alternative Bt corn varieties but not to currently available Bt biopesticides, alleviating one of the main concerns for organic growers. In addition, the tools developed with this population of insects are allowing us to compare populations from diverse geographies to determine spread of resistance allele among armyworm populations.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
205	Plant Management Systems

### **Outcome #17**

#### **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**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Some insects can develop resistance against Bt biopesticides, which contain many different insecticidal proteins. The mechanism allowing for this broad resistance is not known. Insects can develop resistance to biopesticides and entomopathogens by improving their gut regenerative response.

##### **What has been done**

We have performed genomic and proteomic analyses to identify genes that have altered expression in resistant insects to elucidate physiological changes that correspond with resistance. We have identified one of the proteins that seems responsible for the activation of the gut regenerative response by activation of stem cells.

##### **Results**

This allows directed action against expression of this gene to limit the gut healing process and render insects highly susceptible to diverse insecticidal technologies.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
211	Insects, Mites, and Other Arthropods Affecting Plants

**Outcome #18**

**1. Outcome Measures**

Publicize Kudzu Management (Rhodes)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Kudzu, a non-native, invasive weed is very problematic in Tennessee and the rest of the southeastern United States.

**What has been done**

A video covering the biology and management of this weed was produced.

**Results**

This continues to be the number one UTIA video on YouTube. Since its introduction, it has been viewed 80,747 times (up from 63,913 through 2011), and 41 percent of the viewings were on mobile devices. It has wide national and international viewership, and it has been used as a part of the academic instruction program of the United Kingdom's Open University. Top viewing locations include the U.S., Canada, the United Kingdom, Germany and France.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
205	Plant Management Systems
213	Weeds Affecting Plants
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management

**Outcome #19**

**1. Outcome Measures**

Reduce Phosphorous Pollution, Improve Animal Nutrition (Pantalone)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Corn and soybean naturally contain a phosphorous compound known as phytate which is not digestible by poultry or swine. The phytate molecule also binds positively charged minerals such as calcium, iron, and zinc in the feed meal, reducing their nutritional availability to livestock.

**What has been done**

Soybean researchers in southern states have for several years been attempting to break a genetic linkage between one of the two soybean phytate genes and a soybean growth habit gene.

**Results**

Our laboratory was the first to accomplish this, and we now have new low phytate soybean lines that are well adapted to production in the southern U.S.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
104	Protect Soil from Harmful Effects of Natural Elements
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

**Outcome #20**

**1. Outcome Measures**

Identify Microbial Community Structure With No-till (Tyler)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

It has generally been thought that no-till systems result in higher fungal populations compared to tilled systems.

**What has been done**

We evaluated populations on a long-term cotton experiment with tillage and legume and grass cover crop combinations.

**Results**

On the silt loam soil studied, the bacterial populations in all treatments were not dominated by fungi but by bacteria indicating a better microbial community structure as a result of no-tillage.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology

**Outcome #21**

**1. Outcome Measures**

Attack the Soybean cyst Nematode (Hewezi)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

The functional roles of the phytohormone auxin in the initiation and formation of nematode feeding sites were described. These findings represent fundamental breakthroughs not only for our understanding of the establishment of nematode feeding site but also for the function of the phytohormone auxin as a morphogenetic trigger of organogenesis.

**Results**

A novel mechanism of cyst nematode parasitism of host plant has been discovered. New miRNA genes have been identified that are involved in biotic stress responses. A rapid and effective method to quantify soybean resistance to nematode infection was disclosed.

**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



## **V(H). Planned Program (External Factors)**

### **External factors which affected outcomes**

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

### **Brief Explanation**

Cotton was planted and harvested on over 250,000 acres in Tennessee in 2013. The 2013 growing season was characterized by late planting, and cool and relatively wet conditions persisted though the season. The statewide average yield was approximately 850 pounds of lint per acre, and was limited by insufficient heat units to mature late planted cotton fields. Increasing production costs and relatively flat commodity prices are the greatest challenges facing Tennessee cotton producers.

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

Evaluation of UT Extension's cotton production program included on-farm interviews and surveys with producers. Results demonstrated:

- Producers increased yield by 602 pounds by selecting top yielding varieties on 209,475 acres of cotton.
- 212,551 acres of cotton scouted by a producer or independent crop consultant to help make crop management decisions, and 53,652 acres of cotton scouted by a UT-trained scout to help make crop management decisions.
- 530 cotton producers adopted UT recommended resistance management strategies to control pests (weeds, insects and diseases).
- 497 cotton producers increased their knowledge of recommended agronomic practices and understanding of their benefits and use.
- 154 cotton producers report an \$85,294 reduction in pest control costs by following recommended control strategies for insects, weeds or plant diseases.
- 508 cotton producers used data provided by UT publications or UT Internet resources and made changes in their production practices.

### **Key Items of Evaluation**

- 154 cotton producers report an \$85,294 reduction in pest control costs by following recommended control strategies for insects, weeds or plant diseases.
- 508 cotton producers used data provided by UT publications or UT Internet resources and made changes in their production practices.

**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
301	Reproductive Performance of Animals	15%	0%	18%	
302	Nutrient Utilization in Animals	0%	0%	6%	
303	Genetic Improvement of Animals	10%	0%	0%	
304	Animal Genome	0%	0%	5%	
305	Animal Physiological Processes	0%	0%	6%	
306	Environmental Stress in Animals	0%	0%	7%	
307	Animal Management Systems	60%	100%	15%	
311	Animal Diseases	15%	0%	28%	
312	External Parasites and Pests of Animals	0%	0%	5%	
315	Animal Welfare/Well-Being and Protection	0%	0%	2%	
402	Engineering Systems and Equipment	0%	0%	4%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%	0%	4%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	32.0	4.0	0.0	0.0
Actual Paid Professional	44.0	6.1	24.2	0.0
Actual Volunteer	13.0	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
784164	253352	504360	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
3593721	253352	2274167	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
200000	0	1266299	0

### V(D). Planned Program (Activity)

#### 1. Brief description of the Activity

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 with an interest in the state's cattle industry. 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 for their operations.
4. Allowed producers to interact with trained facilitators and encourage sharing of ideas with other producers.

UT AgResearch conducts 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 by UT AgResearch 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.

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 established in May 2007 as an 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 is 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 is the Master Meat Goat Producer Program. The Small Ruminant College has become an annual two-day event covering a different major production theme each year. Along with the two days of both inside lectures and outside hands-on demonstrations, the attendees receive proceedings to complement the topics covered. Work will continue in working with small ruminant farmers as well as with professionals through Heifer International. Presentations and demonstrations in the state are designed for extension agents, government agencies, meat goat organizations, farmer forum initiatives, and 4-H groups.

## **2. Brief description of the target audience**

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

## **3. How was eXtension used?**

This Animal Systems Planned Program was enhanced through the service of:

- 13 Tennessee Extension personnel on the "Beef Cattle" CoP;
- two Tennessee Extension personnel on the "Goat Industry" CoP; and
- two Tennessee Extension personnel on the "HorseQuest" CoP.

Tennessee Extension professionals shared program implementation strategies, outcome measurement, and evaluation protocols with their CoP colleagues.

## **V(E). Planned Program (Outputs)**

### **1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	373952	2094893	67039	0

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

Year: 2013  
 Actual: 2

**Patents listed**

1. Bile salt hydrolase inhibitors as animal growth promoters (Lin)
2. on-site diagnostic technology (Eda)

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	4	34	38

**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
2013	113

**Output #2**

**Output Measure**

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

Year	Actual
2013	452618

**Output #3**

**Output Measure**

- Identified and characterized novel sperm biomarkers for reproductive efficiency in cattle.

2013 University of Tennessee Research and Extension and Tennessee State University Extension Combined Annual Report of Accomplishments and Results  
(Rispoli)

<b>Year</b>	<b>Actual</b>
2013	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	Educational assistance was provided to beef producers resulting in increased Tennessee Department of Agriculture cost-share assistance for improved facilities, equipment and genetics.
4	Beef Production and Marketing: Number of beef producers who improved marketing methods.
5	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.
6	Beef Production and Marketing: The number of calves managed according to Beef Quality Assurance (BQA) guidelines.
7	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.
8	Dairy: Promoting Sustainability of Tennessee Dairy Farms
9	Understand Attachment Processes in Ruminant Pregnancy (Godkin)
10	Treat Campylobacter Infection in Poultry (Zeng)
11	Exploit Pathways for Leanness in Poultry/Humans (Voy)
12	Assaying CBG to Monitor Cattle Stress (Kattesh)
13	Will Producers Prescribe Grazing for GHG Reduction? (Clark, Jensen, Lambert, Yu)
14	Prostaglandin Production in Cattle (Godkin)
15	Can Voluntary Afforestation to Reduce Cattle GHG Emissions? (Clark, Jensen, Lambert, Yu)
16	Willingness-to-Pay for Carbon-friendly Beef Practices? (Clark, Jensen, Lambert)

## **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
- 1890 Extension

### **3a. Outcome Type:**

Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	40

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

#### **Issue (Who cares and Why)**

Challenges facing the animal 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 most impact profitability.

#### **What has been done**

Extension agents and specialists reached more than 440,000 contacts with youth and adults in horse, beef, and dairy programs. Selected programs included Master Beef Producer, Master Goat Producer, group meetings, field days, and one-on-one consultation.

#### **Results**

UT Extension educated farmers on the benefits of warm-season grasses, clover, and stockpiling tall fescue. Extension also demonstrated hay storage, feeding methods to reduce waste and spoilage, and broadleaf weed control. Tennessee farmers saved more than \$19 million from better forage production, including following fertilizer recommendations, storage, and feeding practices.

Experts estimate farmers earned an average of \$8 per head more by managing cattle according to Extension's beef quality assurance program and \$25 per head by selecting bulls based on genetic potential. As a result of these programs, farmers realized \$3.4 million in additional sales revenue. UT Extension assisted farmers with preparing and implementing financial plans for their farms, increasing cash income by a combined \$1.8 million this year.

Extension agents and specialists formulated 1,480 custom rations based on forage sample test results by the UT Soil, Plant and Pest Center. Past research has shown that each ration results in a mean savings of \$1,125 in reduced annual feed costs. Tennesseans realized \$1.6 million in



reduced feed costs for cattle, sheep, goats, and horses. 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 342 horse owners, owning more than 1,000 horses, to save a combined \$1.2 million.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	3046

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
303	Genetic Improvement of Animals

**Outcome #3**

**1. Outcome Measures**

Educational assistance was provided to beef producers resulting in increased Tennessee Department of Agriculture cost-share assistance for improved facilities, equipment and genetics.

Not Reporting on this Outcome Measure

**Outcome #4**

**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**

<b>Year</b>	<b>Actual</b>
2013	5792

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
307	Animal Management Systems

**Outcome #5**

**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**

<b>Year</b>	<b>Actual</b>
2013	4289

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
302	Nutrient Utilization in Animals
307	Animal Management Systems

**Outcome #6**

**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**

<b>Year</b>	<b>Actual</b>
2013	132879

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
307	Animal Management Systems

**Outcome #7**

**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**

<b>Year</b>	<b>Actual</b>
2013	421

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

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

**Outcome #8**

**1. Outcome Measures**

Dairy: Promoting Sustainability of Tennessee Dairy Farms

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Tennessee's dairy producers are an aging demographic, which demonstrates the need to promote dairy farming as an attractive career to the next generation and ensure that required support programs are in place. Milk quality, reproductive management, and cow comfort are key general areas that are likely to have a positive impact on the long-term profitability and sustainability of Tennessee dairy farms.

**What has been done**

Extension dairy programs were conducted in 19 counties in 2013 reaching more than 14,000 contacts in group meetings, demonstrations, and farm visits. More than 4,000 Tennessee youth increased knowledge of dairy management, judging, and showing dairy cattle.

**Results**

?10 producers gained knowledge about certified organic dairy production, other niche marketing opportunities and the Tennessee Agricultural Enhancement program.

?23 producers gained knowledge about the benefits of pasture and grazing for dairy cattle.

?57 producers have gained knowledge about the need for production and sound financial records to manage their operations.

?32 producers have improved herds due to more AI and the use of better bulls and/or more structured crossbreeding in their herds.

?342 producers have received cost share from the Tennessee Agricultural Enhancement program including the livestock improvement program.

?339 producers that have increased profits due to better utilization of forages or grazing.

**4. Associated Knowledge Areas**

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

**Outcome #9**

**1. Outcome Measures**

Understand Attachment Processes in Ruminant Pregnancy (Godkin)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

GATA-1 may play a role in regulation of genes important to trophoblast attachment to the uterine endometrium. A co-culture system of endometrial epithelial cells and trophoblast cells was developed that mimics several molecular and cellular events in vivo attachment processes in

bovine conceptus-endometrium attachment (implantation) during pregnancy and should serve as a valuable tool in the investigation of attachment processes in ruminants.

**Results**

The transcription factor GATA-1 was shown to be expressed in trophoblast and endometrium between days 15 and 21 of pregnancy by a series of in situ hybridization, immunoblot and immunohistochemical methods.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
301	Reproductive Performance of Animals
307	Animal Management Systems

**Outcome #10**

**1. Outcome Measures**

Treat Campylobacter Infection in Poultry (Zeng)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

The studies help understand the pathogenesis mechanism and antibiotics resistance of Campylobacter, which leads to the development of on-farm control and therapeutical application in human.

**What has been done**

Characterized the iron-acquisition system and beta-lactam resistances in Campylobacter, and moved forward the evaluation of different vaccination strategies in chick model. Research on iron-acquisition system leads to the identification of the potential vaccination antigen.

**Results**

Research on beta-lactam resistance in Campylobacter changed our thinking on antibiotic growth promoter in chicken industry and facilitated the development of novel therapy against Campylobacter infection.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

#### Outcome #11

##### 1. Outcome Measures

Exploit Pathways for Leanness in Poultry/Humans (Voy)

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

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

###### Issue (Who cares and Why)

###### What has been done

We have identified novel pathways associated with leanness and fat loss in the domestic chicken. These pathways have the potential to be manipulated favorably by diet and genetic selection in a manner that would reduce fat deposition. They may be equally relevant for human obesity due to similarities between humans and avians with respect to lipid metabolism in adipose tissue.

###### Results

We have begun to establish that some of the same pathways associated with leanness in chickens can also be manipulated in human adipose tissue, which has important implications for human obesity.

#### 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**

Assaying CBG to Monitor Cattle Stress (Kattesh)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

The bioavailability of endogenous cortisol is predominantly influenced by CBG, and in situations where CBG levels are altered, total cortisol levels may not adequately represent the free cortisol fraction.

#### **What has been done**

#### **Results**

The bCBG ELISA we have developed provides a more efficient and precise means for assaying CBG to gain further understanding of the physiological role that it plays in cattle in response to various environmental and management-related stressors.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

**Outcome #13**

**1. Outcome Measures**

Will Producers Prescribe Grazing for GHG Reduction? (Clark, Jensen, Lambert, Yu)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

GreenHouse Gas (GHG) emissions are associated with cattle production.

**What has been done**

Preliminary results suggest that about 32.0% of the producers responding to the survey would not adopt prescribed grazing even if it were profitable to do so. Another 13.3% would adopt it even if unprofitable, and 54.9% would adopt it only if profitable to do so. Among those who were interested in adopting prescribed grazing, at a \$10/acre per year incentive level, about 63.0 % of producers would convert land to prescribed grazing. However, as the incentive level increased, a higher percentage would convert land. At \$90/acre per year, about 76.2 % would convert land. Among those who would convert land, the average number of acres that would be converted was 264.3 acres, while the median was 100 acres.

**Results**

This information is useful for the design and implementation of voluntary programs to reduce GHG emissions associated with cattle production.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

**Outcome #14**

**1. Outcome Measures**

Prostaglandin Production in Cattle (Godkin)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

Bovine uterine endometrial epithelium cell culture system was used to investigate biochemical pathways of prostaglandin production. Through a series of studies using specific inhibitors, gene expression knock-down studies, cyclooxygenase and PG assays, it was determined that phospholipase A2 Group 4A is responsible for production of arachidonic acid used for PG biosynthesis. Then, a series of studies were performed to evaluate the phospholipase D (PLD) signal transduction pathway of oxytocin-stimulated PG production.

**Results**

Inhibition of PA production was shown to severely diminish PG production. Blockage of PAP-1 was shown to inhibit PGF2-alpha production but enhance PGE2 production. PA was shown to stimulate PGE2 production. DAG was shown to stimulate PGF2-alpha production. For the first time, the PLD signaling system was shown to be a major regulator of uterine PG production.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
301	Reproductive Performance of Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

**Outcome #15**

**1. Outcome Measures**

Can Voluntary Afforestation to Reduce Cattle GHG Emissions? (Clark, Jensen, Lambert, Yu)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

Preliminary results suggest that about 71.2% of the producers responding to the survey would not adopt afforestation even if it were profitable to do so. Another 4.1% would adopt it even if unprofitable, and 24.7% would adopt it only if profitable to do so. Among those who were interested in adopting afforestation, at a \$70/acre per year incentive level, about 39.1% of producers would convert land to afforestation. However, as the incentive level increased, a higher percentage would convert land. At \$180/acre per year, about 55.2 % would convert land. Among those who would convert land, the average number of acres that would be converted was 77.12 acres.

**Results**

This information is useful for the design and implementation of voluntary programs to reduce GHG emissions associated with cattle production.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems

**Outcome #16**

**1. Outcome Measures**

Willingness-to-Pay for Carbon-friendly Beef Practices? (Clark, Jensen, Lambert)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

Results of a study showed an estimated mean WTP of \$194 per household per year. Respondents who are married, female, more educated, have higher incomes, live in urban area, not from the Northeastern states, concerned about climate change and food quality, do not demand cheaper food prices, support government regulations on food production, prefer local and organic foods, and have made donations to environmental purposes, are more likely to support and pay for the program.

