2014 Tennessee State University Research Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 05/29/2015

I. Report Overview

1. Executive Summary

This report consists of the FY 2014 research results and accomplishments of the Tennessee State University College of Agriculture, Human and Natural Sciences. In the attached report, you will see that agricultural research at TSU is closely aligned with priority research areas emphasized by NIFA, and that productive research is being conducted in areas of state, national and global concern. In a continuation our recent expansion efforts, this past year we have again enhanced our research capacity through new construction and hiring of a number of new faculty. A new 30,000 sq. ft. agricultural biotechnology building has been completed using NIFA funding and new faculty in the areas of organic production, plant genetics, food safety, and climate studies have been added.
We have a talented faculty who have dedicated themselves to improving the lives of others.
Examples of research accomplishments include:

- New research has led to altered breed selection in meat goat production programs. Research has also triggered a reassessment of long-held beliefs regarding breed selection for carcass traits among researchers and producers.
- New feeding regimes have been developed to optimize growth of alternative poultry species for limited resource producers.
- Research on site-specific fertilizer recommendations produced increased production rates by small fruit producers.
- Economic analysis shed new insight on the connection between high obesity rates, low consumption of fruits and vegetables, and clusters of food deserts in many states in the South.
- Research identified new population groups most at-risk groups for increased obesity.
- New molecular tools have been developed for fighting soft rot, a common disease of fruits and vegetables.
- Our research and outreach programs increased the number of landowners that are more likely to produce biodiesel and create biodiesel production cooperatives
- Nursery producers are saving and estimated $6,812 due to knowledge gained and practices changed.
- Research resulted in new management strategies for commercial nursery insects to reduce labor and chemical costs with fewer environmental impacts.
- Research led to significant improvement in food storage practices, promoting a healthier population with less food-borne illness.

The review of our Annual Report last year cited a concern about the level of quantitative data in the Evaluation Results sections of the planned programs. Efforts have been made to improve in this area and steps have been initiated to integrate more quantitative data in the report. We have also made efforts to add output measures to better demonstrate the level of research. Emphasis continues to be placed on capturing the ultimate impact of our research using the logic model format.
During the past seven years, the College of Agriculture, Human and Natural Sciences at TSU has experienced transformational change, however the goal of agriculture research at TSU remains the same: to generate and communicate new knowledge in the agricultural and environmental sciences for the prosperity of the citizens of Tennessee, the nation and the world. We employ a dedicated faculty and staff who have received their education and training from many of the best institutions and training centers in the United States and several countries around the world. This group of individuals takes pride in

partnering with NIFA to advance agricultural and environmental research at Tennessee State University and make a positive difference in our society. The research detailed in this report illustrates our commitment to educating our students, serving our stakeholders and improving the lives of the world's citizens.
Due to the merging of the land-grant reporting from Tennessee, this will be the last stand-alone Annual Report on research from Tennessee State University. Beginning with the next reporting period, Tennessee State University will partner with the University of Tennessee to submit a single combined Annual Report of research and extension from the State of Tennessee.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	63.0
Actual	0.0	0.0	0.0	67.0

II. Merit Review Process

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

- Internal University Panel
- Expert Peer Review

2. Brief Explanation

Our program review system remains the same has it has in previous years. Each Planned Program in this Annual Report was approved by an internal review panel; some programs had the benefit of an additional review by an external panel. These panels are composed of agricultural researchers and administrators in the 1890 University system. Faculty proposals for Planned Programs are evaluated for relevance, scientific soundness, and appropriateness of planned outcomes. Only those proposed programs that successfully meet all criteria are developed into executable Planned Programs. A number of strategies have been developed to ensure that approved programs are successful, meeting goals and remaining relevant: (1) prior to the initiation of research projects/programs, researchers initiate contact with appropriate stakeholders, i.e. government agencies, community groups/representatives, professional organizations, extension personnel, or industry groups, to identify and prioritize critical needs; (2) periodically during research projects, researchers initiate contact with appropriate stakeholders to evaluate the degree of program/project success; (3) an administrator within the College of Agriculture, Human and Natural Sciences meets with every project leader semiannually to monitor the progress of the planned programs; (4) if the program is not progressing as planned, appropriate remedial steps are initiated. We feel these procedures contribute significantly to ensuring the Planned Programs are executed completely and with maximum benefit to stakeholders.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals

Brief explanation.

We continue to utilize an increased level of stakeholder input in our hiring processes, and have included with stakeholder participation in the selection of new faculty.
For the research activities conducted in the planned programs, community groups, industry associations or individual stakeholders are contacted and solicited for participation. For example, our research programs relating to forestry work closely with the Nashville Metro Tree Advisory Council, the Forestry Division of the Tennessee Department of Agriculture, and with the Tennessee Urban Forestry Council; those programs examining new sources of feed stock for biofuels utilize the expertise and stakeholder evaluation available in our state Plant Material Advisory Committee and Plant Materials Committee; our environmental programs maintain a close relationship with the Cumberland River Compact, a non-profit organization concerned with the health and wellbeing of the Cumberland Watershed that encompasses much of Middle Tennessee. In projects that have clientele who are low income and have young children, agencies such as Head Start, Habitat for Humanity, and Good Food for Good People are involved. For programs where needs were more commodity-based, trade organizations (i.e. Tennessee Organic Growers Association, Tennessee Nursery and Landscape Association, Professional Grounds Maintenance Association, Tennessee Goat Producers Association, Southern Nursery Association, Guinea Fowl Breeders Association) are routinely utilized for input and direction. In other cases, individuals are contacted and participation is requested. For much of the research in the area of nursery plants, surveys of nursery producers were performed and periodic meetings were held with a Nursery Advisory Group that is maintained by the University.
A number of different programs maintain an active presence on social media (Facebook, Twitter) and utilize feedback gained from those sources.