**Results**

This information is useful to understanding consumer WTP for carbon-friendly beef practices and for the design of voluntary labeling programs or public policy designed to reduce GHG emissions associated with beef production.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

## **V(H). Planned Program (External Factors)**

### **External factors which affected outcomes**

- 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 UT Extension beef programing fluctuates form year-to-year depending on several factors including commodity prices, input costs and land value. However, these programs continue to enhance the lives and livelihood of Tennessee beef cattle producers.

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

Extension educational programs have been shown to produce substantial economic returns to the state of Tennessee. Our evaluation studies used research, questionnaires, observations, and sales records to record estimated economic impact.

#### **Better Beef Marketing and Farm Financial Planning**

Experts estimate farmers earned an average of \$8 per head more by managing cattle according to Extension's beef quality assurance program and \$25 per head by selecting bulls based on genetic potential. As a result of these programs, farmers realized \$3.4 million in additional sales revenue. UT Extension assisted farmers with preparing and implementing financial plans for their farms, increasing cash income by a combined \$1.8 million this year.

#### **Optimizing Animal Production**

Extension agents and specialists formulated 1,480 custom rations based on forage sample test results by the UT Soil, Plant and Pest Center. Past research has shown that each ration results in a mean savings of \$1,125 in reduced annual feed costs. Tennesseans realized \$1.6 million in reduced feed costs for cattle, sheep, goats, and horses. 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 342 horse owners, owning more than 1,000 horses, to save a combined \$1.2 million.

### **Key Items of Evaluation**

#### **Optimizing Animal Production**

Extension agents and specialists formulated 1,480 custom rations based on forage sample test results by the UT Soil, Plant and Pest Center. Past research has shown that each

ration results in a mean savings of \$1,125 in reduced annual feed costs. Tennesseans realized \$1.6 million in reduced feed costs for cattle, sheep, goats, and horses. 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 342 horse owners, owning more than 1,000 horses, to save a combined \$1.2 million.

**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
701	Nutrient Composition of Food	5%	0%	0%	
703	Nutrition Education and Behavior	95%	100%	0%	
	<b>Total</b>	100%	100%	0%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	99.0	12.0	13.0	0.0
Actual Paid Professional	75.0	10.3	0.0	0.0
Actual Volunteer	22.0	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
1328278	429147	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
6087324	429147	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
5884343	0	0	0

**V(D). Planned Program (Activity)**

1. Brief description of the Activity

UT and TSU Extension used the Power U curriculum in Tennessee schools and afterschool



programs. Extension personnel and volunteers used the curriculum to teach diet quality to young adolescents. The program was delivered through 10 interactive lessons. 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.

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.

TSU Extension continues to provide education via an annual Children Healthy and Eating Well (CHEW) Conference. This is a USDA grant funded program designed to provide and highlight the latest research and public health initiative to promote healthy eating and active living with a focus on preventing childhood obesity.

## 2. Brief description of the target audience

Tennesseans targeted included consumers and youth. Because of the prevalence of obesity in the state, all consumers were targeted. The TNCEP and EFNEP programs specifically targeted the state's limited resource population. In addition, the TSU Food Nutrition Education Program targeted eligible food stamp recipients.

## 3. How was eXtension used?

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

- 12 Tennessee Extension personnel on the "Families, Food, and Fitness" CoP, and one of the leaders of this CoP is the Director of Strategic Planning for UT Extension.
- 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

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	226612	7376438	392207	0

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

### Patent Applications Submitted

Year: 2013

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

<b>2013</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	1	20	21

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	3806

**Output #2**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	362723

**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 dairy foods.
4	Tennessee Shapes Up: Number of participants who increased consumption of fruits.
5	Tennessee Shapes Up: Number of participants who increased consumption of vegetables.
6	Tennessee Shapes Up: Number of participants increased consumption of whole grains.
7	Tennessee Shapes Up: Number of participants who improved their blood sugar.
8	Tennessee Shapes Up: Number of participants who improved their cholesterol levels.
9	Power U: Helping Youth Make Healthy Choices and Increase Physical Activity
10	Healthy Steps: Extension's Obesity Prevention Program for Pre-Schoolers

**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**

<b>Year</b>	<b>Actual</b>
2013	7660

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	7660

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
703	Nutrition Education and Behavior

**Outcome #3**

**1. Outcome Measures**

Tennessee Shapes Up: Number of participants who increased consumption of dairy foods.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	6052

**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 fruits.

#### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension

#### 3a. Outcome Type:

Change in Action Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2013	7660

#### 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 who increased consumption of vegetables.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	7068

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
703	Nutrition Education and Behavior

**Outcome #6**

**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**

<b>Year</b>	<b>Actual</b>
2013	3382

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
703	Nutrition Education and Behavior

**Outcome #7**

**1. Outcome Measures**

Tennessee Shapes Up: Number of participants who improved their blood sugar.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	260

**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 #8

#### 1. Outcome Measures

Tennessee Shapes Up: Number of participants who improved their cholesterol levels.

#### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension

#### 3a. Outcome Type:

Change in Action Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2013	235

#### 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 #9**

**1. Outcome Measures**

Power U: Helping Youth Make Healthy Choices and Increase Physical Activity

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

According to the Tennessee Department of Education: "Tennessee has the third highest rate of pediatric obesity in the United States and ranks 44th among the 50 states in health outcomes for its adult populace. Since health habits learned during the formative years are crucial to preventing negative health outcomes later in life, early intervention among school-aged youth is necessary and essential in reducing these alarming trends."

**What has been done**

Power U is a statewide program designed to help fourth and fifth graders learn to make healthy choices and increase physical activity. Power U incorporates Common Core State Standards to help students apply decisions about food and physical activity while learning skills needed for successful careers. Students are exposed to a variety of new fruits and vegetables through tasting experiences. Educational messages are reinforced through family newsletters. In 2013, Power U was implemented in 178 classrooms in 50 schools in 20 Tennessee Counties. This represented 11,386 contacts by Extension personnel and 933 contacts by volunteers.

**Results**

Impact data collected using a behavior checklist survey and through teacher and parent comments showed that:

- 2162 of 2987 participants (72%) decreased consumption of high-sugar foods.
- 2113 of 2987 participants (71%) decreased consumption of high-fat foods.
- 2466 of 2987 participants (83%) ate more fruit.
- 1949 of 2987 participants (65%) ate more vegetables.
- 1974 of 2980 participants (66%) increased their intake of dairy foods.
- 2597 of 2987 participants (87%) increased amount of time in physical activity.
- 1913 of 2987 participants (64%) increased their intake of whole grains.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

#### Outcome #10

##### 1. Outcome Measures

Healthy Steps: Extension's Obesity Prevention Program for Pre-Schoolers

##### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

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

###### **Issue (Who cares and Why)**

In 2012-13, almost 31% of children enrolled in kindergarten in Tennessee were overweight or obese. Research shows that children who were overweight in kindergarten were four times more likely to become obese nearly a decade later than five-year-olds of a healthy weight.

###### **What has been done**

Healthy Steps, a nutrition and physical activity program for preschoolers was implemented in 18 Tennessee counties in 2013. 3,117 direct contacts were made in Voluntary Pre-K, Head Start and center-based classrooms; 72,871 indirect contacts were made through exhibits, newspaper articles, publications and television. In addition 4,083 contacts were made by volunteers.

###### **Results**

Surveys were completed by teachers at the end of the program to document program outcomes. ?172 of 175 teachers reported preschool children in their classes were more actively engaged in physical activity.

?177 of 178 teachers reported preschool children in their classes were more willing to taste fruit.

?181 of 184 teachers reported preschool children in their classes were more willing to taste vegetables.

?158 of 167 teachers reported preschool children in their classes were more willing to taste whole-grain foods.

?160 of 169 teachers reported using physical activities from Healthy Steps at least three times

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

- Competing Programmatic Challenges

##### Brief Explanation

#### V(I). Planned Program (Evaluation Studies)

##### Evaluation Results

Power U is a statewide program designed to help fourth and fifth graders learn to make healthy choices and increase physical activity. Power U incorporates Common Core State Standards to help students apply decisions about food and physical activity while learning skills needed for successful careers. Students are exposed to a variety of new fruits and vegetables through tasting experiences. Educational messages are reinforced through family newsletters. In 2013, Power U was implemented in 178 classrooms in 50 schools in 20 Tennessee Counties. Impact data collected using a behavior checklist survey and through teacher and parent comments showed that:

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- 1974 of 2980 participants (66%) increased their intake of dairy foods.
- 2597 of 2987 participants (87%) increased amount of time in physical activity.
- 1913 of 2987 participants (64%) increased their intake of whole grains.

The TSU Extension component of a CHEW pilot study using two TSU undergraduate students who were trained as peer educators and facilitated the interactive nutrition education sessions was also evaluated. Pre- and three months post- program surveys of dietary knowledge and behavior were conducted and height and weight measurements were taken on the first day of camp and at three months post-program. Chi-square tests determined if significant differences existed between those measurements taken prior to the program and those taken three months afterward. Statistically significant improvements included:

- consuming more fresh, frozen or dried fruits for snacks
- consuming more whole grain cereal for snacks using lower fat salad dressing
- reading food labels and percentage categorized as obese (26.7% pre to 20.0% post).

### **Key Items of Evaluation**

Power U is a statewide program designed to help fourth and fifth graders learn to make healthy choices and increase physical activity. Power U incorporates Common Core State Standards to help students apply decisions about food and physical activity while learning skills needed for successful careers. Students are exposed to a variety of new fruits and vegetables through tasting experiences. Educational messages are reinforced through family newsletters. In 2013, Power U was implemented in 178 classrooms in 50 schools in 20 Tennessee Counties. Impact data collected using a behavior checklist survey and through teacher and parent comments showed that:

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- 1949 of 2987 participants (65%) ate more vegetables.
- 1974 of 2980 participants (66%) increased their intake of dairy foods.
- 2597 of 2987 participants (87%) increased amount of time in physical activity.
- 1913 of 2987 participants (64%) increased their intake of whole grains.

The TSU Extension CHEW small pilot study suggests that larger programs using intensive but short-term exposure to healthy food choices could have lasting benefits.

**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
315	Animal Welfare/Well-Being and Protection	0%	0%	12%	
601	Economics of Agricultural Production and Farm Management	30%	5%	26%	
602	Business Management, Finance, and Taxation	5%	0%	0%	
603	Market Economics	10%	0%	6%	
604	Marketing and Distribution Practices	30%	5%	8%	
605	Natural Resource and Environmental Economics	0%	0%	17%	
606	International Trade and Development	0%	0%	2%	
607	Consumer Economics	10%	0%	0%	
608	Community Resource Planning and Development	15%	90%	15%	
610	Domestic Policy Analysis	0%	0%	2%	
901	Program and Project Design, and Statistics	0%	0%	12%	
<b>Total</b>		100%	100%	100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	27.0	3.0	28.0	0.0
Actual Paid Professional	32.0	4.5	32.7	0.0
Actual Volunteer	9.0	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
576121	186136	907540	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2640285	186136	2454541	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
77000	0	1220786	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 could make informed decisions regarding their future. Extension staff trained in farm and financial management helped 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 provided hundreds of workshops to help farmers improve their financial situation. For example, workshops were offered in improved marketing, goal-setting, estate planning, records, taxation, and strategic planning. This educational program is 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).

**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?**

This Economic Infrastructure and Commerce Planned Program was enhanced through the service of:

- 10 Tennessee Extension personnel on the "Entrepreneurs and Thier Communities" CoP, and
- four Tennessee Extension personnel on the "Network Literacy" CoP.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	460357	4041730	26657	0

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

Year: 2013  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
<b>Actual</b>	5	45	50

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

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

**Year                      Actual**



2013 211

**Output #2**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	35621

**Output #3**

**Output Measure**

- Examine Farmers' Market Pricing (Velandia)

<b>Year</b>	<b>Actual</b>
2013	0

**Output #4**

**Output Measure**

- Evaluate the Impact of Poverty Rates on Government Funding (Cho)

<b>Year</b>	<b>Actual</b>
2013	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 and rural business operators implementing improved record systems.
6	Farm Financial Analysis and Planning: Number of farm families who developed whole farm plans to improve their farm financial performance.
7	Tennessee Extension Leadership Development: Small businesses or non-profits developed by limited resource leaders.
8	Extension Agritourism Program Produces \$7.55 Million Impact
9	Doubling Agricultural in Tennessee (English)
10	Analyze the Food Processing Industry's Health (Jensen)
11	Assess the Local Food System/the Knoxville Foodshed (Hellwinckel)

**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**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

{No Data Entered}

**What has been done**

{No Data Entered}

**Results**

{No Data Entered}

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management
607	Consumer Economics

**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
2013	0

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

**Issue (Who cares and Why)**  
{No Data Entered}

**What has been done**  
{No Data Entered}

**Results**  
{No Data Entered}

**4. Associated Knowledge Areas**

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

**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**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**  
{No Data Entered}

**What has been done**  
{No Data Entered}

**Results**  
{No Data Entered}

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management
607	Consumer Economics

**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

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	475

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management

**Outcome #5**

**1. Outcome Measures**

Farm Financial Analysis and Planning: Number of farm families and rural business operators implementing improved record systems.

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	402

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management

**Outcome #6**

**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**

<b>Year</b>	<b>Actual</b>
2013	119

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management

**Outcome #7**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1890 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**  
{No Data Entered}

**What has been done**  
{No Data Entered}

**Results**  
{No Data Entered}

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
608	Community Resource Planning and Development

**Outcome #8**

**1. Outcome Measures**

Extension Agritourism Program Produces \$7.55 Million Impact

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0



### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Agritourism is an opportunity for some Tennessee farmers and agri-entrepreneurs to add value to farm resources. The 2007 Census of Agriculture reports 510 farms offering agritourism and recreational services in Tennessee with receipts totaling \$6.507 million. In addition, 3,581 farms were directly marketing products to consumers with many from venues such as on-farm retail markets or U-pick operations, generating \$15.38 million in sales. A 2005 study by UT estimated for every dollar spent by customers at an agritourism enterprise an additional \$0.85 in economic activity is generated through multiplier effects. Economic impact may be increased through educational programs for farmers interested in agritourism.

#### What has been done

Efforts in agritourism by county agents and state specialists from the Center for Profitable Agriculture during 2013 included direct contacts through 1,068 client visits, on-site visits, direct mail or calls and group meetings with 5,474 individuals. Indirect contacts were made with more than 147,795 people. In addition, the 2013 Tennessee Agritourism Conference was held in Nashville in conjunction with the Tennessee Horticultural Expo. A total of 476 people registered for the Horticultural Expo with approximately 200 attending agritourism events. A survey was conducted of Tennessee agritourism operations with 171 firms responding to the study. In addition, two farm safety workshops and five customer service workshops were conducted.

#### Results

The survey results estimate the economic impact of operations in 2012 of \$34.2 million directly and more than \$54.2 million with multiplier effects. This more than doubled impacts from a 2003/2004 study which estimated direct effects of \$16-17 million. Sixty-three percent of respondents (N=132) reported attending a workshop, conference or tour in the last three years. On average, respondents estimated their change in sales due to these events in 2012 alone at 19.9%. This results in an average change in sales of more than \$23,500, a median increase of \$3,500 and an estimated total change in sales of more than \$7.55 million.

Additionally, 97 farmers, agri-entrepreneurs and community leaders increased their awareness of agritourism as an opportunity to add value to farm resources and foster rural economic development; 90 entrepreneurs increased their awareness of customer service and hospitality as an important part of market planning and implementation; and 30 participants have a better understanding of how to prepare for and respond to an emergency on the farm.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development

## **Outcome #9**

### **1. Outcome Measures**

Doubling Agricultural in Tennessee (English)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

The Governor has indicated that he would like agriculture to double in the next 10 years.

#### **What has been done**

We examined the state of agriculture in 2012-2013 and any trends that came through the data. The result of this work has created the desire to develop an annual report to the Governor.

#### **Results**

Of the total Tennessee economy of \$500 billion, the agri-forestry Industrial Complex can account for \$66.4 billion or 13% of the state's economy in 2011. Comparing Tennessee agricultural production to Alabama, Arkansas, Georgia, Kentucky, Missouri, Mississippi, North Carolina, South Carolina, and Virginia, net farm income In 2011, according to USDA ERS estimates, the net farm income for Tennessee was \$.80 billion and ranked 7th, followed by AL, SC, and VA. Our neighbor state, MO, had approximately 4.17 times the net farm income. In 2011, according to USDA ERS estimates, the market value of ag & forestry products sold by Tennessee farms was \$4.47 billion. Comparing Tennessee and its 9 neighboring states, Tennessee ranked 8th, followed by SC and VA. Our neighbor state, NC, had approximately 2.67 times the farm value from ag and forestry products. North Carolina's farm market value of ag & forestry products sold was \$11.94 billion.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics

**Outcome #10**

**1. Outcome Measures**

Analyze the Food Processing Industry's Health (Jensen)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

The results from the economic impact analysis of the state's agroforestry industries were used in strategic planning for the state's agriculture.

**Results**

Analysis from a multi-year comparison of agro-forestry industries showed that despite an economic downturn, the food processing industry had remained resilient. Tennessee is well positioned in terms of skilled labor comparative advantage for food processing compared to surrounding states. In total, food and fiber products manufacturing generate \$25.6 billion in direct economic activity and \$38.4 in total economic activity. These industries employ over 50,000 directly and over 133,000 when including multiplier effects. Within the state, food and fiber manufacturing is very diverse, with only poultry processing holding over a 10% share of direct economic activity. Poultry processing is followed by soft drinks, tobacco, wet corn milling, and dog and cat food manufacturing in terms of direct economic activity. Generally a location quotients greater than 1 suggests relative 'comparative advantage' with respect to skilled labor pool for that industry. The state had 20 food manufacturing industries which had location quotients of 1 or greater, suggesting a skilled labor comparative advantage in these industries.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management
603	Market Economics

605	Natural Resource and Environmental Economics
607	Consumer Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis

**Outcome #11**

**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**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

There has been increasing interest and activity in building our local food system, but people do not know much of the current food system.

**What has been done**

I completed a Local Food System Assessment of the Knoxville Foodshed.