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

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Needs Assessments
- Use Surveys
- Other (See explanation below.)

Brief explanation.

Our methods to identify appropriate stakeholders are consistent with those used in previous years. We do not employ a single defined strategy to identify stakeholders, rather they are identified through methods most suitable for a specific program. Our goal is to identify stakeholders in a manner that will provide the most useful and accurate feedback possible about stakeholder

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

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

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals

Brief explanation.

Most stakeholder input is collected in either face-to-face discussions or via survey instruments. Each of these methods are effective. The face-to-face discussions are often held with community group representatives or trade association representatives, or with individual stakeholders in a group setting, this allows for questions and answers to direct and stimulate discussion of areas of importance to stakeholders. Survey instruments are a useful tool to assess information from broader groups of stakeholders. While some stakeholders prefer the anonymity and brevity of a survey instrument (often resulting in increased participation), a survey instrument does not always allow for discussion of previously unrecognized areas of concern.
Recently, the use of social media has increased. Feedback gained from Facebook and Twitter has been used to collect information on stakeholder needs and concerns.
In addition, audience response 'clickers' and associated software have been purchased and made available to our faculty, permitting them to incorporate opportunities for real-time feedback during group presentations or engagements.

3. A statement of how the input will be considered

- To Identify Emerging Issues
- Redirect Research Programs
- To Set Priorities

Brief explanation.

As previously stated, we have increased the use of stakeholder representatives in our hiring processes. Insights provided by these individuals place emphasis on the communication skills and knowledge of current discipline needs/trends rather than the traditional items such publication and grant history/potential. New faculty hired in these positions reflect these qualities.
An example of stakeholder feedback is in our nursery research programs. In our quest to increase the efficacy of insecticide treatments for the federal fire ant quarantine, a treatment was developed that involved applying a reduced amount of insecticide to two sides of a root ball. Stakeholder feedback clearly demonstrated the savings in insecticide costs was not as important to the stakeholders as the management needed to rotate the rootball, and an alternative treatment that did not necessitate rootball manipulation was developed. In our biofuels program, stakeholder feedback demonstrated the need for the development of more advanced methods of enhancing switchgrass production. That program is now addressing this issue. Also, as in most recent years, a concern of stakeholders, regardless of area of research, is in the areas of economics and health. Examples of concerns are curtailing expenses, increasing efficiency, finding new markets and, finally, staying in

business. Much of our research, regardless of topic or emphasis, addresses these economic themes.

Brief Explanation of what you learned from your Stakeholders

As in most recent years, a concern of stakeholders, regardless of area of research, is in the areas of economics and health. Examples of concerns are curtailing expenses, increasing efficiency, finding new markets and, finally, strategies to simply stay in business. Much of our research, regardless of topic or emphasis, addresses these economic themes.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	0	3384226

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	0	3384226
Actual Matching	0	0	0	3384226
Actual All Other	0	0	0	0
Total Actual Expended	0	0	0	6768452

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger - improving animal production for small producers

☑ 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				20%
302	Nutrient Utilization in Animals				20%
303	Genetic Improvement of Animals				10%
307	Animal Management Systems				10%
601	Economics of Agricultural Production and Farm Management				20%
604	Marketing and Distribution Practices				20%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	8.5
Actual Paid	0.0	0.0	0.0	13.4
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	676845
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	676845
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

Conduct seminars, conferences, hands-on clinics, provide written and hands-on training to producers, participate in industry events and develop industry-targeted publications based on research findings.
Conduct research on the longitudinal survival and reproductive output of meat goat does.
Conduct research on nutritional requirements for Guinea fowl.
Perform genome mapping of important production qualities in Guinea fowl.
Conduct literature review of available secondary information.
Conduct focus group meetings to collect information from producers and consumers.
Develop and administer surveys to selected producers and consumers.
Collect and analyze available marketing data.
Identify selected meat goat consumers/ethnic groups/communities.

2. Brief description of the target audience

Dairy and meat goat producers
National meat goat industry
Institutions of meat goat research
Ruminant livestock producers
Students
Public officials
Guinea fowl and poultry industries
Small farmers
Scientific community
Extension specialists

3. How was eXtension used?

Two webinars were conducted.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	985	1200	500	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	5	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Producer workshops to improve animal production in small farm and limited resource populations.

Year	Actual
2014	17

Output #2

Output Measure

- Dietary recommendations for improved Guinea fowl production.