**Results**

My report will soon be printed by the city of Knoxville and distributed to local policymakers and the public. The result is forthcoming. I listed 3 priorities for growth which have potential.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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

## V(H). Planned Program (External Factors)

### External factors which affected outcomes

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

### Brief Explanation

## V(I). Planned Program (Evaluation Studies)

### Evaluation Results

**Extension Agritourism Program Produces Substantial Economic Impacts** - A survey was conducted of Tennessee agritourism operations with 171 firms responding to the study. In addition, two farm safety workshops and five customer service workshops were conducted. The survey results estimate the economic impact of operations in 2013 of \$34.2 million directly and more than \$54.2 million with multiplier effects. This more than doubled impacts from a 2003/2004 study which estimated direct effects of \$16-17 million. Sixty-three percent of respondents (N=132) reported attending a workshop, conference or tour in the last three years. On average, respondents estimated their change in sales due to these events in 2013 alone at 19.9%. This results in an average change in sales of more than \$23,500, a median increase of \$3,500 and an estimated total change in sales of more than \$7.55 million. Impacts reported from other agritourism educational events included the following:

- 97 farmers, agri-entrepreneurs and community leaders increased their awareness of agritourism as an opportunity to add value to farm resources and foster rural economic development.
- 90 entrepreneurs increased their awareness of customer service and hospitality as an important part of market planning and implementation.
- 89 participants developed goals to implement the hospitality habits discussed.
- 88 participants plan to evaluate their businesses customer service performance and consider ways to improve it.
- 32 participants have a better understanding of how to keep customers and employees safe.
- 30 participants have a better understanding of how to prepare for and respond to an emergency on the farm.
- 29 participants will implement or change one practice or procedure to improve safety and/or prepare for emergencies on the farm.

### Key Items of Evaluation

**Extension Agritourism Program Produces Substantial Economic Impacts** - A survey was conducted of Tennessee agritourism operations with 171 firms responding to the study. In addition, two farm safety workshops and five customer service workshops were conducted. The survey results estimate the economic impact of operations in 2013 of \$34.2 million directly and more than \$54.2 million with multiplier effects. This more than doubled impacts from a 2003/2004 study which estimated direct effects of \$16-17 million. Sixty-three percent of respondents (N=132) reported attending a workshop, conference or tour in the last three years. On average, respondents estimated their change in sales due to these events in 2013 alone at 19.9%. This results in an average change in sales of more than \$23,500, a median increase of \$3,500 and an estimated total change in sales of more than \$7.55 million.

**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
102	Soil, Plant, Water, Nutrient Relationships	20%	80%	25%	
112	Watershed Protection and Management	80%	5%	16%	
131	Alternative Uses of Land	0%	10%	0%	
133	Pollution Prevention and Mitigation	0%	0%	13%	
135	Aquatic and Terrestrial Wildlife	0%	0%	11%	
136	Conservation of Biological Diversity	0%	0%	3%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	1%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	2%	
205	Plant Management Systems	0%	5%	1%	
212	Pathogens and Nematodes Affecting Plants	0%	0%	7%	
213	Weeds Affecting Plants	0%	0%	2%	
215	Biological Control of Pests Affecting Plants	0%	0%	2%	
216	Integrated Pest Management Systems	0%	0%	1%	
402	Engineering Systems and Equipment	0%	0%	6%	
403	Waste Disposal, Recycling, and Reuse	0%	0%	1%	
404	Instrumentation and Control Systems	0%	0%	6%	
721	Insects and Other Pests Affecting Humans	0%	0%	3%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	25.0	0.0

Actual Paid Professional	5.0	0.7	36.9	0.0
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
96020	31023	855916	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
440047	31023	2593303	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
50000	0	1486926	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.

**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.

**3. How was eXtension used?**

eXtension was not used in this program

**V(E). Planned Program (Outputs)**



**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

**Patent Applications Submitted**

Year: 2013

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	0	73	73

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Validate our vehicle terrain model for the U.S. Army. (Ayers)

Year	Actual
2013	1

**Output #2**

**Output Measure**

- Apply the Soil and Water Assessment Tool to a rural Tennessee watershed dominated by animal agriculture. (Hawkins)  
Not reporting on this Output for this Annual Report

**Output #3**

**Output Measure**

- Improve the SWAT model subroutine for pathogen transport in agricultural watersheds. (Hawkins)  
Not reporting on this Output for this Annual Report

**Output #4**

**Output Measure**

- Elucidate signals that regulate phage reproduction of temperate bacteriophage will provide targets for controlling plant, animal, and human pathogen, biofilms, nitrogen fixation in symbiotic nitrogen-fixing bacteria, and regulation of toxin production in food-borne pathogens. (Radosevich)  
Not reporting on this Output for this Annual Report

**Output #5**

**Output Measure**

- Optimize non-chemical methods of soil disinfestation for Tennessee vegetable and small fruit producers, supported by a grant from USDA-NIFA with collaborators in Tennessee, Florida, and California. This is an important issue for growers considering the impending loss of methyl bromide as a soil fumigant. (Butler)

<b>Year</b>	<b>Actual</b>
2013	1

**Output #6**

**Output Measure**

- Develop practical systems for organic forage production in Tennessee, both for organic ruminant livestock production and for integration into sod-based crop rotations. These systems have potential to increase economic viability of family farms and decrease negative environmental impacts of agriculture. (Butler)  
Not reporting on this Output for this Annual Report

**Output #7**

**Output Measure**

- Finalized research on factors that affect the adoption of water conservation programs and water pricing structures for four Southern U.S. states including Tennessee (Boyer)

<b>Year</b>	<b>Actual</b>
2013	0

**Output #8**

**Output Measure**

- Developed and applied GPS-based streambank video mapping to the Driftwood River and Upatoi Creek (Ayers)

<b>Year</b>	<b>Actual</b>
2013	0

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	See nursery and nursery crop use of bioactive natural products in place of conventional pesticide on tomato, percent of operators adopting (Gwinn).
2	Microbial Processes in Carcass Decomposition (DeBruyn)
3	Cattle producer adoption of water-quality BMPs (Clark, Lambert, Walker)
4	Land Application of Lignocellulostic Biochar (Radosevich, Labbe)
5	Microorganism-Based Soil Phosphorus Index (Radosevich)
6	Characterize oomycete plant pathogens in drainage areas (Lamour)
7	Reduce hypoxia in the Gulf of Mexico (Duncan)
8	Evaluate soil quality under biodegradable mulch (Lee)
9	Stabilizing antimony-contaminated soils (Essington)
10	Leverage Stormwater Management Center (Buchanan, Tyner, Yoder, Ludwig)
11	Streambank erosion and TMDL (Ayers)
12	Using GIS to improve GPS machine control (Freeland)
13	Water in the Andean Paramo (Lee)

**Outcome #1**

**1. Outcome Measures**

See nursery and nursery crop use of bioactive natural products in place of conventional pesticide on tomato, percent of operators adopting (Gwinn).

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

Microbial Processes in Carcass Decomposition (DeBruyn)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

Our research has contributed to a better understanding of the spatial and temporal dynamics of soil microorganisms under environmental perturbations and disturbances such as contamination with organic pollutants.

**Results**

We've begun to reveal the microbial decomposition processes occurring post mortem during carcass decomposition ? while we've long understood that microbes are a crucial part of decomposition, we have provided a first look at what types of microbes are involved and what processes they are using. We demonstrated optimum composting strategies for carcasses (e.g. cattle, feral hog) for producers and landowners who are in need of efficient disposal with minimal environmental impact.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

### **Outcome #3**

#### **1. Outcome Measures**

Cattle producer adoption of water-quality BMPs (Clark, Lambert, Walker)

#### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

#### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Oostanaula Creek within McMinn and Monroe Counties of Tennessee is listed as an impaired waterbody due to pathogens (E. coli), phosphates and siltation.

##### **What has been done**

These grants are focused on understanding farmers willingness or reluctance to implement BMPs, as well as looking at new methods to discriminate between bacteria from beef and dairy cattle, as well as identify, model and quantify the sources of sediment in the stream.

##### **Results**

Preliminary analysis suggests that there was a clear preference for BMP bundles that did not include stream crossings. Younger, more educated producers with higher income levels who plan to bequeath the farm to family members were more willing to adopt the BMPs. Producers also appear most interested in adopting rotational grazing and pasture improvement practices.

Preliminary regression analysis suggests that producers respond positively to incentives and that some BMPs are complements. Results of this study will be useful for the design and implementation of voluntary programs to reduce impacts of cattle production on water quality.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
112	Watershed Protection and Management
131	Alternative Uses of Land
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife

#### **Outcome #4**

##### **1. Outcome Measures**

Land Application of Lignocellulostic Biochar (Radosevich, Labbe)

##### **2. Associated Institution Types**

- 1862 Research

##### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

##### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

###### **Issue (Who cares and Why)**

Land application of lignocellulostic biochar derived from fast pyrolysis provides the potential to sequester carbon in soils resulting in a carbon-negative bioenergy process and improvement of the physico-chemical properties of soils.

###### **What has been done**

###### **Results**

Biochar amendment did not alter microbial community structure, expression of amoA, or nitrification rates. The biochar was also found to be fairly recalcitrant in the soil environment especially for biochar prepared at high pyrolysis temperatures. The results suggest that biochar can be added to soil without impacting soil prokaryotic biota and has good potential as a means of sequestering carbon for extended periods of time.

##### **4. Associated Knowledge Areas**

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

205 Plant Management Systems  
403 Waste Disposal, Recycling, and Reuse

### **Outcome #5**

#### **1. Outcome Measures**

Microorganism-Based Soil Phosphorus Index (Radosevich)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Action Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Empirically derived soil tests for phosphorus often underestimate the amount available for plant uptake. Thus, soil test recommendations are often too conservative leading to over application and build-up of P in agricultural soils over time. Release of this P to water bodies can negatively impact water quality.

##### **What has been done**

A direct query of soil microorganisms by assaying gene-expression levels may offer a superior means of evaluating bioavailable P concentrations. We designed and evaluated a test to measure the expression of *pstS* a phosphorus transporter gene.

##### **Results**

Good correlation between gene expression and P-concentration was observed but only when the C:P ratio of soil was high. We also optimized a bioluminescent bioreporter assay for measuring bioavailable soil P. This assay has good potential to improve soil P testing which will benefit producers and lead to more effective soil nutrient management with decreased impacts on water quality.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

205	Plant Management Systems
404	Instrumentation and Control Systems

## **Outcome #6**

### **1. Outcome Measures**

Characterize oomycete plant pathogens in drainage areas (Lamour)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

For our stream monitoring project we wanted to know which oomycete plant pathogens are present in 8 different drainage areas of Tennessee.

#### **What has been done**

We described the frequency and distribution of these pathogens.

#### **Results**

This provides an important baseline for measuring the future impact of these pathogens on natural ecosystems and in agricultural settings.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
212	Pathogens and Nematodes Affecting Plants



## **Outcome #7**

### **1. Outcome Measures**

Reduce hypoxia in the Gulf of Mexico (Duncan)

### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

Hypoxia in the Gulf of Mexico is being mostly attributed to nutrient runoff and leaching from row crop production in the Mississippi River basin. Producers need to (a) be aware of the problem at hand and current regulatory issues, (b) be exposed to alternative, more sustainable management strategies that are also economically beneficial, and (c) have their sustainability documented and shared because the majority of large-scale TN row crop producers are extremely good stewards of their land and the scrutiny they are under is not warranted.

#### **What has been done**

An integrated, multi-disciplinary research, education, and outreach program has been established to develop, document, and disseminate information about sustainable production management strategies to Tennessee producers. Field days, county and multi-county meetings, on-farm demonstrations, news articles, publications, personal contacts and information gained from applied research projects were used to promote the adoption of these sustainable management methods.

#### **Results**

510,000 row crop acres in Tennessee are currently being grid or zone soil sampled to determine the right fertilizer application rate on a site-specific basis. Tennessee row crop producers maximized profitability and reduced the risk of nutrient runoff or leaching in surface or groundwater resources by applying the right fertilizer rate at the right place on 450,000 acres by using variable rate application technology. Approximately 500 producers and Extension professionals attending field days, workshops and county meetings increased their knowledge and skills pertaining to best management practices that reduce environmental impacts and maintain/improve crop profitability.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
205	Plant Management Systems

#### Outcome #8

##### 1. Outcome Measures

Evaluate soil quality under biodegradable mulch (Lee)

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

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

###### **Issue (Who cares and Why)**

Biodegradable mulch films are desirable alternatives to black plastic polyethylene mulches in agriculture. Efforts are ongoing to engineer biodegradable mulches that could be incorporated into the soil at the end of the crop season, and decomposed by microorganisms ultimately to CO<sub>2</sub>, H<sub>2</sub>O, and biomass. However, whether changes in soil quality occur during or following biodegradation is unknown.

###### **What has been done**

A 24-month in-situ study evaluated impacts on soil quality following burial of five different biodegradable mulches across three geographically distinct locations (Knoxville, TN; Lubbock, TX; Mount Vernon, WA) in both high tunnel and open field tomato production systems.

###### **Results**

Our results showed that mulches degraded at different rates depending on mulch type and geographic location. During the 18 months of study period, impacts of the biodegradable mulches on soil quality index were minor and dependent upon production system and time of incubation at all locations. However, negative impacts showed up late in the study, underlining the need for longer-term investigations, especially considering that these products comprise polymers, additives, and fillers that are foreign to a soil environment.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse

**Outcome #9**

**1. Outcome Measures**

Stabilizing antimony-contaminated soils (Essington)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

Our research concerning the retention of antimony by common soil minerals indicates that this metal toxin is strongly and irreversibly retained by soil minerals in acidic soil environments, particularly by iron and manganese minerals. These findings suggest that antimony in acidic soils may have low bioaccessibility; however, antimony bioaccessibility and mobility is high in neutral to alkaline soil. Mechanistic geochemical models were developed and successfully applied to predict the distribution of antimony between the immobile adsorbed phase and the mobile soil solution phase.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships

112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

**Outcome #10**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Better stormwater management is needed to reduce sediment loading.

**What has been done**

**Results**

The impact for the SMART Center project is already tremendous, allowing for expanded research in Best Management Practices and stormwater technologies, for outreach to the entire stormwater management community, and for training of both university students and professionals. Work on the Center is progressing slowly but surely, trying to make maximum use of the limited funding we have brought in to date. Significant impacts include hosting a Environmental Education conference, developing a tool for practitioners to use in analyzing stormwater plans, and developing the Manual that will be used statewide in making those plans.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
112	Watershed Protection and Management
131	Alternative Uses of Land
133	Pollution Prevention and Mitigation

135 Aquatic and Terrestrial Wildlife  
402 Engineering Systems and Equipment

**Outcome #11**

**1. Outcome Measures**

Streambank erosion and TMDL (Ayers)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

TMDL development for sediment from streambank erosion is lacking.

**What has been done**

**Results**

A novel technique to develop TMDL and total streambank erosion rates was developed.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
402	Engineering Systems and Equipment

**Outcome #12**

**1. Outcome Measures**

Using GIS to improve GPS machine control (Freeland)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Examine possible RF communication issues impacting precision agriculture.

**What has been done**

A test was conducted employing a tractor-based RTK system mounted on a road vehicle. The instrumented vehicle was used to traverse the highways around two commercial RTK reference towers. A viewshed analysis based upon terrain blockage and tower distance was performed. Results were compared to a comprehensive radiofrequency path design tool (Pathloss Ver. 4), which is a simulation model for radio links that operate in the frequency range of 30 MHz to 100 GHz.

**Results**

Highway tests of RTK base station reception show the Pathloss (PL) model predicted the data fit of both high and low probability areas. The PL model was found slightly more robust in its accurate prediction of RF reception than the LOS model. Both models performed better at predicting areas of reception than of non-reception. The PL model had higher inaccurate prediction of reception regions, whereas the LOS model had higher inaccurate prediction of non-reception regions. Base-to-tractor separation distances, forestation, and terrain blockages were the primary factors for maintaining the tractor RF link with the base station. As a low-cost tool, the site-specific success in communicating with a reference base station can be determined by using the positioning output from the RTK receiver plotted within Google Earth.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
402	Engineering Systems and Equipment

### **Outcome #13**

#### **1. Outcome Measures**

Water in the Andean Paramo (Lee)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Ecuador's páramos have fundamental roles in regulating the water resources of the region. As land uses in the páramo change and as glaciers shrink, human population increases, and the per-capita demand for water and hydroelectricity grows, there is cause for concern for the future water supply of the Ecuadorian sierra and of the larger region that depends on waters flowing from the Ecuadorian Andes.

##### **What has been done**

This three-year NSF project is completed this year. We investigated the effects of land-use change on the ability of páramo soils to absorb, store, and transmit water at two study areas: páramos of the community of Zuleta and of the Mazar Wildlife Reserve.

##### **Results**

Soil moisture differed significantly among land uses. Plantations of trees have a drying effect on páramo soils. Soils under the pine plantation at Zuleta was significantly drier than soils at all other sites, and upper horizon soils at the two Mazar Reserve pine plantation sites held less moisture than grassy sites at the Reserve. No significant differences in soil moisture were associated with the frequency of burning, except where fire exclusion had allowed woody plants to colonize. The change in land use from grass to pine plantation appears to change soil in ways that affect its ability to transmit and store water. Results of this study suggest that management to promote water-related ecosystem services in páramos should not include tree plantation but could include grazing and burning.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
----------------	-----------------------

102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
131	Alternative Uses of Land

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Public Policy changes
- Competing Public priorities

**Brief Explanation**

{No Data Entered}

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}



**V(A). Planned Program (Summary)**

**Program # 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%	
	<b>Total</b>	100%	100%	0%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	13.0	2.0	0.0	0.0
Actual Paid Professional	12.0	1.7	0.0	0.0
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
216045	69801	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
990106	69801	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
500000	0	0	0

**V(D). Planned Program (Activity)**

1. Brief description of the Activity

In 2013, UT and TSU Extension supported 10 regional and local social marketing campaigns in family economics. These campaigns were 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 conferences to strengthen the capacity of educators to teach financial and savings education. Extension deployed its On My Own curriculum and youth Tennessee Saves in over 100 financial education simulations. Additional classes, newsletters, news releases and community events were conducted for adult audiences in budgeting, savings, avoiding fraud, and estate planning.