Year	Actual
2014	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Direct contact meat goat producers will have increased knowledge of altered doe selection techniques (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).
2	Direct contact meat goat producers will practice altered doe selection techniques (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).
3	Goat producer doe non-recorders will have knowledge of the advantages of doe record keeping (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).
4	Goat producer doe non-recorders will practice doe record keeping (More sustainable, diverse, and resilient food systems across scales).
5	Guinea fowl producers will have knowledge of calcium and phosphorus recommendations for optimal nutrition (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).
6	Guinea fowl producers will adopt calcium and phosphorus recommendations for optimal nutrition (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).
7	Guinea fowl producers will adopt lysine recommendations for optimal nutrition (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).
8	Guinea fowl producers will have knowledge of lysine recommendations for optimal nutrition.
9	Guinea fowl producers will experience increased profitability of production (More sustainable, diverse, and resilient food systems across scales).
10	Goat producers will have an increased knowledge of meat goat marketing channels.
11	Goat researchers will have an increased understanding of the constraints and prospects of the meat goat industry.
12	Goat producers will expand their marketing to identified channels and markets.
13	Consumers will be aware of the healthy benefits of goat meat consumption.
14	Meat goat producers will be aware of consumer preferences for meat goat products.
15	Percentage of meat goat producers and researchers with a better understanding of how maternal genetics can affect meat goat carcass yield (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).
16	Meat goat producers will have increased income by marketing through new channels (More sustainable, diverse, and resilient food systems across scales).

Outcome #1

1. Outcome Measures

Direct contact meat goat producers will have increased knowledge of altered doe selection techniques (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	400

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers need to better assess the ability of breeds to contribute to an efficient production of market kids under limited inputs.

What has been done
A set of presentations and research updates were developed and distributed.

Results
Because of research outcomes, 400 commercial producers gained a better understanding of the benefits and techniques to evaluate breeds for use in commercial meat goat herds.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Direct contact meat goat producers will practice altered doe selection techniques (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Meat goat producers need to better assess the ability of breeds to contribute to an efficient production of market kids under limited inputs.

What has been done
A set of presentations and research updates were developed and distributed to various producer groups.

Results
Based on our research findings, an increasing number of experienced and new producers are altering their breed selection to establish or improve their meat goat breeding programs. It is estimated that 50% have modified their approach to breed selection.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Goat producer doe non-recorders will have knowledge of the advantages of doe record keeping (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Meat goat managers raising seedstock recognize the need to properly select breeding females within breeding herds for enhanced fitness.

What has been done
A system of doe herd evaluation has been offered to record and select breeding stock based on objective performance measurements. A new web-based meat goat genetic evaluation system has been established.

Results
As demonstrated by our research findings, producers have begun to reconsider the need to record performance to improve the genetic and economic status of their meat goat breeding programs.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Goat producer doe non-recorders will practice doe record keeping (More sustainable, diverse, and resilient food systems across scales).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Meat goat managers raising seedstock recognize the need to properly select breeding females within breeding herds for enhanced fitness.

What has been done
A system of doe herd evaluation has been offered to record and select breeding stock based on objective performance measurements.

Results
Implementation of performance recording within purebred meat goat herds has occurred on a limited basis (about 30%).

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Guinea fowl producers will have knowledge of calcium and phosphorus recommendations for optimal nutrition (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
While the guinea fowl industry is growing in the United States, there are constraints in developing a thriving and sustainable industry because of lack of established nutrient requirements to guide the formulation of least-cost rations. Information on the required dietary levels of calcium, phosphorus and lysine, a limiting amino acid that would ensure optimum performance of these birds, is limited.

What has been done
Dietary calcium (Ca) and phosphorus requirement for optimum growth performance of the Pearl Grey guinea fowl replacement pullets and laying hens were evaluated.
Dietary Lysine requirement for both the French and Pearl grey varieties of the Guinea Fowl were evaluated.

Results
Pearl Grey guinea fowl replacement seems to utilize more efficiently diets containing 0.8% Ca and 0.32-0.48% available phosphorus. Pearl Grey Guinea Fowl laying hens utilized more efficiently diets containing 3.25 to 3.75% calcium and 0.35 to 0.40% available phosphorus. Number of producers with knowledge of these values has not yet been calculated.
The French guinea fowl broilers be fed diets containing 1.10 % lysine during the exponential growth phase seems to provide optimum growth performance. Findings from this research also suggest that Pearl grey guinea fowl replacement pullets (females) and males be fed diets containing 1.16% and 0.98-1.22% lysine, respectively.
Results have not been publicized yet, making the outcome count zero.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #6

1. Outcome Measures

Guinea fowl producers will adopt calcium and phosphorus recommendations for optimal nutrition (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The costs associated with the production of guinea fowl need to minimized for producers to realize maximum profit as this species becomes more accepted in American diets.

What has been done
Data on calcium, phosphorus and lysine requirements of the pearl grey guinea fowl replacement pullets and laying hens were shared with the scientific community at the International Poultry Scientific Forum and also the annual Poultry Association Conference, and the guinea fowl industry.

Results
Assessment of number of number of producers who have adopted the recommendations has not been completed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #7

1. Outcome Measures

Guinea fowl producers will adopt lysine recommendations for optimal nutrition (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Lysine is an essential amino acid in poultry and lack thereof in diets of the guinea fowl will compromise optimum growth and production performance. Currently the lysine requirements of the guinea fowl are not known.

What has been done
The lysine requirement of both the French and Pearl grey guinea fowl broiler were evaluated.

Results
Feeding the French Guinea fowl broilers diets containing 1.10% lysine during the exponential growth phase seems to be more economical and optimal. There were no significant differences (P>0.05) in body weight gain, feed consumption, feed conversion and carcass components of birds fed the 1.10, 1.16 and 1.22% lysine diets. Female Pearl grey guinea fowl responded better to diets containing 1.16% lysine from hatch to 16 WOA, whereas males responded better to diets containing 0.98-1.22% lysine. Therefore, we recommend that Pearl grey guinea fowl replacement pullets (females) and males be fed diets containing 1.16% and 0.98-1.22% lysine, respectively. Data on number of growers adopting the recommendations is not yet available.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #8

1. Outcome Measures

Guinea fowl producers will have knowledge of lysine recommendations for optimal nutrition.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The costs associated with the production of Guinea fowl need to minimized for producers to realize maximum profit as this species becomes more accepted in American diets.

What has been done
Research to determine the optimum levels of lysine is complete and the information being disseminated to stake holders.

Results
Optimum levels are being communicated to producers, thus no opportunity for producer knowledge/adoption of optimized levels yet.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #9

1. Outcome Measures

Guinea fowl producers will experience increased profitability of production (More sustainable, diverse, and resilient food systems across scales).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Feeding constitutes more than 65% of the total cost of poultry production. Minimizing this cost by establishing the lysine requirement will minimize this cost and encourage participation in guinea fowl production.

What has been done
Research to determine the optimum levels of lysine has been completed and recommendations being disseminated to stakeholders for adoption.

Results
No results to report as yet.

A note about all of the five Guinea fowl research outcomes: the PI for this research has recently been assigned a substantial administrative role in the department, and his research responsibility has been reduced, leading to a lower level of research completion than previously planned.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #10

1. Outcome Measures

Goat producers will have an increased knowledge of meat goat marketing channels.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	431

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Goat producers need to know what consumers are looking for in their goat meat and goat products. Consumers are looking for information on alternative to red meets to meet nutritional and cultural needs with goat meat. Processors want connection with producers and consumers to maximize the use of facilities. Researchers seek opportunities to gain new knowledge about meat goat and goat meat. Students desire to learn about goat meat marketing research, how to conduct survey, and analyze data. Goats are important in the economy of Tennessee and relatively little is known about this industry.

What has been done
Project continued mentoring, training and supervising 10 students (7 graduate students and 3 undergraduate students) in conducting research and marketing. These students were involved with literature review, survey design, data collection, data coding, data entry and analysis using IBM SPSS statistics, Microsoft office and the internet. Project team collaborated in designing and implementing educational activities for the target audiences (meat goat producers, consumers, researchers, students and stakeholders). Education and outreach included: local seminars and symposiums for students and researchers; producer related expos, field days and tours or outreach.
Team conducted research, training and education that enhanced producer skills and understanding of issues in marketing goat meat channels, processing capacity, and industry complexity in Tennessee.

Results
An analysis of recent survey (2014) found few custom slaughtered facilities sparingly located were insufficient to support local meat goat production and demand in Tennessee.
However these facilities were certified, in good sanitary condition and have the capacity to

process goat meat. Furthermore, results also showed that it cost less to process large volume of animals at reduced cost, saving both the consumer money in per unit cost and producer in transportation, maximizes facility efficiency for processor. These findings support the theory that facility size plays an important role in processing larger volumes with efficiency, lowering the average fixed costs per animal.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
604	Marketing and Distribution Practices

Outcome #11

1. Outcome Measures

Goat researchers will have an increased understanding of the constraints and prospects of the meat goat industry.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	240

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Researchers, students, producers, consumers and stakeholders interested in addressing marketing issues in marketing, assisting producers and consumer enhance their incomes by meeting the demand for goat meat.

What has been done
Assisted target audiences with research, training, seminars and symposium, education to increase their skills, knowledge, awareness and interest in issues consuming goat meat and exploring opportunities to increase their incomes.

Results
Goat producers mentioned they faced unreliable marketing outlets, limited meat processing, logistics, seasonal demand, and lack of consumer information. Consumers faced transportation barriers to slaughter and process live animals or meat cultural and nutritional needs. Some respondents expressed their inability to transport live animals to and from the slaughter plants

economically. Processors stated they had safety concerns such as cross contamination, poor records, traceability, exposure to infectious disease and transmission.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
604	Marketing and Distribution Practices

Outcome #12

1. Outcome Measures

Goat producers will expand their marketing to identified channels and markets.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	75

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Meat goat producers, beginning farmers, individual seeking alternative income opportunities, researchers, students, processors, consumers, stakeholders and legislators interested in goat meat, sustainable agriculture and the economy of Tennessee. Small-scale goat producer need to know what consumers are looking for in their goat meat and goat products. Also, consumers are looking for information on alternative to red meets to meet nutritional and cultural needs.

What has been done
Project team designed and administered survey instruments to meat goat producers, and meat processors on marketing and industry issues. Conducted literature review, collected and analyzed data used in developing presentations, publishing student research, and conducting educational outreach with target audiences.

Results
Making the market connections between buyers and seller becomes one of the greatest challenges. An examination of data collected showed 85 percent of producers sold their goats during religious holidays and festivals. Goat auctions, on-farm sales, contract arrangements among others were the most common marketing methods used by Tennessee producers. Chi-square test for relationship between sales channel and business success was significant. Goat

producers who used the auction as their preferred goat marketing channel were more successful than those who use other outlets.