**2. Brief description of the target audience**

Youth and adults were targeted for this program. UT Extension remains 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?**

This Family Economics planned program was enhanced through the service of 11 Tennessee Extension personnel on the "Financial Security for All" 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**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	107772	3474864	92640	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	1	0	1

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	4350

**Output #2**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	33193

**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**

<b>Year</b>	<b>Actual</b>
2013	3678

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	563

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	3678

**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
2013	0

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

##### Issue (Who cares and Why)

{No Data Entered}

##### What has been done

{No Data Entered}

##### Results

{No Data Entered}

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
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**

<b>Year</b>	<b>Actual</b>
2013	259

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	841

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	563

**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
2013	5

#### 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)

#### External factors which affected outcomes

- Competing Public priorities
- Competing Programmatic Challenges

## **Brief Explanation**

### **V(I). Planned Program (Evaluation Studies)**

#### **Evaluation Results**

The Tennessee Saves program teaches personal savings and financial management. The 2013 statewide evaluation confirmed economic impacts from previous years:

- 50% of participants increased their savings or investment, generating an annual estimated savings/investment of \$4.4 million.
- 33% reduced debt an average of \$208 per month, for a total estimated debt reduction of more than \$1.1 million annually.

#### **Key Items of Evaluation**

The Tennessee Saves program teaches personal savings and financial management. The 2013 statewide evaluation confirmed economic impacts from previous years:

- 50% of participants increased their savings or investment, generating an annual estimated savings/investment of \$4.4 million.
- 33% reduced debt an average of \$208 per month, for a total estimated debt reduction of more than \$1.1 million annually.

**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
125	Agroforestry	0%	0%	2%	
205	Plant Management Systems	0%	20%	0%	
311	Animal Diseases	0%	0%	10%	
403	Waste Disposal, Recycling, and Reuse	0%	0%	1%	
501	New and Improved Food Processing Technologies	0%	0%	16%	
502	New and Improved Food Products	0%	0%	6%	
503	Quality Maintenance in Storing and Marketing Food Products	0%	5%	0%	
504	Home and Commercial Food Service	0%	20%	0%	
702	Requirements and Function of Nutrients and Other Food Components	0%	0%	7%	
703	Nutrition Education and Behavior	0%	0%	8%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	100%	5%	32%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%	0%	5%	
806	Youth Development	0%	50%	1%	
901	Program and Project Design, and Statistics	0%	0%	5%	
903	Communication, Education, and Information Delivery	0%	0%	7%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	0.5	26.0	0.0

Actual Paid Professional	9.0	1.2	40.4	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
160033	51704	614246	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
733412	51704	2257714	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
139369	0	2143058	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 specifically 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.

**2. Brief description of the target audience**

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

**3. How was eXtension used?**

This Food Safety planned program was enhanced through the service of four Tennessee Extension personnel on the "Food Safety" CoP, including the leader who serves as a specialist in the UT Extension Department of Family and Consumer Sciences. Tennessee Extension personnel shared implementation strategies, outcome measurement, and evaluation protocols with their CoP colleagues.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	201687	6223443	284652	0

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

**Patent Applications Submitted**

Year: 2013

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
<b>Actual</b>	2	86	88

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

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

Year	Actual
2013	12030

**Output #2**

**Output Measure**

- Number of research-based publications distributed by Extension to educate producers, processors, and consumers.

<b>Year</b>	<b>Actual</b>
2013	4922298

**Output #3**

**Output Measure**

- Developed procedures for fortifying ground coffee with bioactive compounds (Zivanovic)

<b>Year</b>	<b>Actual</b>
2013	0

**Output #4**

**Output Measure**

- Created and applied chitosan-gallic acid multifunctional packaging for reduction of oxidation and extension of shelf life of foods susceptible to rancidity. (Zivanovic)

<b>Year</b>	<b>Actual</b>
2013	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	Adoption of a homogenization pasteurization process as an alternative to thermal processing by small or mid-sized juice processors (Davidson).
6	If petroleum prices continue to increase, we may identify several applications for chitosan to replace cellulose in the pharmaceutical or plastics industries (Zivanovic).
7	Pending chitosan being granted GRAS (Generally Recognized As Safe) status, our research will lead to applications in edible films and food additives with anti-microbial and thickening properties (Zivanovic).
8	Preserving Foods Safely At Home
9	Finding Salmonella with novel molecular approaches (D'Souza)
10	Genetic markers for mastitis susceptibility (Pighetti)
11	Inactivation of viral pathogens (D'Souza, Davidson)
12	Pet food safety (Zivanovic)
13	Prevent (rather than respond to) food-borne illness (Buchanan, Critzer, Wszelaki, Lockwood)
14	Target leading foodborne human pathogen <i>C. jejuni</i> (Lin)



**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**

<b>Year</b>	<b>Actual</b>
2013	11717

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	1531

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
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**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	310

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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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**

Adoption of a homogenization pasteurization process as an alternative to thermal processing by small or mid-sized juice processors (Davidson).

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

{No Data Entered}

**What has been done**

{No Data Entered}

**Results**

{No Data Entered}

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

**Outcome #6**

**1. Outcome Measures**

If petroleum prices continue to increase, we may identify several applications for chitosan to replace cellulose in the pharmaceutical or plastics industries (Zivanovic).

Not Reporting on this Outcome Measure

**Outcome #7**

**1. Outcome Measures**

Pending chitosan being granted GRAS (Generally Recognized As Safe) status, our research will lead to applications in edible films and food additives with anti-microbial and thickening properties (Zivanovic).

Not Reporting on this Outcome Measure

**Outcome #8**

**1. Outcome Measures**

Preserving Foods Safely At Home

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Approximately 1 in 5 U.S. households can their own food, and 65% of those households can vegetables. Home canned food poses a risk for foodborne illness if not done safely.

**What has been done**

In 2013, Extension provided education about home food preservation through classes, news articles, and answering questions from clientele. Extension made 10,662 direct contacts with food

preservation education during 2013; 3.5 million contacts were made using indirect methods such as exhibits, newspaper articles, publications, radio, television, and web sites.

**Results**

The following impacts were reported:

- ?569 dial-gauge lids were tested.
- ?265 of 286 participants surveyed preserved foods following a tested recipe.
- ?250 of 283 participants process high-acid foods in a water bath canner.
- ?393 of 501 participants surveyed canned pickles following a tested recipe.
- ?392 of 483 participants surveyed canned tomatoes following a tested recipe.
- ?475 of 624 participants surveyed canned vegetables following a tested recipe.
- ?229 of 263 participants surveyed process low-acid foods in a pressure canner.
- ?380 of 506 participants surveyed processed pickles in a water-bath canner.
- ?452 of 585 participants surveyed processed tomatoes in a water-bath or pressure canner.
- ?391 of 508 participants surveyed processed vegetables in a pressure canner.

**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 #9**

**1. Outcome Measures**

Finding Salmonella with novel molecular approaches (D'Souza)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Salmonella and human norovirus outbreaks have been on the rise and novel rapid methods to detect as well as control these outbreaks to provide safe food and prevent outbreaks are needed.

## What has been done

### Results

Rapid detection using novel molecular approaches (LAMP) that do not require expensive thermocyclers has resulted in significant improvements in detection sensitivity and speed over traditional cultural methods and standard molecular assays such as polymerase chain reaction (PCR). This developed technology has decreased assay time for timely food-product release.

## 4. Associated Knowledge Areas

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

## Outcome #10

### 1. Outcome Measures

Genetic markers for mastitis susceptibility (Pighetti)

### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2013	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Mastitis, an inflammation of the mammary gland most commonly caused by bacteria, negatively impacts milk safety and represents one of the most economically devastating diseases in the dairy industry.

#### What has been done

Research from our lab has identified a series of genetic markers for mastitis susceptibility and has the potential to select for cows and sires more resistant to disease, thereby enhancing dairy cow health and safety of the milk supply. By using genetic markers which identify cows resistant or susceptible to infection, we can identify what mechanisms lead to these differences.

**Results**

Once known, novel strategies can be developed that target these mechanisms and prevent or treat infections in cattle and potentially other species.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
311	Animal Diseases
722	Zoonotic Diseases and Parasites Affecting Humans

**Outcome #11**

**1. Outcome Measures**

Inactivation of viral pathogens (D'Souza, Davidson)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Norovirus and Hepatitis A virus are responsible for a majority of the foodborne illnesses in the US and can be transmitted through water or foods.

**What has been done**

Efficacious inactivation strategies for foodborne bacterial and viral pathogens will help curb outbreaks. The producers and food industry will be tremendously benefited by using the results obtained from the research with optimal process times and use of natural antimicrobials to help prevent recalls or allow for timely recalls of product, thus protecting public health and agriculture.

**Results**

We have determined the thermal inactivation kinetics of norovirus surrogates and Hepatitis A virus in buffer, spinach and blue mussels. This is the first time that the thermal inactivation kinetics of these viruses has been characterized and modeled. Knowing what temperatures and times are required to kill these viruses will assist in improving food safety in the US and globally. Additionally, discovering that HAV is particularly heat resistant may lead to its use as a model for pasteurization.



**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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
722	Zoonotic Diseases and Parasites Affecting Humans

**Outcome #12**

**1. Outcome Measures**

Pet food safety (Zivanovic)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

Analyzed pet food products produced with novel natural antimicrobial compounds for potentially toxic degradation products.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
502	New and Improved Food Products
702	Requirements and Function of Nutrients and Other Food Components

### **Outcome #13**

#### **1. Outcome Measures**

Prevent (rather than respond 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**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

The Food Safety Modernization Act of 2011 emphasizes the prevention of food-borne illnesses rather than responding to outbreaks. In response to this act, the U.S. FDA has developed new regulations regarding the use of surface water during the growing, harvesting, packing, and holding of produce for human consumption. Because irrigation water is one of the most likely points of pathogen contamination, methods are needed that can reliably and economically disinfect irrigation as it is applied to fresh produce.

##### **What has been done**

Since 2010, food safety workshops and projects have been conducted across the state to help growers become more familiar with GAPs (Good Agricultural Practices), write their food safety plans to prepare for third party audits, and test their irrigation water quality.

##### **Results**

From preliminary results gathered through water testing, UT has evaluated the survival of foodborne illness pathogens from surface water on produce and methods to mitigate the risk of produce contamination from irrigation water. Through the UT food safety programs, over 1,500 growers and agents have been trained and a food safety webpage has been created.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
501	New and Improved Food Processing Technologies
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and

	Naturally Occurring Toxins
722	Zoonotic Diseases and Parasites Affecting Humans
903	Communication, Education, and Information Delivery

**Outcome #14**

**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
2013	0

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

**Issue (Who cares and Why)**

Campylobacter jejuni is the leading foodborne human pathogen in the United States and many other industrialized countries. Increasing evidence also indicates that antibiotic use in poultry selects for resistant C. jejuni, posing a significant threat to public health.

**What has been done**

Our studies focus on the development of innovative strategies to control Campylobacter infection in humans and in animal reservoirs, consequently reducing the occurrence of foodborne illness.

**Results**

Our studies may open new avenues for treatment and prevention of resistant foodborne pathogens important in animal health and food safety.

**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
722	Zoonotic Diseases and Parasites Affecting Humans

## **V(H). Planned Program (External Factors)**

### **External factors which affected outcomes**

- Competing Public priorities
- Competing Programmatic Challenges

### **Brief Explanation**

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

In 2013, UT and TSU Extension provided education about home food preservation through classes, news articles, and answering questions from clientele. Extension made 10,662 direct contacts with food preservation education during 2013; 3.5 million contacts were made using indirect methods such as exhibits, newspaper articles, publications, radio, television, and web sites. The following impacts were reported:

- 569 dial-gauge lids were tested.
- 265 of 286 participants surveyed preserved foods following a tested recipe.
- 250 of 283 participants process high-acid foods in a water bath canner.
- 393 of 501 participants surveyed canned pickles following a tested recipe.
- 392 of 483 participants surveyed canned tomatoes following a tested recipe.
- 475 of 624 participants surveyed canned vegetables following a tested recipe.
- 229 of 263 participants surveyed process low-acid foods in a pressure canner.
- 380 of 506 participants surveyed processed pickles in a water-bath canner.
- 452 of 585 participants surveyed processed tomatoes in a water-bath or pressure canner.
- 391 of 508 participants surveyed processed vegetables in a pressure canner.

### **Key Items of Evaluation**

In 2013, UT and TSU Extension provided education about home food preservation through classes, news articles, and answering questions from clientele. Extension made 10,662 direct contacts with food preservation education during 2013; 3.5 million contacts were made using indirect methods such as exhibits, newspaper articles, publications, radio, television, and web sites. The following impacts were reported:

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- 229 of 263 participants surveyed process low-acid foods in a pressure canner.

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- 380 of 506 participants surveyed processed pickles in a water-bath canner.
- 452 of 585 participants surveyed processed tomatoes in a water-bath or pressure canner.
- 391 of 508 participants surveyed processed vegetables in a pressure canner.

**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%	3%	
123	Management and Sustainability of Forest Resources	75%	100%	28%	
124	Urban Forestry	0%	0%	1%	
125	Agroforestry	10%	0%	0%	
133	Pollution Prevention and Mitigation	0%	0%	4%	
135	Aquatic and Terrestrial Wildlife	10%	0%	21%	
136	Conservation of Biological Diversity	0%	0%	3%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	3%	
206	Basic Plant Biology	0%	0%	2%	
213	Weeds Affecting Plants	0%	0%	1%	
215	Biological Control of Pests Affecting Plants	0%	0%	7%	
301	Reproductive Performance of Animals	0%	0%	3%	
311	Animal Diseases	0%	0%	2%	
312	External Parasites and Pests of Animals	0%	0%	3%	
605	Natural Resource and Environmental Economics	5%	0%	7%	
721	Insects and Other Pests Affecting Humans	0%	0%	2%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%	0%	3%	
903	Communication, Education, and Information Delivery	0%	0%	7%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890

Plan	4.0	0.5	47.0	0.0
Actual Paid Professional	9.0	1.2	45.2	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
160033	51704	815438	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
733412	51704	3349973	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
43040	0	3546886	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

UT and TSU Extension cooperated with the Tennessee Forestry Association to plan and conduct group meetings to inform forest landowners of issues pertaining to forestry and wildlife. Topics included management and marketing. Volunteers were recruited and trained to present at group meetings, provide information, demonstrate equipment and provide materials for demonstrations. UT and TSU Extension provided education at local, regional and statewide events, such as the Tennessee Forest Festival to inform the general public about forest management issues. Demonstrations were provided for landowners and forestry workers. Extension Agents and Specialists educated attendees at County Forestry Landowners Association. UT and TSU Extension worked closely with private consultants, Tennessee Wildlife Resources Agency employees, Tennessee Division of Forestry and others in forestry related industries to develop educational programs and activities for professionals and landowners.

UT and TSU Extension will continue one-on-one contacts with landowners throughout the year and use mass media and newsletters to inform the general public on issues and educational opportunities related to natural resources. Both UT and TSU Extension will provide leadership for conducting programs that target 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 serve 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 personnel on the "Climates, Forests and Woodlands" CoP,
- one Tennessee Extension personnel on the "Extension Wildfire Information Network" CoP,
- one Tennessee Extension personnel on the "Feral Hogs" CoP, and
- one Tennessee Extension personnel on the "Wildlife Damage Management" CoP.

Tennessee Extension personnel shared implementation strategies, outcome measurement, and research results with their CoP colleagues.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	23222	1811514	9193	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0



**Patents listed**

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

**Number of Peer Reviewed Publications**

<b>2013</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	10	76	86

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Release of Hemlock Woolly Adelgid predators reared in Tennessee (Parkman).

<b>Year</b>	<b>Actual</b>
2013	121000

**Output #2**

**Output Measure**

- Field validation/demonstration of remotely-controlled acoustic monitoring system for monitoring grassland birds on no-entry zones in military installations (Buehler).  
Not reporting on this Output for this Annual Report

**Output #3**

**Output Measure**

- Develop phytosanitary methods for disinfecting walnut logs that are currently under quarantine for walnut twig beetle. (Taylor)

<b>Year</b>	<b>Actual</b>
2013	0

**Output #4**

**Output Measure**

- In next four years reintroduce four to eight missing species into TN & NC portions of the Pigeon River, and supplement/augment existing numbers of species (see perhaps another four that have recolonized). (Wilson)  
Not reporting on this Output for this Annual Report

**Output #5**

**Output Measure**

- Developed a web-based application that allows users to view the estimated amenity values of forest landscapes (Cho)

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<b>Year</b>	<b>Actual</b>
2013	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	Forest Landowner Education: Number of landowners who improved profitability (marketing) of forest ownership.
3	Tennessee Master Logger Program
4	Log-on Before You Log
5	Thousand Cankers Disease on black walnut (Grant, Lambdin, Hadziabdic, Windham)
6	Develop Apps for IPM (Fulcher, Hale, Windham)
7	Wintering habitat for black ducks (Gray)
8	Black fly/gnat suppression (Moulton)
9	Cellulose nanocrystals (Wang)
10	Deer harvest strategies for Oak Ridge (Muller)
11	Elk restoration and genetic diversity (Muller)
12	Suppression of Emerald Ash Borer (Grant, Wiggins)
13	Ground cover for better mine reclamation (Franklin)
14	Insecticide effects on Hemlock (Lambdin, Grant)
15	Northern Bobwhite protection and restoration (Buehler)
16	Predatory beetles against HWA (Lambdin, Grant, Wiggins)
17	Protecting amphibians from ranavirus (Gray)

18	Wildlife-mediated ecosystem services (Kwit)
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**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
2013	215

**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**

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

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	105

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

**Outcome #3**

**1. Outcome Measures**

Tennessee Master Logger Program

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Training of loggers in Best Management Practices (BMPs) is necessary to protect water quality during forest harvesting operations.

**What has been done**

In 2013, 20 continuing education logger workshops were held with 410 loggers, foresters, and landowners.