4. Associated Knowledge Areas

KA Code	Knowledge Area
604	Marketing and Distribution Practices

Outcome #13

1. Outcome Measures

Consumers will be aware of the healthy benefits of goat meat consumption.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	355

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Health conscious consumers seeking alternative to red meat or reduce their cholesterol tend to choose goat meat. Immigrants who have a taste for goat meat, or want to satisfy nutritional needs and first time eaters also may enjoy eating goat meat. These individuals need education and information about availability of meat goat and goat products in Tennessee. Many consumers are looking for information on alternative to red meets to meet nutritional and cultural needs. An opportunity exists to fill their demand with the abundant supply of goat meat by Tennessee producers.

What has been done
Project provided consumer education on healthy aspects to enhance market connections. Seminars, symposium, meetings, posters and tour were used in discussing the nutritional value and benefits of consuming goat meat.

Results
Secondary data showed that goat meat is low in saturated fat and cholesterol, rich in protein compared to other red meats. Sixty four percent of the respondents said that advertising the product in grocery stores and restaurants, consumer education, taste sampling at fairs, festivals and local food stores, product packaging, better market conditions and among others were listed as viable factors influencing the popularity of goat meat among Americans.

4. Associated Knowledge Areas

KA Code	Knowledge Area
604	Marketing and Distribution Practices

Outcome #14

1. Outcome Measures

Meat goat producers will be aware of consumer preferences for meat goat products.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	255

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers and marketers seeking to expand their farm operations, alternative farm income generating opportunities and sustainable agriculture may consider adding the goat enterprise to their ranch or farm operation.

What has been done
Project team conducted training, mentoring and made presentation in meetings, seminars, expos, field days, tours and related outreach with students, researchers; producers, marketers and potential consumers.

Results
Nearly 60% of the respondents expressed the need to make goat meat available in grocery stores, promote attributes and health benefits in comparison to beef, pork, and chicken; young ranchers must enter the industry, increase the supply of meat goat to maximize processing plant capacities Producers now have better understanding of the consumer preference of goat meat. Subsequently, producers can develop marketing strategies to satisfy consumer needs with local supply of meat goats. Consumers now know more about the benefits of goat meat, they can increase their on farm purchases of goat meat.

4. Associated Knowledge Areas

KA Code	Knowledge Area

601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #15

1. Outcome Measures

Percentage of meat goat producers and researchers with a better understanding of how maternal genetics can affect meat goat carcass yield (Enhanced capacity of a sustainable global food system including new/improved plants, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The meat goat industry has been directed towards the production of market kids over the last 10-15 years under the assumption that Boer germplasm is superior for carcass yield among goat breeds.

What has been done
Research data were provided to industry participants that provides new insight on relative breed evaluations for meat goat carcass traits.

Results
A reassessment of long-held beliefs regarding breed selection for carcass traits is occurring among researchers and producers engaged in meat goat production.

4. Associated Knowledge Areas

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

Outcome #16

1. Outcome Measures

Meat goat producers will have increased income by marketing through new channels (More sustainable, diverse, and resilient food systems across scales).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	39

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Reducing the current barriers to market infrastructure will increase accessibility, facilitate supply and demand of goat meat. Consumers who preferred goat meat now have extra disposable income want to spend on goat meat for special occasions. Goat meat is not readily available to consumers in American grocery stores and supermarkets. Producers and families with farmland are looking for alternative crop to supplement their family income. This presents the opportunity to raise goats to meet consumer needs. Therefore, opportunities exist for small farmers to increase their income potential by adding meat goat enterprise to their operation

What has been done
Developed and administered face-to-face surveys to participating goat producers during three visits at the auction market in Columbia, Tennessee.

Results
The respondents were in the 51-80 years of golden age category, technology is very present on goat ranches. Nearly one-half use computer technology in tracking marketing, genetic and financial records. Although 40 (38%) of the respondents earned a part of their family income from goat enterprise, majority 92% of their earnings were from gross sales under $20,000. Only few, 8% of the respondents said they earned $50,000 and more per year. Many farmers explained that rising goats provided them with alternative source of family income. Additionally, data analysis revealed that 85 percent of goat producers worked off-farm full-time in such various capacities as automobile mechanic, construction worker, electrician, factory workers, high school teachers, retired or some other occupation. Fifteen percent of the producers raised goats as their primary occupation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

A note about all of the five Guinea fowl research outcomes: the PI for this research has recently been assigned a substantial administrative role in the department, and his research responsibility has been reduced, leading to a lower level of research completion than previously planned.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Project evaluations have been developed and implemented. Four evaluations have been implemented before and after evaluation of participation in educational seminars, symposiums, workshops and outreach conferences with producers, students/researchers and consumers. These instruments captured knowledge gain by participants in these events. A very high percentage (85%) of end-users of meat goat products surveyed stated improved knowledge non-meat uses for goat, including dairy, fiber, cosmetics, agro-tourism, pets, brush control, and related valuable uses. Much of the goat research communicates a reluctance to implement recommendations: while 80% of the producers surveyed knew about the recommendations, only about 25-30% were implementing the recommendations. The project is evaluating options to improve the adoption rate.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Global Food Security and Hunger - enhancing sustainability of agricultural plant production

☑ 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%
111	Conservation and Efficient Use of Water				5%
131	Alternative Uses of Land				25%
132	Weather and Climate				5%
133	Pollution Prevention and Mitigation				5%
204	Plant Product Quality and Utility (Preharvest)				10%
601	Economics of Agricultural Production and Farm Management				30%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	9.5
Actual Paid	0.0	0.0	0.0	14.0
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	707303
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	707303
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

Conduct workshops and stakeholder meetings.
Provide training.
Conduct research experiments.
Set up a soil carbon laboratory.
Develop a course description and course material pertinent to the program.
Conduct research experiments on nutrient uptake, translocation, accumulation and partitioning in plants using various elements using organic and mineral fertilizers.
Explore the potentials of plug transplanting and grafting technology for organic transplants.
Conduct hands-on training and workshops on visual nutrient deficiency symptoms of food crops and ornamentals.
Train and educate students and extension agents in plant mineral nutrition management.
Develop alley cropping agroforestry systems for carbon storage.

2. Brief description of the target audience

Organic and conventional growers of food crops and ornamentals
Professional design practitioners
Community stakeholders
Farmers, forest landowners, environmental and conservation conscious individuals
Undergraduate and graduate students
Scientific community, extension agents

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	534	1030	30	160

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

Patent Applications Submitted

Year: 2014

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	3	4	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of venues to inform stakeholders about characteristics, trends, and significant changes in supply distribution of produce commodities in the U.S.

Year	Actual
2014	1

Output #2

Output Measure

- Number of workshops held on use of specialized fertilizer formulations to reduce environmental nutrient contamination.

Year	Actual
2014	26

Output #3

Output Measure

- Number of workshops held to educate landowners on carbon sequestration strategies.

Year	Actual
2014	3

Output #4

Output Measure

- Number of workshops held addressing agricultural sustainability.

Year	Actual
2014	3

Output #5

Output Measure

- Number of venues to inform stakeholders about current issues on fruit and vegetable consumption/demand and its impact on overweight/obesity.

Year	Actual
2014	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Producers will adopt use of specialized fertilizer formulations to reduce environmental nutrient contamination (Enhanced capacity of a sustainable global food system including new/improved plans, animals, technologies and management systems).
2	Producers will realize reduction in crop loss through the use of specialized fertilizer formulations to reduce environmental nutrient contamination.
3	Producers will realize increases in crop yield and income as a result of the use of specialized fertilizer formulations.
4	Producers and businesses in the produce industry and policy makers will have increased knowledge of characteristics, trends, and significant changes in supply distribution of produce commodities in the U.S. (more sustainable, diverse, and resilient food systems across scales).
5	Students will have increased knowledge of characteristics, trends, and significant changes in supply distribution of produce commodities in the U.S. (more sustainable, diverse, and resilient food systems across scales).
6	Farm/forest landowners will have an increased knowledge of multi-function land management techniques(Improve climate mitigation strategies and their adoption).
7	Farm/forest landowners will adopt multi-function land management techniques(Improve climate mitigation strategies and their adoption).
8	Farm/forest landowners will realize increased income as a result of multi-function land management techniques (Improve climate mitigation strategies and their adoption).
9	Educators (i.e. Extension agents, state forestry officials) will have increased knowledge of multi-function land management techniques
10	Producers and businesses in the produce industry, consumers, educators, researchers, and policy makers will have increased knowledge about current issues on fruit and vegetable consumption/demand and its relationship with overweight/obesity in the U.S.
11	Students will have increased knowledge about current issues on fruit and vegetable consumption/demand and its relationship with overweight/obesity in the U.S.
12	Number of crops producing pathogen-inducer chemicals that can be used to screen germplasm.
13	Producers informed about greenhouse gases (GHG) emission as a result of fertilizer application in corn production systems.
14	Producers informed about optimizing fertilizer inputs and water use efficiency to mitigating greenhouse gases emission in row crop production.
15	Students trained in greenhouse gas monitoring

Outcome #1

1. Outcome Measures

Producers will adopt use of specialized fertilizer formulations to reduce environmental nutrient contamination (Enhanced capacity of a sustainable global food system including new/improved plans, animals, technologies and management systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Challenges of cultural practices including water and fertility management for healthy seedling production.
Alternative nutrient sources such as chicken manure, green manure as a source of NPK in organic seedling establishment will be beneficial.

What has been done
Presentation of papers at scientific conferences.
Three presentations at the American Society for Horticultural Science Annual Conference 2014
Research outcomes were communicated across the scientific community, extension specialists, extension agents, graduate students, undergraduate students and growers.

Results
The disseminated information improved nutrient management in food crops, soil fertility and minimized losses. Alternative nutrient sources may also represent a cost savings factor in small sized farm production of food crops.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Producers will realize reduction in crop loss through the use of specialized fertilizer formulations to reduce environmental nutrient contamination.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Insufficient information is available to growers concerning site and crop specific fertilizer application techniques for production for specialized crops, i.e. blueberry production.

What has been done
Workshops were conducted to highlight the impact of nitrogen forms, source and rate and pH levels for crops such as blueberry.

Results
Growers and master gardeners, blueberry producers gained knowledge on the importance of fertilizer source, rate, and application protocols.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Producers will realize increases in crop yield and income as a result of the use of specialized fertilizer formulations.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One of the long range goals, as stated in the Tennessee State University master plan, is to develop excellence in agriculture and to provide training to minority students in the advanced field of plant biotechnology.

What has been done
Two graduate and four undergraduate students were trained in site and crop specific nutrient formulation techniques. Techniques were communicated to producers.