**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). 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 since 1983 or about 90 percent of the state logging workforce.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

**Outcome #4**

**1. Outcome Measures**

Log-on Before You Log

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Privately family forests own 87 percent of Tennessee's 14 million acres of forestland. This ownership class is very important for the protection and wise use of the state's forest resources, as well as for producing timber necessary to sustain the state's wood industry.

**What has been done**

UT Extension's "Log-on Before You Log" website went live in 2013. The site serves as a clearing-house for current forest stewardship educational material, including best management practices (BMPs).

**Results**

In 2013 there were 636 unique visits (or an average of two per day) to the "Log-On Before You Log" website. The site survey indicated that 97% of the visitors owned forestland, with total ownership of 83,912 acres. Impacts included: 67% indicated they would seek professional help when marketing timber, 91% gained better understanding about forestry BMPs, and 94% would implement forestry BMPs as a result of viewing the website.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

**Outcome #5**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Thousand canker disease (TCD) has been found in two additional counties in Tennessee in since the first six counties were identified to have the disease. The disease has also been found in four other states with two of those states being reported to have TCD in 2013.

**What has been done**

Information regarding genetic differentiation and spatial structure of *Geosmithia morbida* in the eastern United States provided a first insight into population genetics of the pathogen and plausible explanation of disease spread into the native area. The paper is the first to describe genetic diversity of *G. morbida* isolates in the native range of black walnut.

### Results

Our study revealed high haploid genetic diversity among seven *G. morbida* populations with evidence of gene flow, isolation by distance and significant differentiation among two identified genetic clusters. Our ultimate goal is to provide a platform for informed disease management to prevent widespread epidemics in the native region of black walnut and conservation of public and private land resources.

## 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
215	Biological Control of Pests Affecting Plants

## Outcome #6

### 1. Outcome Measures

Develop Apps for IPM (Fulcher, Hale, Windham)

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Condition Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2013	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

#### What has been done

An app, IPMPro, and an e-book, IPM for Select Deciduous Trees in Southeastern Nursery Production, were developed by the Southern Nursery IPM Group.



**Results**

Users of the app for mobile phones and tablets estimate that the app has saved them over \$1,350,000 as a group. Users were surveyed and savings were reported by eliminating sprays or effectively timing sprays using alerts issued by IPMPro. Users of the e-book estimate the economic impact at over \$1,280,000 using information in this book written by members of the Southern Nursery IPM Group. Readers of the book stated that information in the book helped them identify pests and diseases, plan IPM strategies and was an overall useful reference.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
124	Urban Forestry
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
903	Communication, Education, and Information Delivery

**Outcome #7**

**1. Outcome Measures**

Wintering habitat for black ducks (Gray)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Black ducks migrate and winter in Tennessee.

**What has been done**

Findings: (1) American black ducks (*Anas rubripes*) wintering in Tennessee used flooded forest and shrub edges in greater proportion to their availability compared to other habitats, and (2) food abundance and foraging effort by wintering black ducks were low in forested and scrub-shrub wetlands compared to other habitats.

**Results**

These results indicate that wetlands with woody vegetation are important for wintering black ducks in Tennessee for life history activities other than foraging. Natural resource agencies should provide forested or scrub-shrub wetlands in close proximity to habitats with high food abundance (e.g., moist-soil wetlands, flooded cornfields) for black ducks that are migrating and wintering in the interior United States.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
125	Agroforestry
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

**Outcome #8**

**1. Outcome Measures**

Black fly/gnat suppression (Moulton)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Female gnats belonging to the Simulium jenningsi species group are nuisance and sometimes biting pests of humans and livestock throughout eastern North America. Large outbreaks in east Tennessee in areas adjacent to the French Broad and Pigeon Rivers in Cocke and Sevier counties precipitated a control program that ran successfully from 2007 until 2009, when funding became problematic due to the recession. Females of SJG species are so structurally similar they cannot be identified by eye and thus species identity and most likely natal watercourses (all black flies develop in running water) cannot be ascertained.

**What has been done**

A molecular phylogenetic means of SJG species identification was discovered.

**Results**

This DNA fingerprinting method will allow more precise stream/river targeting to control SJG pest species resulting in less total cost and environmental exposure to the control agent, *Bacillus thuringiensis* var. *israelensis* endotoxins.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
721	Insects and Other Pests Affecting Humans

**Outcome #9**

**1. Outcome Measures**

Cellulose nanocrystals (Wang)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Due to the advantages of cellulose nanocrystals (CNCs) high modulus, low density, high aspect ratio, and negligible thermal expansion, they have attracted much attention from materials scientists. As a functional material, the mechanical properties of CNC films are very important. The CNC films studied in the previous researches were all prepared by sulfuric acid hydrolysis and were not modified, but the moduli of these CNC films had a considerable range, from 2 to 8.3 GPa.

**What has been done**

**Results**

Our recent research has solved this mystery. The results show that the environmental conditions had a great influence on the mechanical properties of pure CNC films and attracted great attention.

**4. Associated Knowledge Areas**

**KA Code**    **Knowledge Area**  
125            Agroforestry

**Outcome #10**

**1. Outcome Measures**

Deer harvest strategies for Oak Ridge (Muller)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Deer overabundance has caused many new management challenges. We need critical information essential on deer ecology for managers to successfully develop deer harvest strategies to minimize conflicts.

**What has been done**

Physiology controls how an animal functions in its natural environment. Physiology is the core of applied wildlife management because extra resources (nutrition) are used to maximize reproduction and survival. My work looks at the interaction of physiology and population growth and well-being.

**Results**

Hunting seasons for white-tailed deer occur during the peak breeding season to make mature males easier to harvest. We found these excursions beyond the home range during the breeding season also occurred in female deer. Harvest seasons timed during the rut are effective for both males and females because of increasing movements and exposure to unfamiliar areas beyond normal home ranges.

**4. Associated Knowledge Areas**

**KA Code**    **Knowledge Area**  
123            Management and Sustainability of Forest Resources  
135            Aquatic and Terrestrial Wildlife

301 Reproductive Performance of Animals  
605 Natural Resource and Environmental Economics

**Outcome #11**

**1. Outcome Measures**

Elk restoration and genetic diversity (Muller)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Elk restoration projects try to maximize genetic diversity

**What has been done**

We looked at genetic structure of elk from the source population and again in translocated animals in Tennessee and North Carolina.

**Results**

There may be a problem with segregation of elk related to source populations.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
301	Reproductive Performance of Animals

**Outcome #12**

**1. Outcome Measures**

Suppression of Emerald Ash Borer (Grant, Wiggins)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

A new invasive insect threat (emerald ash borer) has been documented in 21 counties in Tennessee, representing the southernmost distribution of this insect pest in the U.S. This insect threatens to greatly reduce, if not cause the extinction of, populations of ash in the U.S., leading to tremendous economical and ecological losses.

**What has been done**

Entomologists at UTIA are at the forefront of research focusing on emerald ash borer in the southern U.S., with efforts directed at implementation of biological control to protect ash trees in forests, nurseries, and urban areas.

**Results**

Results of studies on parasitoids of EAB in Tennessee will help determine if these insects are suitable and effective natural enemies in southern climates. The recovery of the introduced *S. agrili* indicates this non-native biological control agent can successfully parasitize EAB and overwinter in the southern U.S., and this finding will help inform future management decisions by leaders of the USDA APHIS Emerald Ash Borer Program. Results from both on-going and planned studies, as well as continued monitoring of release sites and activities at new study sites in 2014, will further help assess parasitoids of EAB in the south.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
125	Agroforestry
215	Biological Control of Pests Affecting Plants

**Outcome #13**

**1. Outcome Measures**

Ground cover for better mine reclamation (Franklin)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

There is an ongoing effort to restore forests that have been altered or removed by human activity but forest restoration can be hindered by invasive species, poor soil properties, and changing climate.

**What has been done**

We studied how these factors influence the establishment and growth of trees native to Tennessee.

**Results**

Working on reclaimed mine sites, we showed that the selection of ground cover species is important for the success of reforestation, that herbaceous cover greater than 60% impedes forest establishment, and that a single, low-rate application of fertilizer increases the growth but not survival of trees. Because we were able to demonstrate successful reforestation of reclaimed mine sites and transfer this technology to industry, more than 90% of new coal mining permits in TN have designated forestry as the end land use, restoring the ecosystem services to thousands of acres mined of land in east TN.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
125	Agroforestry
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

**Outcome #14**

**1. Outcome Measures**

Insecticide effects on Hemlock (Lambdin, Grant)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Insecticides are an essential component of management plans directed at hemlock woolly adelgid in forest systems. Without these management tools, the numbers and health of our hemlocks in our forests would decline tremendously. Maintaining forest viability and sustainability enhances the aesthetics of our tourist region as well as contributes to forest ecology, conservation of native species, and enhancement of wildlife, including our aquatic organisms (such as trout).

**What has been done**

We investigated the persistence and efficacy of a widely used insecticide, imidacloprid, and its metabolites to determine how long they provided adequate control of hemlock woolly adelgid in a typical managed forest.

**Results**

Our results demonstrated that pesticidal compounds were still present in twigs and needles 5 to 7 years after treatment and that adelgid populations were suppressed during those years. These results will enable management personnel to refine and enhance their Long-term Management Plan for Hemlock Woolly Adelgid resulting in longer years between treatments while still adequately protecting the trees, yielding financial savings and minimizing potential secondary impacts to non-target organisms or to the environment.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
125	Agroforestry
133	Pollution Prevention and Mitigation



**Outcome #15**

**1. Outcome Measures**

Northern Bobwhite protection and restoration (Buehler)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Grassland bird populations are declining at a greater rate than any other bird group across North America. Because of these declines, major conservation initiatives, like the National Bobwhite Conservation Initiative, have been launched to reverse the population declines. Over a billion dollars have been invested in federally subsidized conservation practices focused on promoting native grasses in agricultural settings.

**What has been done**

We evaluated the population response of grassland birds to these conservation practices at multiple spatial scales across the Central Hardwoods Bird Conservation Region. We monitored over 5000 monitoring points across the region, recording the abundance of nine focal species at these points from 2008-2012. We modeled the relationship of species occupancy and abundance with conservation covariates and a variety of other landscape parameters.

**Results**

In general, the relationship between the presence or amount of conservation near a point and bird occupancy and abundance was fairly weak. We have concluded that either more conservation is needed and/or the management of these practices need to be improved to elicit a stronger response and turn population declines around.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

**Outcome #16**

**1. Outcome Measures**

Predatory beetles against HWA (Lambdin, Grant, Wiggins)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Loss of tree species will change the composition of forests comparable to the loss of the chestnut tree during the 1930's by dramatically destroying habitats used by invertebrates and mammals.

**What has been done**

UT entomologists remain at the forefront of research focusing on the exotic, invasive hemlock woolly adelgid. Efforts are focused on implementing biological control and chemical insecticides while minimizing any adverse environmental, non-target impacts. These research efforts have contributed to improved tree health in many forested areas, and without these efforts, most eastern hemlock trees would be dead.

**Results**

Results of studies on the establishment of Ln and St against HWA are important for several reasons. Documenting the seasonality of both beetle species, the emergence period and density of Ln under tree canopies, the immigration and establishment of St into a non-release site, and the ability of both species to coexist validates the continued use of these natural enemies against HWA, expands what is known of these predatory species, and will enhance future release protocols. The collection of both beetle species in multiple sites, and the resulting spatial and statistical analyses of factors associated with establishment and coexistence, will further advance knowledge on when and how to release these predators in the future, ultimately improving predator establishment.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

136	Conservation of Biological Diversity
215	Biological Control of Pests Affecting Plants
605	Natural Resource and Environmental Economics

**Outcome #17**

**1. Outcome Measures**

Protecting amphibians from ranavirus (Gray)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Amphibian species are susceptible to ranavirus.

**What has been done**

Findings: (1) fish and turtles can be subclinically infected with ranavirus, (2) transmission of ranavirus among fish, turtles and amphibians through water is possible, and (3) species composition of amphibian communities affects the likelihood of an outbreak.

**Results**

Fish and turtles could function as reservoirs for ranaviruses, and facilitate outbreaks in amphibian communities. Also, amphibian communities composed of highly susceptible amphibian species may be more prone to outbreaks. Future surveillance studies should focus on detecting ranavirus and monitoring amphibian communities composed of highly susceptible amphibian species and where turtles or fish are present.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

**Outcome #18**

**1. Outcome Measures**

Wildlife-mediated ecosystem services (Kwit)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

To highlight the importance of wildlife-mediated ecosystem services, I rekindled interests in seed dispersal ecology, and initiated research aimed at redirecting the importance of ants as seed dispersers of myrmecochorous plants.

**Results**

Field, greenhouse, and laboratory work, in collaboration with a UTK colleague, has resulted in promising preliminary data highlighting the non-random nature of ant nest locations, and will form the focus of a NSF preliminary proposal to be submitted in January 2014.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity

## **V(H). Planned Program (External Factors)**

### **External factors which affected outcomes**

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

### **Brief Explanation**

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

In 2013 there were 636 unique visits (or an average of two per day) to the Log-On Before You Log website. The site survey indicated that 97% of the visitors owned forestland, with total ownership of 83,912 acres. Impacts include:

- 67% indicated they would seek professional help when marketing timber,
- 91% gained better understanding about forestry BMPs, and
- 94% would implement forestry BMPs as a result of viewing the website.

### **Key Items of Evaluation**

In 2013 there were 636 unique visits (or an average of two per day) to the Log-On Before You Log website. The site survey indicated that 97% of the visitors owned forestland, with total ownership of 83,912 acres. Impacts include:

- 67% indicated they would seek professional help when marketing timber,
- 91% gained better understanding about forestry BMPs, and
- 94% would implement forestry BMPs as a result of viewing the website.

**V(A). Planned Program (Summary)**

**Program # 10**

**1. Name of the Planned Program**

Global Food Security and Hunger

Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
205	Plant Management Systems	50%	0%	0%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%	0%	0%	
212	Pathogens and Nematodes Affecting Plants	5%	0%	0%	
213	Weeds Affecting Plants	0%	5%	0%	
216	Integrated Pest Management Systems	0%	10%	0%	
307	Animal Management Systems	0%	35%	0%	
601	Economics of Agricultural Production and Farm Management	40%	50%	0%	
	<b>Total</b>	100%	100%	0%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	23.0	2.0	101.0	0.0
Actual Paid Professional	23.0	3.1	0.0	0.0
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
400084	129261	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1833531	129261	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
49992	0	0	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

Various needs assessments conducted by Extension specialists have shown that the following practices are key for Tennessee row crops producers: conservation tillage; planting insect-tolerant crops; planting herbicide-tolerant crops; spraying with foliar fungicide to manage disease; using recommended varieties.

Note: all UT Agresearch inputs, funding, and reporting for this planned program have been re-allocated to "Agronomic Crops" and "Animal Systems".

**2. Brief description of the target audience**

The program was targeted to all Tennessee corn, soybeans, wheat and commercial vegetable producers.

**3. How was eXtension used?**

The Global Food Security and Hunger planned program was enhanced through the service of:

- four Tennessee Extension personnel on the "Bee Health" CoP, including the CoP Leader;
- two Tennessee Extension personnel on the "Corn and Soybean" CoP;
- one Tennessee Extension personnel on the "eOrganic" CoP; and
- three Tennessee Extension personnel on the "Grapes" 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**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	46028	4508845	853	0

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

Year: 2013  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	5	0	5

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of exhibits displayed to educate producers.

Year	Actual
2013	39

**Output #2**

**Output Measure**

- Number of research-based publications distributed to educate producers.

Year	Actual
2013	45784

**Output #3**

**Output Measure**

- Exploitation of the strong resistance mechanism in epazote against the plant parasitic nematode, *Meloidogyne incognita* (Bernard)  
 Not reporting on this Output for this Annual Report



**Output #4**

**Output Measure**

- Release a new soybean variety tailored to Tennessee needs (Pantalone).  
Not reporting on this Output for this Annual Report

**Output #5**

**Output Measure**

- Develop avenues to protect Tennessee forests from attack by the sudden oak death pathogen *Phytophthora ramorum*. (Lamour)  
Not reporting on this Output for this Annual Report

**Output #6**

**Output Measure**

- Identify virulence factors utilized by *S. uberis* to infect bovine mammary epithelial cells. (Oliver, Almeida, Prado, Luther)  
Not reporting on this Output for this Annual Report

**Output #7**

**Output Measure**

- Continue to exploit pesticides not only for their weed-killing potential, but also for their nutritional enhancement potential (Armel and Kopsell).  
Not reporting on this Output for this Annual Report

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Wheat: Number of acres utilized precision agriculture technologies for variable rate application of plant growth regulators, defoliant, or pesticides.
2	Wheat: Number of producers who adopted UT recommended resistance management strategies to control pests (weeds, insects, diseases).
3	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).
4	Soybeans: Percentage increase in Tennessee soybean yield by using recommended crop management strategies for insects, weeds, or plant diseases.
5	Corn: Percentage increase in Tennessee corn yield by using recommended crop management strategies for insects, weeds, or plant diseases.
6	Corn: Number of producers who reported harvesting higher corn yields and/or better quality crops using university variety trials.
7	Additional income earned by Tennessee producers by using UT Extension crop variety research trial results (in millions of dollars).
8	Agronomic testing of corn, soybean, wheat, grain sorghum and oats, varieties tested. (Allen)
9	Target number of research laboratories using our reverse-genetic tool for Phytophthora gene function analysis (Lamour).
10	Production of a 'hand-held' diagnostic device for Johne's disease by merging our diagnostic method and microfluidic technology. (Eda)

**Outcome #1**

**1. Outcome Measures**

Wheat: Number of acres utilized precision agriculture technologies for variable rate application of plant growth regulators, defoliant, or pesticides.

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

Wheat: Number of producers who adopted UT recommended resistance management strategies to control pests (weeds, insects, diseases).

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	516

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #3**

**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
- 1890 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	3756

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #4**

**1. Outcome Measures**

Soybeans: Percentage increase in Tennessee soybean yield by using recommended crop management strategies for insects, weeds, or plant diseases.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	8

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #5**

**1. Outcome Measures**

Corn: Percentage increase in Tennessee corn yield by using recommended crop management strategies for insects, weeds, or plant diseases.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	8

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
601	Economics of Agricultural Production and Farm Management

**Outcome #6**

**1. Outcome Measures**

Corn: Number of producers who reported harvesting higher corn yields and/or better quality crops using university variety trials.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	1174

**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
601	Economics of Agricultural Production and Farm Management

### Outcome #7

#### 1. Outcome Measures

Additional income earned by Tennessee producers by using UT Extension crop variety research trial results (in millions of dollars).

#### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension

#### 3a. Outcome Type:

Change in Condition Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2013	196

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

##### **Issue (Who cares and Why)**

Tennessee farmers produce about 2.85 million acres of oilseed, grain and cotton crops. UT Extension crop variety testing data is used extensively by 80% of these farmers to select the seed that they use to plant their crops.

##### **What has been done**

County Standardized Variety Trials were conducted on corn(52 hybrids), soybeans(72 varieties) and wheat(18 varieties) in large strip-trials on producers' farms in approximately 28 counties throughout Tennessee as well as 5 Kentucky counties. Data from all of these crop trials were compiled and published together on the variety trial website (<http://varietytrials.tennessee.edu>) and on <http://UTCrops.com>. Additionally, hard copies were distributed to farmers, extension agents, seed industry reps, consultants and other interested clientele.

## Results

Results from the variety testing program have helped farmers increase yields by identifying the varieties that will perform best in their farming operations. In 2013, the higher yields resulted in approximately \$196.8 million in additional income to Tennessee farmers.

#### 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
601	Economics of Agricultural Production and Farm Management

#### Outcome #8

##### 1. Outcome Measures

Agronomic testing of corn, soybean, wheat, grain sorghum and oats, varieties tested. (Allen)

Not Reporting on this Outcome Measure

#### Outcome #9

##### 1. Outcome Measures

Target number of research laboratories using our reverse-genetic tool for Phytophthora gene function analysis (Lamour).

Not Reporting on this Outcome Measure

#### Outcome #10

##### 1. Outcome Measures

Production of a 'hand-held' diagnostic device for Johne's disease by merging our diagnostic method and microfluidic technology. (Eda)

Not Reporting on this Outcome Measure

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

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

##### Brief Explanation

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 950,000 acres in Tennessee in 2013. The 2013 growing season was optimal in both temperature and rainfall for high corn yields and many growers reported some of the best yields ever in non-irrigated fields. The final state average yield was 156 bushels/acre (Jan 2014 USDA crops report). Corn prices were lower than in recent years due to the large U.S. crop with producers receiving less than \$5.00 per bushel for their crop on average.

Soybeans were planted and harvested on more than 1.3 million acres in Tennessee in 2013. Moderate temperatures and above normal rainfall created good to excellent yields in most counties across the state and there was a final state average yield of 46 bushels/acre (Jan 2014 USDA crops report). Soybean prices were good and most producers received more than \$12.00 per bushel for their crop. Projected cash receipts for soybeans in 2013 are more than 660 million dollars.

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

#### **Crop Variety Trials, Pest Control, and Marketing**

UT Extension crop variety testing data is used extensively by 80% of these farmers to select the seed that they use to plant their crops. Results from the variety testing program have helped farmers increase yields by identifying the varieties that will perform best in their farming operations. In 2013, the higher yields resulted in approximately \$196.8 million in additional income to Tennessee farmers. Farmers reported \$3.9 million in reduced pest control costs by following Extension recommendations for controlling insects, weeds, or plant diseases. Row crop producers increased returns by \$3.6 million on 132,000 acres by using forward pricing market opportunities as compared to selling at harvest.

### **Key Items of Evaluation**

#### **Crop Variety Trials, Pest Control, and Marketing**

UT Extension crop variety testing data is used extensively by 80% of these farmers to select the seed that they use to plant their crops. Results from the variety testing program have helped farmers increase yields by identifying the varieties that will perform best in their farming operations. In 2013, the higher yields resulted in approximately \$196.8 million in additional income to Tennessee farmers. Farmers reported \$3.9 million in reduced pest control costs by following Extension recommendations for controlling insects, weeds, or plant diseases. Row crop producers increased returns by \$3.6 million on 132,000 acres by using forward pricing market opportunities as compared to selling at harvest.

**V(A). Planned Program (Summary)**

**Program # 11**

**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%	0%	0%	
724	Healthy Lifestyle	70%	100%	0%	
805	Community Institutions, Health, and Social Services	25%	0%	0%	
	<b>Total</b>	100%	100%	0%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	23.0	2.0	0.0	0.0
Actual Paid Professional	20.0	2.8	0.0	0.0
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
360076	116335	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1650177	116335	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
155975	0	0	0

**V(D). Planned Program (Activity)**

1. Brief description of the Activity

**Dining with Diabetes** is 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 included:

- Contracting: Weekly contracting helped participants master something new.
- Feedback: Opportunities were provided to report and record progress and explore different behaviors.
- Modeling: Program participants and the trainer served as models. The course emphasized 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 was 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.

**Tai Chi** will also target arthritis sufferers. Extension will offer this exercise instructional program to individuals throughout the state. Research indicates that this regimen builds strength and is helps those with arthritis to reduce pain and increase mobility.

## 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?

This Health and Safety planned program was enhanced through the service of:

- two Tennessee Extension personnel on the "Drinking Water and Human Health" CoP, and
- seven Tennessee Extension personnel on the "Extension Disaster Education Network" 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

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	163796	7632979	26289	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	1	0	1

**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
2013	339

**Output #2**

**Output Measure**

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

Year	Actual
2013	174103

**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 reduced A1c.
5	Dining with Diabetes: Number of participants surveyed who reduced blood cholesterol.
6	Dining with Diabetes: Number of participants surveyed who reduced blood pressure.
7	Dining with Diabetes: Number of participants surveyed who eat at least five servings of fruits and vegetables each day.
8	Dining with Diabetes: Number of participants surveyed who now use artificial sweeteners.
9	Dining with Diabetes: Number of participants surveyed who use spices and other seasonings to cut back on fat, sugar, and salt.
10	Tai Chi: Number of participants surveyed who continue doing the Tai Chi after the Tai Chi program ends.
11	Tai Chi: Number of participants surveyed who have no pain from arthritis.

**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**

<b>Year</b>	<b>Actual</b>
2013	4452

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2013	3731

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	435

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

**Outcome #4**

**1. Outcome Measures**

Dining with Diabetes: Number of participants surveyed who reduced A1c.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	191

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services



**Outcome #5**

**1. Outcome Measures**

Dining with Diabetes: Number of participants surveyed who reduced blood cholesterol.

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	446

**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 #6**

**1. Outcome Measures**

Dining with Diabetes: Number of participants surveyed who reduced blood pressure.

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	446

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
724	Healthy Lifestyle

**Outcome #7**

**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**

<b>Year</b>	<b>Actual</b>
2013	446

**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 #8

##### 1. Outcome Measures

Dining with Diabetes: Number of participants surveyed who now use artificial sweeteners.

##### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	404

##### 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 #9**

**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**

<b>Year</b>	<b>Actual</b>
2013	404

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
724	Healthy Lifestyle
805	Community Institutions, Health, and Social Services

**Outcome #10**

**1. Outcome Measures**

Tai Chi: Number of participants surveyed who continue doing the Tai Chi after the Tai Chi program ends.

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	344

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
724	Healthy Lifestyle

**Outcome #11**

**1. Outcome Measures**

Tai Chi: Number of participants surveyed who have no pain from arthritis.

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	297

**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

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

- Competing Public priorities
- Competing Programmatic Challenges

##### Brief Explanation

#### V(I). Planned Program (Evaluation Studies)

##### Evaluation Results

The Dining with Diabetes curriculum was implemented in 35 counties in 2013 with 6,931 direct contacts from the program's 275 group meetings. Impacts included:

- 90% (n=429) participants were confident they can better manage their diabetes as a result of participating in this program.
- 90% (n= 191) participants are getting necessary health screenings such as eye, food and dental exams six months after completing the program.
- 86% (n=191) participants are keeping up-to-date with immunizations such as flu and pneumococcal shots six months after completing the program.
- 83% (=173 participants are preventing or treating other health conditions such as heart and blood vessel problem, kidney disease, nerve damage and food problems six months after completing the program.
- 89% (n=191) participants are regularly checking their blood sugar six months after completing the program.
- 79% (n= 191) participants are using the Healthy Plate Method six months after completing the program.
- 96% (n=421) participants can choose foods that do not cause a sharp rise in blood sugar.
- 74% (n=191) participants have reduces their A1c six months after completing the program.

##### Key Items of Evaluation

The Dining with Diabetes curriculum was implemented in 35 counties in 2013 with 6,931 direct contacts from the program's 275 group meetings. Impacts included:

- 90% (n=429) participants were confident they can better manage their diabetes as a result of participating in this program.
- 90% (n= 191) participants are getting necessary health screenings such as eye, food and dental exams six months after completing the program.
- 86% (n=191) participants are keeping up-to-date with immunizations such as flu and pneumococcal shots six months after completing the program.
- 83% (=173 participants are preventing or treating other health conditions such as heart and blood vessel problem, kidney disease, nerve damage and food problems six months after completing the program.
- 89% (n=191) participants are regularly checking their blood sugar six months after completing the program.
- 79% (n= 191) participants are using the Healthy Plate Method six months after completing the program.
- 96% (n=421) participants can choose foods that do not cause a sharp rise in blood sugar.
- 74% (n=191) participants have reduced their A1c six months after completing the program.

**V(A). Planned Program (Summary)**

**Program # 12**

**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%	9%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	6%	
202	Plant Genetic Resources	0%	0%	4%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	2%	
204	Plant Product Quality and Utility (Preharvest)	0%	20%	0%	
205	Plant Management Systems	60%	70%	12%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%	0%	6%	
212	Pathogens and Nematodes Affecting Plants	0%	5%	43%	
213	Weeds Affecting Plants	10%	0%	6%	
215	Biological Control of Pests Affecting Plants	0%	0%	2%	
216	Integrated Pest Management Systems	10%	5%	6%	
312	External Parasites and Pests of Animals	10%	0%	0%	
607	Consumer Economics	0%	0%	4%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	36.0	4.5	26.0	0.0
Actual Paid Professional	36.0	5.0	24.3	0.0
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
640134	206818	751351	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2933650	206818	1918927	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1159168	0

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

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.

TSU Extension works with the community and schools to develop community gardens for the purpose of improving food security and promoting community resource development. It evaluates the suitability, marketability and profitability of alternative and niche crops for small and limited resource producers. It has created its own community garden at the TSU Agricultural Research and Education Center to enhance food security, outreach and education for residents living in a portion of Nashville known to be a food desert.

### 2. Brief description of the target audience

- Farmers/producers who had traditional livestock and tobacco operations, but were looking to improve income through the Green Industry.
- Master Gardeners who volunteered to provide community service through horticulture.
- Business owners who needed research-based information to start, maintain or expand their greenhouse, landscaping, or nursery business.
  
- Urban and rural limited resource and under-served youth and adults

### 3. How was eXtension used?

This Horticultural Systems planned program was enhanced through the service of 14 Tennessee Extension personnel on the "Consumer Horticulture" CoP. Tennessee Extension personnel shared

2013 University of Tennessee Research and Extension and Tennessee State University Extension Combined Annual Report of Accomplishments and Results  
 implementation strategies, outcome measurement, and evaluation protocols with their CoP colleagues.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	284492	2090083	112940	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 3

**Patents listed**

1. Empire Dogwood (Evans, Trigiano, Wadl, Windham)
2. Red Steeple Dogwood (Evans, Trigiano, Wadl, Windham)
3. Pam's Mountain Bouquet Dogwood (Evans, Trigiano, Wadl, Windham)

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
<b>Actual</b>	1	45	48

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Horticultural workshops and conferences.

Year	Actual
2013	12

**Output #2**

**Output Measure**

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

Year	Actual
------	--------

2013 295

**Output #3**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	28293

**Output #4**

**Output Measure**

- Continue to investigate resistant mechanisms (traits) for dogwood anthracnose in flowering dogwood. (M. Windham)

<b>Year</b>	<b>Actual</b>
2013	0

**Output #5**

**Output Measure**

- Understand the secondary effects of chemical applications that will allow turfgrass managers to better use these products, to save money and reduce overall inputs to the environment. (Brosnan, Horvath)  
Not reporting on this Output for this Annual Report

**Output #6**

**Output Measure**

- Demonstrated use of rootstocks to increase field-grown tomato yield (Deyton)

<b>Year</b>	<b>Actual</b>
2013	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	Extension Responds to the Needs of Tennessee's Ornamental Horticulture Industry
4	Turfgrass Weed Management Strategies
5	Assessing and reintroducing <i>Pityopsis ruthii</i> (Trigiano, Wadl)
6	Brassica and Se effects on nutrition and cancer (Sams)
7	Gentic diversity in dogwood cultivars (Windham, Windham, Trigiano, Wadl)
8	Downy mildew control (Lamour, Trigiano)
9	Fungal resistance in tomato (Bost)
10	Greenhouse production (Deyton, Sams)
11	Late blight in tomato (Bost)
12	Molecular Markers for Horticultural Traits (Trigiano, Ownley, Wadl)
13	Mustard seed meal biofumigation of strawberries (Deyton, Sams)
14	Nursery participation in Ag Enhancement Program funding (Fulcher)
15	Off-target damage from pasture herbicides (Rhodes)
16	Olive production in Tennessee? (Ownley)
17	Organic initiative (Wszelaki)

18	Rose rosette virus (Windham)
19	Taro Leaf Blight pathogen (Lamour)
20	Better timing of pesticide applications (Klingeman)
21	Using genetics against Phytophthora blight (Lamour)

**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
2013	1552

**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**

<b>Year</b>	<b>Actual</b>
2013	3831

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

Extension Responds to the Needs of Tennessee's Ornamental Horticulture Industry

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Challenges facing the commercial horticulture industry include marketing, sustainable cultural practices, environmental and human health risks, invasive species, regulations, and profitability.

**What has been done**

Extension personnel conducted commercial nursery and landscape educational programs reaching over 22,817 direct contacts during 2013. More than 11,600 direct mail and telephone calls were made to assist the commercial ornamental horticulture industry. Best production and landscape management practices were taught at 684 group meetings and over 300 on-site visits.

**Results**

The total economic impact of Extension's commercial ornamental and landscape horticulture programming was estimated at \$474,150 in increased savings, increased income, and one-time capital purchases. Additional impacts included:

- ?370 professionals added additional services and/or marketing practices.
- ?218 professionals developed or made adjustment to their business plans.
- ?1150 professionals implemented recommended cultural practices: fertilization, soil sampling, propagation, irrigation, etc.
- ?788 professionals implemented recommended management practices for pest control.
- ?1140 professionals increased their knowledge of plant culture (e.g. fertilization, soil mixing and/or sampling, propagation, irrigation, transplanting and installation).
- ?1361 professionals increased their knowledge of plant pests and integrated pest management.
- ?1556 professionals increased their knowledge of proper plant selection.
- ?837 professionals practiced proper plant selection and installation practices.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems

#### **Outcome #4**

##### **1. Outcome Measures**

Turfgrass Weed Management Strategies

##### **2. Associated Institution Types**

- 1862 Extension

##### **3a. Outcome Type:**

Change in Condition Outcome Measure

##### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

###### **Issue (Who cares and Why)**

Turfgrass professionals and homeowners need effective and economical methods for controlling turfgrass weeds. The cost of controlling weeds in highly maintained turf was reported to be \$200 million in 1994, and increases at a rate of 2-5% annually.

###### **What has been done**

In 2013, UT Extension launched a mobile website to assist practitioners in selecting herbicides for use in turfgrass and ornamental areas, <http://mobileweedmanual.com>. The site was optimized for use on mobile devices such as smartphones and iPads. This site was reviewed by colleagues at peer-institutions, and it was used by over 12,000 individuals in 100 different countries, all 50 U.S. states, and 166 municipalities in Tennessee.

###### **Results**

UT Extension focused on effective, economical strategies for controlling weeds in various turfgrass areas. Our results indicated that proper turfgrass management practices translate to fewer applications of herbicides, which consequently produced substantial savings for turfgrass managers. We estimated that in 2013, \$10 million was saved from adoption of Extension turfgrass recommendations.

##### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
213	Weeds Affecting Plants



## **Outcome #5**

### **1. Outcome Measures**

Assessing and reintroducing *Pityopsis ruthii* (Trigiano, Wadl)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

*Pityopsis ruthii* (Ruth's golden aster) has a high potential to yield previously unknown genes or gene pathways and physiological changes associated with drought and flood tolerance because it has evolved tolerance to extreme environments, seemingly without significant modification of plant architecture, anatomy, or development. Plant breeders, geneticists, and researchers developing models for drought tolerance in agronomic crops will benefit from an additional robust genetic model for environmental tolerance in a small, flowering dicot.

#### **What has been done**

We now have the tools to assess genetic diversity of the endangered species, *Pityopsis ruthii*. Our clonal tissue culture production system may allow us to reintroduce the plant into native habitats and aid in the total recovery program for this species.

#### **Results**

We have identified several diseases found on *P. ruthii* that may impact the production of this plant as an ornamental. Also, we have identified several insects pest that occur on the plant. Both insect and diseases may impact *P. ruthii* as an ornamental plant and delay the formation of a new company designed to propagate and introduce new plants into the ornamental industry.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
211	Insects, Mites, and Other Arthropods Affecting Plants

**Outcome #6**

**1. Outcome Measures**

Brassica and Se effects on nutrition and cancer (Sams)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Nutrition plays a role in cancer growth.

**What has been done**

We demonstrated that foliar applications of Se can increase Se content in Brassica vegetables while still maintaining high levels of glucosinolates. We demonstrated that ITCs from Brassica decreased the growth of Human Colon Cancer cells in vitro and that Se also decreased the cancer cell growth.