Results
Four producers reported increased production when using site-specific fertilizer recommendations.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Producers and businesses in the produce industry and policy makers will have increased knowledge of characteristics, trends, and significant changes in supply distribution of produce commodities in the U.S. (more sustainable, diverse, and resilient food systems across scales).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
An evaluation of trends and significant changes in farm and supply distribution of produce commodities will provide empirical evidence and perspectives for policy makers, producers and businesses to evaluate needs and opportunities, and to effectively design and implement policies and programs that create market access and opportunities for fresh produce farmers and businesses. Research on these issues, though invaluable to various stakeholders, is very limited or not up to date. This study provides the most up-to-date empirical evaluation of the recent developments in the fresh produce market.

What has been done
Completed the first and third objectives of the project, which are to characterize trends and identify significant changes in production and supply of produce commodities in selected states in the U.S., and to draw implications for building and strengthening local food systems and increasing affordable and accessible produce products for consumers based on the findings. Activities include collecting additional data, compiling and combining data, conducting and updating analysis, and summarizing the study and findings.

Results
The findings suggest: 1. The domestic supply is concentrated in California (51%) and 6 other minor producing states (31% total). 2. Production and harvest areas exhibited evident and statistically significant decline, while yield showed no evident change. 3. California experienced higher decrease in product and harvest than other states, while some states showed increases in both. 4. Inflation adjusted price fluctuated but on average showed a slight and statistically significant upward trend. The price grew twice as much as in other states than in California. 5. Production decline dominated price increase, and hence production value experienced significant decline.

The analysis also suggests high obesity rates, low consumption of fruits and vegetables, and clusters of food deserts are associated with each other in many states in the South. Direct-to-consumer sales were active market outlets for small farmers and accounted for over half of direct-to-consumer sales for all based on 2007 Census of Agriculture. The south has a larger share of small farms but accounted much less in direct-to-consumer sales compared with the rest of the nation. These may suggest potential growth of direct-to-consumer sales, especially for small farms and in the South, and it may meet the needs to increase access to healthy foods where obesity rates are high and consumption of healthy foods is low.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

Outcome #5

1. Outcome Measures

Students will have increased knowledge of characteristics, trends, and significant changes in supply distribution of produce commodities in the U.S. (more sustainable, diverse, and resilient food systems across scales).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Skilled personnel are vital to sustainable growth in the produce industry and increasing supply of healthy foods for consumers. It is important to inform and educate students of critical issues, recent developments, current situation, and future perspectives and opportunities in the produce industry. Knowledge gained will help them make informed decisions on their careers and beyond and encourage them to make contributions to communities.

What has been done
Activities of the project include teaching, training, professional development activities for students at TSU. Many students reached by the project are minority students such as African American, African, Asian, and Middle-eastern students. Two graduate students have participated in this project. The two graduate students received one-on-one mentoring, training, and hands-on experiential learning.

Results
Fifteen students enrolled in two courses were introduced to background, literature, needs, critical and emerging issues, data sources, methodologies, and findings and implications. These students also practiced a pedagogical student project developed from the data and analysis of this study. The study has directly increased the knowledge of at least 50 students about characteristics, trends, and changes in the U.S. fresh produce industry, and is estimated to impact even more people as the students spread the knowledge. This will have a spillover and long-term

impact on the labor force in the fresh produce industry.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Farm/forest landowners will have an increased knowledge of multi-function land management techniques(Improve climate mitigation strategies and their adoption).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	60

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small producers generally lack the knowledge and skill-sets needed to properly manage their natural resources, are frequently underserved by existing education programs, or are simply unaware of the many opportunities available to them at the state and federal level. High investment costs, combined with the long rotation periods until forest products are ready for market deter many from investing more substantively in traditional forestry operations. Training in multi-function land management techniques will offer limited-resource landowners opportunity to successfully attain their goals with forestland management practices and flexibility of establishing a mixed-use system.

What has been done
Various outreach activities were held to communicate research findings to small acreage landholders.

Results
A total of 60 smallholding farmers, forest landowners, and ranchers increased their knowledge of research-based multi-function land management techniques.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

Outcome #7

1. Outcome Measures

Farm/forest landowners will adopt multi-function land management techniques(Improve climate mitigation strategies and their adoption).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	45

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small producers generally lack the knowledge and skill-sets needed to properly manage their natural resources, are frequently underserved by existing education programs, or are simply unaware of the many opportunities available to them at the state and federal level. High investment costs, combined with the long rotation periods until forest products are ready for market deter many from investing more substantively in traditional forestry operations. Training in multi-function land management techniques and skills on decision-making tools will offer limited-resource landowners opportunity to successfully attain their goals with forestland management practices and flexibility of establishing a mixed-use system.

What has been done
Research was conducted on strategies to enhance the multi-use income capacity of property. In an effort to help land owners develop and enhance the multi-use valuable natural and forest resources enterprise, the program provided a series of training workshops for forest and ranch landowners on variety of techniques available in Google Mapping tools through demonstrations, hands-on exercises, and discussion. Landowners were introduced to Google Earth Tools for supporting decision making, increasing landowner knowledge about physical features in their wooded property.

Results
The activities in this project boosts skills and promote interest in using available decision-making tools. The land owners were very enthusiastic to learn and explore while literally having a bird?s eye view their lands on Google Earth, identify and mark features, measure variety attributes on their land. Participants have learned where to get property information and about estate planning.