**Results**

Brassica vegetables high in both Se and Glucosinolates will provide improved human nutrition benefits. We continue to investigate the potential synergistic impact of the two metabolites on cancer growth.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)

## **Outcome #7**

### **1. Outcome Measures**

Genetic 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**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

Demonstration of non-significant loss of genetic diversity of flowering dogwood in the eastern United States is important to selection/breeding of new dogwood cultivars for Tennessee nursery industry.

#### **What has been done**

The genetic diversity of flowering dogwood in the GSMNP is intact despite massive dieoffs due to dogwood anthracnose. Dogwoods in the park will not disappear as once thought. Accelerated breeding of flowering dogwood cultivars with improved disease resistance, heat or drought tolerance, and other aesthetically appealing ornamental traits can now be enhanced with EST-SSRs via transcriptomics.

#### **Results**

The new cultivars, especially 'Mountain Bouquet' represent something entirely new in *C. kousa* cultivars. The fused bracts of 'Mountain Bouquet' should make this tree an excellent seller in Japan and the upright forms of 'Empire' and 'Red Steeple' make them ideal for avenue plantings in Japan. We believe that these trees will be excellent products for TN grower and improve the nursery's financial position through greater sales.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

212 Pathogens and Nematodes Affecting Plants  
607 Consumer Economics

### **Outcome #8**

#### **1. Outcome Measures**

Downy mildew control (Lamour, Trigiano)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Action Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Downy mildew epidemics damage spinach.

##### **What has been done**

Population structure of two important downy mildew species can now be studied using Site-Specific Recombinase (SSR) technology. Information on the genetic structure of these populations is important for understanding the life history of the pathogens and developing control and management strategies for the diseases. For our downy mildew of spinach project our goal was development of novel molecular markers useful to track epidemics in space and time.

##### **Results**

We've identified thousands of new markers and are currently applying them to populations in Arizona where disease pressure is heavy.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)

205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

### **Outcome #9**

#### **1. Outcome Measures**

Fungal resistance in tomato (Bost)

#### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

#### **3a. Outcome Type:**

Change in Action Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Tomato crops are sprayed routinely to minimize damage from diseases, primarily early blight. The spray products used to control early blight had become ineffective, due to the development of resistance in the causal fungus.

##### **What has been done**

Research was conducted to identify effective alternative control products, and to design spray programs that accommodated these products.

##### **Results**

Those spray programs were then verified in a full-season field trial. Within a year of the recognition of the resistance problem, growers were notified of the new spray programs and the need to use them, beginning with the Fall 2013 crop.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
607	Consumer Economics

**Outcome #10**

**1. Outcome Measures**

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
2013	0

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

**Issue (Who cares and Why)**

Growers face both new and chronic pest and disease obstacles to production.

**What has been done**

We developed and refined Greenhouse production practices for several crops including strawberry, tomato, pepper, galea melon, and cucumber.

**Results**

We identified promising strawberry cultivars for fall and winter greenhouse production. We continued to demonstrate that Biologicals controls can be used to control mite, thrip, aphid and white fly populations. Greenhouse tomato yields have been increased to over 24 pounds per plant on a short harvest spring crop. This yield should prove to be commercially successful for growers interested in greenhouse vegetable production. We evaluated cultivars for quality and yield as a spring and fall crop. We assisted numerous growers with setting up greenhouse production systems based on our research results.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
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 #11**

### **1. Outcome Measures**

Late blight in tomato (Bost)

### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

Late blight is a disease of tomato that seldom occurs but can inflict ruin on a tomato crop.

#### **What has been done**

The sudden appearance of this disease in 2013 was met with an educational program of newsletter and newspaper articles. Gardeners and commercial growers were alerted to the presence of the disease and the threat it posed.

#### **Results**

Remedial treatments contributed to saving much of the \$50 million commercial crop and home garden tomatoes.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

## **Outcome #12**

### **1. Outcome Measures**

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**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

Development of genetic linkage maps for dogwood and redbud will lay a foundation for marker assisted selection for desirable traits.

#### **What has been done**

Clarification of the phylogentic relationships and development of marker systems for the aforementioned ornamentals will aid in breeding inter- and intra-specific hybrids. Additionally, proprietary materials may be identified and legally protected if necessary using unique DNA markers developed in our laboratory.

#### **Results**

Results of the redbud study support previously reported phylogenetic relationships of the North American and western Eurasian species and indicate suitability of these markers for mapping studies involving *C. canadensis* and *C. chinensis*. Results also support pedigrees from ornamental tree breeding programs for the widely cultivated *C. canadensis* and *C. chinensis* species, which are important ornamentals in the US and comprised the majority of the samples analyzed. We have been contacted by a number of large producers of redbud seeking information on the genetics of their redbuds and how to protect and enforce their plant patents.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources



204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

### **Outcome #13**

#### **1. Outcome Measures**

Mustard seed meal biofumigation of strawberries (Deyton, Sams)

#### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

#### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Need to increase yields of strawberries.

##### **What has been done**

Two research trials demonstrated that biofumigation with mustard meal in late summer before autumn planting of plasticulture strawberries can increase spring-time yields compared to untreated plots.

##### **Results**

The mustard meal treatment did not control weeds but apparently modified soilborne micro-organism populations. In a commercial planting, yields from mustard meal treated plots were the same as yields from conventionally fumigated (PicChlor60) plots. The mustard meal treatment may be especially beneficial for organic growers.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

- 212 Pathogens and Nematodes Affecting Plants
- 213 Weeds Affecting Plants
- 215 Biological Control of Pests Affecting Plants
- 216 Integrated Pest Management Systems

**Outcome #14**

**1. Outcome Measures**

Nursery participation in Ag Enhancement Program funding (Fulcher)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Tennessee nursery producers were not offered the same opportunity that producers of other agricultural products were to compete for Tennessee Ag Enhancement Program (TAEP) funding.

**What has been done**

I formed a committee that a) proposed to develop the Tennessee Master Nursery Producer program to the Tennessee Department of Agriculture as a qualifier for this funding, b) prepared a proposal for a Specialty Crops Block grant to fund the program, and c) used the grant funding to develop the course.

**Results**

In 2012, 45 people participated in this course. Graduates estimated saving an average of \$4,272 per grower for a total of \$192,240. In addition, course graduates enrolled in the TAEP qualified for 50% rather than 35% in cost share on their TAEP grant, saving an additional \$27,523.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
204	Plant Product Quality and Utility (Preharvest)

205 Plant Management Systems  
607 Consumer Economics

### **Outcome #15**

#### **1. Outcome Measures**

Off-target damage from pasture herbicides (Rhodes)

#### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

#### **3a. Outcome Type:**

Change in Action Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

##### **Issue (Who cares and Why)**

Most high-value crops in Tennessee, such as tobacco (\$3,500/A) and tomato (\$11,470/A) are very sensitive to most pasture herbicides, and off-target problems with these herbicides have been numerous over the past 40-plus years.

##### **What has been done**

The recent development of highly active, persistent pasture herbicides has increased the importance of this issue for Tennessee's agricultural economy. We are conducting a concentrated effort in herbicide stewardship.

##### **Results**

If successful in preventing the loss of 5 percent of the acreage of each crop, this will result in savings to Tennessee's agricultural economy of \$5.1 million.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
213	Weeds Affecting Plants

## **Outcome #16**

### **1. Outcome Measures**

Olive production in Tennessee? (Ownley)

### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

Growers interested in high value crops who have experience with fruit and tree crops, such as blueberries, but want to diversify their farming operations may want to consider olives.

#### **What has been done**

In the past 10 years, consumption of olive oil has tripled in the U.S due to its reported health benefits. U.S. consumption is now 10% of world production, while the U.S. only produces 1.3% of our olive oil consumption. Clearly there is room for growth of this commodity in the U.S.

#### **Results**

We have shown that cold hardy olive trees can be established (3-yr-period) in the climate of East Tennessee.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
607	Consumer Economics

**Outcome #17**

**1. Outcome Measures**

Organic initiative (Wszelaki)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

The five-year UT-TDA Organic Initiative was officially and successfully completed.

**Results**

In those five years, we conducted over 170 educational events reaching over 8,000 people. The OSCP website has reached over 43,000 clients since its inception in 2009, with nearly 25,000 clients in Tennessee. The number of certified organic operations in TN more than doubled since the start of the initiative in 2008. The UT Organic and Sustainable Crop Production Program was recognized as one of the Top 6 Land-grant University Organic Programs in the country.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants

216	Integrated Pest Management Systems
312	External Parasites and Pests of Animals

**Outcome #18**

**1. Outcome Measures**

Rose rosette virus (Windham)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Rose rosette is a virus disease that has destroyed hundreds of thousands of roses in the mid-south in the last 10 years. Since there are not management plans for this disease, rose rosette often destroys whole gardens or planting of roses once it is found in a garden.

**What has been done**

We have identified two management strategies that allow people growing roses to be able to manage this disease and save their plantings of roses.

**Results**

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

**Outcome #19**

**1. Outcome Measures**

Taro Leaf Blight pathogen (Lamour)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Our goal was a better understanding of diversity for the Taro Leaf Blight pathogen (*Phytophthora colocasiae*) across the Pacific region.

**What has been done**

We, unexpectedly, found a few clonal lineages were responsible for most of the epidemics in China, Vietnam and Hawaii.

**Results**

This is allowing taro breeders to focus their efforts on developing new lines of taro able to withstand attack of the most virulent lineages.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

**Outcome #20**

**1. Outcome Measures**

Better timing of pesticide applications (Klingeman)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Trap design and seasonal flight activity of economic pests can help us improve our pesticide applications.

**What has been done**

We continue to optimize traps and develop seasonal flight profiles of economically important nursery and landscape pests, including metallic wood boring beetle, clearwing moth, long-horned beetle, and ambrosia beetle species common across the eastern U.S.

**Results**

Collaborative research efforts remain focused on improving trap designs, kairomone attraction profiles and direct monitoring of walnut twig beetle seasonal flights.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems



**Outcome #21**

**1. Outcome Measures**

Using genetics against Phytophthora blight (Lamour)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Phytophthora (the plant-destroyer) is a plant-damaging water mold that causes enormous worldwide economic losses to crops.

**What has been done**

For our ongoing vegetable blight project we developed new markers and applied them to populations of *P. capsici* across all of China.

**Results**

This revealed that long-lived clonal lineages are responsible for much of the annual damage to pepper and providing crucial information to pepper breeders.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
212	Pathogens and Nematodes Affecting Plants

## **V(H). Planned Program (External Factors)**

### **External factors which affected outcomes**

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

### **Brief Explanation**

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

TSU Extension used a series of 12 outreach workshops to improve the cultural practices of small Fruits and Vegetables production program. As a result of the program growers begin to understand the importance and adoption of Good Agricultural Practices on their farms. Other evaluation results revealed that:

- 30% of 60 fruit and/or vegetable producers adopted a season extension practices includes row covers, high tunnels, greenhouses, and/or plastic mulches
- 40% of 60 fruit and/or vegetable producers adopted nutrient management program
- 50 % of 40 fruit and/or vegetable producers aware of food safety plan for their farm and begin to adopt in their farm
- 40 % of 25 fruit and/or vegetable producers adopted organic and/or sustainable production practices on their farm
- 60% of 30 growers interested in growing blueberries

### **Key Items of Evaluation**

**V(A). Planned Program (Summary)**

**Program # 13**

**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%	
	<b>Total</b>	100%	100%	0%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	19.0	2.0	0.0	0.0
Actual Paid Professional	17.0	2.4	0.0	0.0
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
304063	98238	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1393484	98238	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
185000	0	0	0

**V(D). Planned Program (Activity)**

1. Brief description of the Activity

The Human Development planned program involved professionals, parents, child care providers, older adults, and community leaders. Child care providers, adolescents, and parents who are divorced or

incarcerated, court-ordered parents and relatives as caregivers were all targeted for this program.

To help the target audience gain awareness, the following were used: 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 disseminated. Extension FCS 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. This course provided them with strategies for minimizing those effects.

TSU Extension also partners with child care providers to provide greater access to emergency preparedness tools, increase specific knowledge about emergency preparedness with regard to infants, and offer additional informational resources to help develop these plans to caretakers of infants.

For 2013 - 2017, TSU Extension Family and Community Health programs will place special emphasis on "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 21<sup>st</sup> Century). TSU Extension will produce and distribute resource materials and educational programs on a variety of topics for interested individuals, caregivers, and professionals. Various methods will be 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 is the only provider of this instruction.

**3. How was eXtension used?**

This Human Development planned program was enhanced through the service of five Tennessee Extension personnel on the "Family Caregiving" 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**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	66889	2507214	33761	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	2	0	1

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

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

Year	Actual
2013	131

**Output #2**

**Output Measure**

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

Year	Actual
2013	66212

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Parenting Skills for Incarcerated Inmates: Number of inmates who acquired knowledge about the importance of effective communication required to build parent/child relationships.
2	Parenting Skills for Incarcerated Inmates: Number of inmates who demonstrated their knowledge of positive parent/child relationships by writing to their child.
3	Child Care/Parenting: Number of parents and childcare providers who report using suggested guidance techniques more often.
4	Parenting Skills for Incarcerated Inmates: Number of inmates who now have an ongoing relationship with their children and demonstrate the need not to violate the law.
5	Child Care/Parenting: Number of parents and child care providers who report putting down or blaming their child less.
6	Child Care/Parenting: Number of parents and child care providers who report talking, singing and playing more with their children than before the program.
7	Divorcing Parents: Number of parents who plan to decrease exposure of their children to parental conflict.
8	Caregiving Education: Number of caregivers who report the Extension program helped them to minimize stress.

**Outcome #1**

**1. Outcome Measures**

Parenting Skills for Incarcerated Inmates: Number of inmates who acquired knowledge about the importance of effective communication required to build parent/child relationships.

**2. Associated Institution Types**

- 1890 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

{No Data Entered}

**What has been done**

{No Data Entered}

**Results**

{No Data Entered}

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
802	Human Development and Family Well-Being

**Outcome #2**

**1. Outcome Measures**

Parenting Skills for Incarcerated Inmates: Number of inmates who demonstrated their knowledge of positive parent/child relationships by writing to their child.

**2. Associated Institution Types**

- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**  
{No Data Entered}

**What has been done**  
{No Data Entered}

**Results**  
{No Data Entered}

**4. Associated Knowledge Areas**

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

**Outcome #3**

**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
------	--------



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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
802	Human Development and Family Well-Being

**Outcome #4**

**1. Outcome Measures**

Parenting Skills for Incarcerated Inmates: Number of inmates who now have an ongoing relationship with their children and demonstrate the need not to violate the law.

**2. Associated Institution Types**

- 1890 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

{No Data Entered}

**What has been done**

{No Data Entered}

**Results**

{No Data Entered}

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
802	Human Development and Family Well-Being

**Outcome #5**

**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**

<b>Year</b>	<b>Actual</b>
2013	908

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
802	Human Development and Family Well-Being

**Outcome #6**

**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**

<b>Year</b>	<b>Actual</b>
2013	32

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
802	Human Development and Family Well-Being

**Outcome #7**

**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**

<b>Year</b>	<b>Actual</b>
2013	1620

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
802	Human Development and Family Well-Being

**Outcome #8**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	1280

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

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
802	Human Development and Family Well-Being

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Government Regulations

**Brief Explanation**

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

UT Extension implemented a 21st Century Community Learning Center in five Tennessee counties. This program provides afterschool programming with a focus on homework, math, science, and nutrition. In Dickson County, 65 students showed increased school attendance, improved academic performance, increased reading, and increased academic scores in reading and math.

**Key Items of Evaluation**

UT Extension implemented a 21st Century Community Learning Center in five Tennessee counties. This program provides afterschool programming with a focus on homework, math, science, and nutrition. In Dickson County, 65 students showed increased school attendance, improved academic performance, increased reading, and increased academic scores in reading and math.

**V(A). Planned Program (Summary)**

**Program # 14**

**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
101	Appraisal of Soil Resources	0%	0%	4%	
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	7%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	14%	
202	Plant Genetic Resources	0%	0%	2%	
205	Plant Management Systems	0%	100%	11%	
206	Basic Plant Biology	0%	0%	6%	
212	Pathogens and Nematodes Affecting Plants	0%	0%	3%	
215	Biological Control of Pests Affecting Plants	0%	0%	2%	
402	Engineering Systems and Equipment	0%	0%	7%	
404	Instrumentation and Control Systems	0%	0%	7%	
501	New and Improved Food Processing Technologies	0%	0%	3%	
511	New and Improved Non-Food Products and Processes	0%	0%	27%	
512	Quality Maintenance in Storing and Marketing Non-Food Products	80%	0%	1%	
601	Economics of Agricultural Production and Farm Management	0%	0%	1%	
603	Market Economics	10%	0%	0%	
605	Natural Resource and Environmental Economics	10%	0%	0%	
607	Consumer Economics	0%	0%	1%	
608	Community Resource Planning and Development	0%	0%	2%	
610	Domestic Policy Analysis	0%	0%	2%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	0.5	84.0	0.0
Actual Paid Professional	5.0	0.6	66.0	0.0
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
80016	25852	649391	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
366706	25852	4839404	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	5291318	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

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 are identifying 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.

Extension agents and specialists in 4 counties as well as Tennessee State University and the Plant Sciences unit reported 470 contacts through 33 group meetings, 16 contacts through 2 on-site visits, 12 contacts from direct mail/telephone calls, and 2 contacts from client visits to the Extension office. In addition, there were 4 exhibits, 10 publications and one radio program that reached 45, 467, and 20,000 contacts, respectively.

**2. Brief description of the target audience**

This planned program was targeted to Tennessee farmers. Secondary audiences included consumers of both basic and applied research and the general public.

**3. How was eXtension used?**

The Sustainable Energy planned program was enhanced through the service of five Tennessee Extension professionals on the "Sustainable Ag Energy" 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**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	389	20512	111	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 7



**Patents listed**

1. Switchgrass promoter (PvUBI1) and uses thereof (Stewart, Mann)
2. Materials and methods for the production of biodiesel (Chen, Zhao)
3. Methods, systems and devices for simultaneous production of lactic acid and propylene glycol from glycerol (Ye, Liu)
4. Development of a renewable carbon-based bio-modifier for asphalt cement (Huang, Ye, Zhao, Shu)
5. Hydroxide Catalysts for Lignin Depolymerization (Chmely, & ??)
6. Antimicrobial and anti-inflammatory activity of switchgrass-derived extractives (Labbe, Ownley, Gwinn, Moustaid-Moussa, D'Souza)
7. Efficient cobalt-catalyzed oxidative degradation of lignin (Bozell, Biannic)

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	11	136	147

**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
2013	467

**Output #2**

**Output Measure**

- Identify the prevalence of foliar and root diseases of switchgrass in Tennessee and the major fungal pathogens associated with seed (Ownley).  
Not reporting on this Output for this Annual Report

**Output #3**

**Output Measure**

- Release improved high yielding synthetic and hybrid varieties of switchgrass. (Bhandari, Allen)  
Not reporting on this Output for this Annual Report

**Output #4**

**Output Measure**

- Agricultural mulches formed from biobased poly(lactic acid) and poly(hydroxy alkanoate) blends using Meltblown nonwovens textile technology provide good durability for a 1-3 season duration that is biodegradable under ambient soil environments (Hayes)

<b>Year</b>	<b>Actual</b>
2013	0

**Output #5**

**Output Measure**

- Purification of proteins from fermentation broths of agricultural feedstocks at >95% yield has occurred when employing a novel method based on extraction using 3-phase microemulsion systems and pH-degradable surfactants (Hayes)

<b>Year</b>	<b>Actual</b>
2013	0

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Majority of first-pass biomass size reduction done with knife grids or other technology more efficient than rotary (Womac).
2	In-field size reduction and/or compacting done on majority of cellulosic biomass harvested in Tennessee (Womac).
3	Number of growers producing switchgrass as an energy crop. (Jackson)
4	Number of acres of switchgrass grown in Tennessee as an energy crop. (Jackson)
5	Farmer-owned biomass cooperative to help capture economic advantage of bioenergy production (Tiller).
6	Evaluate precision-farming / variable-rate technology for switchgrass and other bioenergy crops (Tyler).
7	Mills using integrated process to produce bioenergy plus enhanced-strength OSB (Wang).
8	Switchgrass pathogens and diseases (Ownley, Zale, Gwinn, Windham)
9	Switchgrass rust control (Windham, Windham)
10	Switchgrass logistics and handling (Womac)
11	Biorefinery coproducts (Bozell)
12	Evaluating the economic impacts of a biorefinery (Larson)
13	Fuel crop effects on soil properties (English, Lee, Tyler)
14	Gene flow in switchgrass and papaya (Kwit)
15	'Green roof' research (Stewart)
16	Impact of cellulosic biofuel industry on the rural economy (Clark, Jensen, Lambert, Yu)
17	Insects to help with biofuel production (Jurat-Fuentes, Klingeman, Oppert)

18	Process analytics of bio-based products (Young)
19	Reduce cost of biomass delivered to biorefinery (English)
20	Switchgrass biomass yield improvement (Bhandari, Allen)
21	Switchgrass extractives as bioactive compounds (Canaday, Gwinn, Labbe, Ownley)
22	Switchgrass storage (English, Larson, Tyler, Yu)

### **Outcome #1**

#### **1. Outcome Measures**

Majority of first-pass biomass size reduction done with knife grids or other technology more efficient than rotary (Womac).

Not Reporting on this Outcome Measure

### **Outcome #2**

#### **1. Outcome Measures**

In-field size reduction and/or compacting done on majority of cellulosic biomass harvested in Tennessee (Womac).

Not Reporting on this Outcome Measure

### **Outcome #3**

#### **1. Outcome Measures**

Number of growers producing switchgrass as an energy crop. (Jackson)

Not Reporting on this Outcome Measure

### **Outcome #4**

#### **1. Outcome Measures**

Number of acres of switchgrass grown in Tennessee as an energy crop. (Jackson)

Not Reporting on this Outcome Measure

**Outcome #5**

**1. Outcome Measures**

Farmer-owned biomass cooperative to help capture economic advantage of bioenergy production (Tiller).

Not Reporting on this Outcome Measure

**Outcome #6**

**1. Outcome Measures**

Evaluate precision-farming / variable-rate technology for switchgrass and other bioenergy crops (Tyler).

Not Reporting on this Outcome Measure

**Outcome #7**

**1. Outcome Measures**

Mills using integrated process to produce bioenergy plus enhanced-strength OSB (Wang).

Not Reporting on this Outcome Measure

**Outcome #8**

**1. Outcome Measures**

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
2013	0

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

**Issue (Who cares and Why)**

Identification of switchgrass diseases will enable development of management guidelines to reduce poor stand establishment, to maximize yields for biofuel production, and to reduce negative impacts of fungal pathogens and their toxic metabolites on the biofuel conversion process.

**What has been done**

We have identified several fungal plant pathogens that can cause significant disease and biomass yield loss in switchgrass.

**Results**

Most of these pathogens are seedborne, which has led to recommendations for certified seed and seed treatments.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants

**Outcome #9**

**1. Outcome Measures**

Switchgrass rust control (Windham, Windham)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Switchgrass rust is one of the most common diseases of switchgrass in fields around Vonore, TN. Switchgrass rust, *Puccinia emaculata*, reduces growth and biomass of switchgrass in ornamental and agronomic plantings in Tennessee and these epidemics are fueled by asexual spores,

urediospores.

**What has been done**

A plant has been identified that has superior resistant to ornamental and agronomic strains of rust.

**Results**

Tests are underway to determine the ornamental qualities of this selection and if the plant can be used as a new variety of switchgrass for agronomic (biofuel) uses.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
212	Pathogens and Nematodes Affecting Plants

**Outcome #10**

**1. Outcome Measures**

Switchgrass logistics and handling (Womac)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

As a low-density feedstock, switchgrass size reduction, compaction, and transport are crucial for it to become a successful fuel crop.

**What has been done**

In order to measure and document improvements, the bulk-format system from field-to-biorefinery was conceived and implemented through a competitive \$5M DOE high tonnage logistics grant in cooperation with Genera Energy. GPS tracking of all mobile equipment (5 tractors and 2 semi trucks) was developed in order to identify limiting factors, field efficiency, equipment utilization, and other indicators of productivity. We oversaw statistical experiments designed to determine

capacity and throughput for bulk handling, reclaim, conveyance, and compaction systems.

### Results

Data are currently being analyzed for energy use (kWh/DryMg) for reclaim, meter, convey, dust collection, and compaction operations to compare differences due to particle sizes from forage harvester, coarse tub grind, and fine tub grind. These data sets are unique to the biomass industry and are needed by decision makers to determine optimum feedstock supply systems.

## 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
608	Community Resource Planning and Development

### Outcome #11

#### 1. Outcome Measures

Biorefinery coproducts (Bozell)

#### 2. Associated Institution Types

- 1862 Research

#### 3a. Outcome Type:

Change in Knowledge Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2013	0

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

##### Issue (Who cares and Why)

To be competitive, fuel crops must produce coproducts analogous to those in the petrochemical industry.

##### What has been done

(1) Lignin is 25% of terrestrial biomass and a key source of renewable carbon, but its structural complexity prevents easy incorporation as a starting material for chemicals or fuels. (2) In contrast the structure of carbohydrates is regular and understood. However, they possess many sites of



very similar reactivity, making it difficult to develop selective conversion processes. (3) The petrochemical industry achieves significant control over their conversion processes because they understand these systems at the molecular level.

**Results**

Our work (1) is developing selective chemical and biocatalytic systems able to handle this heterogeneity, and has focused on lignin isolation and conversion. (2) exploits catalytic systems able to achieve high selectivity in the presence of functional groups of similar reactivity. (3) pursues analogous control for renewable carbon sources, which provides the ability to tailor processes for eventual end users.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management

**Outcome #12**

**1. Outcome Measures**

Evaluating the economic impacts of a biorefinery (Larson)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

Evaluating the economic impacts of a potential biorefinery is a key step in the assessment of the economic, environmental, and social impacts of LCB-based biofuels production on a rural community.

**What has been done**

A spatially-oriented, mixed integer mathematical programming model was used to evaluate the economic impact of a biorefinery for alternative harvest and storage systems for a 13-county region in East Tennessee.

**Results**

Results indicated that additional jobs were created in the region. An estimated 1,025 to 1,096 jobs (many are seasonal) were added in agricultural activities. In addition, operation of the biorefinery was expected to increase 60 jobs directly, 324 jobs indirectly, while another 148 were through increased household expenditures.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development

#### Outcome #13

##### 1. Outcome Measures

Fuel crop effects on soil properties (English, Lee, Tyler)

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

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

###### Issue (Who cares and Why)

How does switchgrass change soil properties?

###### What has been done

One additional year of soil temperature and moisture data were collected. Fuel crop effects on soil: this five-year project is completed.

###### Results

There was an increase in SOC (especially in deeper soil profile) of roughly 1 Mg ha<sup>-1</sup> from 2008 to 2011. The data still support our previous findings: a significant influence on CO<sub>2</sub> flux. The summer months exhibited the highest flux rate followed by spring, fall, and finally winter. Many of the agricultural characteristics of the seven bordering states are represented in Tennessee such as cropping systems, soil type, weather, and farm type and size. Thus, our results found in

Tennessee will be applicable in neighboring states as well.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

**Outcome #14**

**1. Outcome Measures**

Gene flow in switchgrass and papaya (Kwit)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

The molecular documentation of contemporary gene flow is of interest to the conservation biology community, as well as regulators who enforce and set standards for transgene biocontainment.

**What has been done**

In this area, I assisted colleagues by overseeing work on pollen flow and diagnostic SNP identification in agronomic switchgrass cultivars, as well as methodological refinement for transgene detection in non-transgenic papaya fruits.

**Results**

The former work will provide the foundation for pollen flow and hybridization potential of switchgrass as a biofuel crop.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
205	Plant Management Systems

**Outcome #15**

**1. Outcome Measures**

'Green roof' research (Stewart)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

**What has been done**

The Low Impact Development Demonstration Area (LIDDA) is a living laboratory, community outreach and outdoor recreational space for visitors, faculty and students.

**Results**

The installed rain garden and hardscapes have already begun to teach our students the practical application of their studio design courses. Undergraduate students continue to use the LIDDA as a hands-on construction learning area as they design and install various construction components. The LIDDA aids homeowners in incorporating sustainable practices in residential applications. It also serves as the home for UT's first green roof.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
404	Instrumentation and Control Systems
608	Community Resource Planning and Development

## **Outcome #16**

### **1. Outcome Measures**

Impact of cellulosic biofuel industry on the rural economy (Clark, Jensen, Lambert, Yu)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

The impact of cellulosic biofuel industry on the rural economy is an important question to policy makers of regional development.

#### **What has been done**

We applied a GIS model and an input-output framework to determine the potential location of the biofuel industry and its economic impact.

#### **Results**

The total economic impact of a 11 mgy cellulosic biofuel industry is considerably less than 1% for changes in employment. If a 11 mgy target is achieved, the change in total value added to the Southeastern region economy is 0.75%. While the relative impacts to the entire economy are modest, over the medium to long run, the cumulative impact of these gains may be substantial.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis

**Outcome #17**

**1. Outcome Measures**

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
2013	0

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

**Issue (Who cares and Why)**

Better approaches are needed to metabolize cellulose and lignin for biofuel production from woody materials. Currently used endoglucanases for saccharification of plant biomass in ethanol production have limitations of stability and activity under stringent environments.

**What has been done**

Insect cellulases work under very stringent environments in the insect gut. We have identified a group of insects with very high cellulolytic activity and performed sequencing of expressed genes to identify highly active enzymes that can be used in efficient degradation of plant biomass.

**Results**

These enzymes have applications for increasing biofuel production efficiency.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

**Outcome #18**

**1. Outcome Measures**

Process analytics of bio-based products (Young)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Wood product producers need to minimize costs and improve quality.

**What has been done**

The new and emerging biofuels industry could directly benefit from optimization of throughput and improved quality of bioenergy and biofuels from use of a statistical software system that predicts real-time strength properties of manufactured materials.

**Results**

The corporate training seminars in statistical process control and advanced data mining have documented direct financial benefits to the participating companies ranging from approximately \$20,000 to \$300,000 per year.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
404	Instrumentation and Control Systems
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics

**Outcome #19**

**1. Outcome Measures**

Reduce cost of biomass delivered to biorefinery (English)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

**Issue (Who cares and Why)**

A lack of knowledge about biomass feedstocks as well as advanced biomass technologies leads to lack of willingness to invest in those technologies and in new crops.

**What has been done**

A Full Systems Analysis of feedstock production to end-use helps both technology developers and investors identify viable applications of biomass for fuels, power, or products. I have examined the costs of harvest, storage, and transportation of switchgrass.

**Results**

Our estimates are that a chop, transport, densify, and store system will significantly reduce costs. We are currently evaluating the chemical composition of samples of biomass that we took during storage.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development



**Outcome #20**

**1. Outcome Measures**

Switchgrass biomass yield improvement (Bhandari, Allen)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

Development of improved high biomass yielding switchgrass cultivars for use in bioenergy feedstock.

**What has been done**

The research focuses on enhancing feedstock biomass yield of lowland switchgrass cultivar in Tennessee and the other areas in south eastern regions of USA.

**Results**

Biomass yield improvement is a primary emphasis of switchgrass cultivar development, which can be achieved by accumulation of additive genes, and/or exploitation of heterosis. The past two years' work has been significant in establishing a strong breeding program in switchgrass. Several plants selected after two years of field evaluation will be directly used in the production of cycle-1 improved experimental varieties. The seed will be available for testing, and superior varieties will be eventually release to growers. Establishment is a major hurdle in switchgrass production, which could be attributable to seed dormancy and small seed size. One cycle of selection for high germination and high seed density from Alamo and Kanlow population is completed, and experimental varieties were produced by intercrossing selected genotypes. Seed is available for field testing in 2014.

**4. Associated Knowledge Areas**

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

## **Outcome #21**

### **1. Outcome Measures**

Switchgrass extractives as bioactive compounds (Canaday, Gwinn, Labbe, Ownley)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

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

#### **Issue (Who cares and Why)**

While the carbohydrate content of switchgrass averages 60-65%, about 10-15% of the dry weight biomass is composed of non-structural compounds (i.e. extractives). This significant fraction contains and/or generates during lignocellulosic biomass pretreatment chemicals that inhibit enzymes and yeasts involved in saccharification and fermentation.

#### **What has been done**

We have demonstrated that the extractives contain bioactive components that can be used to protect plants against pathogens as well as modulate immune and inflammatory responses in humans.

#### **Results**

Utilizing the extractives portion of switchgrass as a biopesticide and as an anti-inflammatory would add value to this biomass fraction and offer significant opportunities for increasing the sustainability of agriculture.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
215	Biological Control of Pests Affecting Plants
605	Natural Resource and Environmental Economics

**Outcome #22**

**1. Outcome Measures**

Switchgrass storage (English, Larson, Tyler, Yu)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

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

**Issue (Who cares and Why)**

The quality of biomass feedstock is crucial to the feasibility of bioenergy industry.

**What has been done**

We continued research to evaluate the effects of alternative outdoor storage methods on the composition of switchgrass that potentially influence biofuel yields. Data from a bale storage experiment at Vonore, TN were used for the study. Switchgrass was sampled for dry matter before baling with the BaleTech III on each harvest date and then at regular intervals to evaluate changes in composition.

**Results**

Preprocessed switchgrass stored using the BaleTech III system had lower cellulose and higher lignin and ash content than large agricultural round bales. Our findings suggest that sugars available for conversion to ethanol may be lower in switchgrass processed using the BaleTech III system. The outgoing plant-gate break-even prices of ethanol was estimated to be higher with the bale Tech III preprocessing system than with an agricultural round bale system to harvest and store switchgrass.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
512	Quality Maintenance in Storing and Marketing Non-Food Products

## **V(H). Planned Program (External Factors)**

### **External factors which affected outcomes**

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

### **Brief Explanation**

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

An Extension biofuels program was conducted by UT and TSU Extension in five counties with these evaluation results:

- 154 producers gained the knowledge necessary to determine whether they could profitably produce a dedicated energy crop for either on-farm production of renewable energy or for sale to a bio-refinery or other energy producer.
- 154 producers learned about different types of renewable energy options and what renewable energy systems would be technically and economically feasible to operate at the farm level.
- 55 producers learned about the four steps in the process for converting biomass into cellulosic ethanol: preprocessing, pretreatment, hydrolysis, and fermentation and distillation.

### **Key Items of Evaluation**

An Extension biofuels program was conducted by UT and TSU Extension in five counties with these evaluation results:

- 154 producers gained the knowledge necessary to determine whether they could profitably produce a dedicated energy crop for either on-farm production of renewable energy or for sale to a bio-refinery or other energy producer.
- 154 producers learned about different types of renewable energy options and what renewable energy systems would be technically and economically feasible to operate at the farm level.
- 55 producers learned about the four steps in the process for converting biomass into cellulosic ethanol: preprocessing, pretreatment, hydrolysis, and fermentation and

2013 University of Tennessee Research and Extension and Tennessee State University Extension Combined Annual Report of Accomplishments and Results  
distillation.

**V(A). Planned Program (Summary)**

**Program # 15**

**1. Name of the Planned Program**

Climate Change

Reporting on this Program

Reason for not reporting

Activities for this planned program have been reassigned, with most being reported in the Sustainable Energy planned 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
132	Weather and Climate	0%	100%	0%	
	<b>Total</b>	0%	100%	0%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	0.0
Actual Paid Professional	0.0	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	0
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

No active program.

**2. Brief description of the target audience**

No active program.

**3. How was eXtension used?**

{No Data Entered}

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

**Patent Applications Submitted**

Year: 2013

Actual: {No Data Entered}

**Patents listed**

{No Data Entered}

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

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	0	0	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- {No Data Entered}

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**



**Outcome #1**

**1. Outcome Measures**

{No Data Entered}

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

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

**Brief Explanation**

{No Data Entered}

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}