The 60 participants own a total of 1115.8 acre of Forestland.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

Outcome #8

1. Outcome Measures

Farm/forest landowners will realize increased income as a result of multi-function land management techniques (Improve climate mitigation strategies and their adoption).

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Educators (i.e. Extension agents, state forestry officials) will have increased knowledge of multi-function land management techniques

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Understanding multi-function land management involves basic human spatially thinking and making decisions based on geography. Geospatial information systems (GIS) are useful tools, helping everyone from scientists to citizens to solve spatial problems. Geospatial information systems are becoming increasingly important affecting a variety of areas ranging from sustainable land management to precision agriculture. Providing practical and useful training in GIS tools in this information age is critical to promote the skill of specialists, researchers and county extension agents.

What has been done

Training sessions were conducted using mobile GIS-lab with 25 laptop computers, already purchased via grant-leveraged funding.

Results
A training session on introduction to ArcGIS-online was provided to over 40 TSU extension agents. Hands-on training sessions on the use of GIS tool Geocoding of addresses were conducted in Rutherford County 4H group. About 15 young adults and their parents were participated in these two-day sessions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

Outcome #10

1. Outcome Measures

Producers and businesses in the produce industry, consumers, educators, researchers, and policy makers will have increased knowledge about current issues on fruit and vegetable consumption/demand and its relationship with overweight/obesity in the U.S.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The analysis of demand for fruits and vegetables and related issues is critical to study the future development of the produce industry. This study examines the relationship between fruit and vegetable consumption and adult obesity prevalence. The study also investigates whether and how obesity rates differ among various demographic and socioeconomic groups and factors that affect the propensity for consuming more fruits and vegetables.

What has been done
Examined factors associated with demand, needs and issues, and hence to better understand market environment and marketing opportunities, which might have contributed to and/or will potentially promote or hinder the growth of local production and farms of produce commodities and consumer access to these healthy foods where they are needed the most. Completed the analysis of trends and cross-state distribution of fruit and vegetable consumption and obesity

rates. Summarized work and findings on this topic in the previous and current periods.

Results

Findings include: 1. About 23.46% U.S. adults consumed the recommended daily levels of fruits and vegetables, and the low consumption rates are common across states. 2. There is no significant change or trend in fruit and vegetable consumption level from 1996 to 2009. 3. Many states in the northeast have the highest or higher consumption rates, and many in the south have the lowest or lower consumption rates among all. 4. The highest consumption rates changed very little over time, whereas all the lowest consumption rates have decreased over time. 5. Any states in the south have the highest or higher obesity rates (the lowest and lower fruits and vegetable consumption rates). The top five are all from the south, whereas many states in the northeast have the lowest or lower obesity rates (the highest and high fruits and vegetable consumption rates). 6. Obesity rate increased across all states during the study period. However, obesity prevalence gets worse much faster for those states that already have very high obesity rates. 7. Fruit and vegetable consumption has a negative and statistically significant effects on obesity rates, and the effect has become stronger in recent years, higher in 2009 than the period average during 1996-2009 8. Fruit and vegetable consumption appears to have higher and statistically significant effect on obesity compared with other two health-related behavior/choices, physical activity and smoking.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

Students will have increased knowledge about current issues on fruit and vegetable consumption/demand and its relationship with overweight/obesity in the U.S.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

It is important to inform and educate our students about the current and critical issues on food, agriculture, health and nutrition so that they can make informed decisions on their consumptions and career choices. They can also make contributions to and have positive impact in communities.

What has been done
The study and its findings were incorporated into the curricula of two graduate-level courses, Decision-making in Agribusiness, and Food Marketing and Retail Management. Students were introduced to background and critical issues, literature, and findings of this study.

Results
Fifteen students were enrolled in these two graduate-level courses. These students were introduced to background and critical issues, literature, and findings of this study. Students participated in discussions in various occasions when the study was mentioned and discussed throughout the course.

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

Number of crops producing pathogen-inducer chemicals that can be used to screen germplasm.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With over 80 crops susceptible to soft rot, identification of a molecule that serves to induce virulence of soft rot pathogens even in segment of these host crops will significantly impact many the production of many crops and thereby improve American agriculture.

What has been done

Using the tools of analytical and preparatory chemistry, we have developed a method of purifying the inducer from two host crops: celery and potato. The level of purity is being determined after which we shall determine the chemical identify of the inducer.

Results
The inducer is extractable from the crude material with water and in a dialysis bag with MWCO of 1kDa. The bioactivity (induction of exoenzyme production in Pectobacterium carotovorum) is consistently retained in the aqueous fraction following organic solvent extraction under neutral, acidic or basic conditions. Reverse Phase-HPLC analysis on a C8 column shows a single peak eluting very early (before the injection peak), indicating that the compound is very hydrophilic. Size exclusion chromatography shows a single peak with a retention time corresponding to the lower exclusion limit, indicating the compound is of low molecular mass. The UV-Vis spectrum shows absorbance in the lower UV range (200-220nm) and very little absorbance above 230nm. The combination of FT-IR and NMR scans of the extract and some other results indicate the active ingredient is of carbohydrate nature.

4. Associated Knowledge Areas

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

Outcome #13

1. Outcome Measures

Producers informed about greenhouse gases (GHG) emission as a result of fertilizer application in corn production systems.

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Producers informed about optimizing fertilizer inputs and water use efficiency to mitigating greenhouse gases emission in row crop production.

Not Reporting on this Outcome Measure

Outcome #15

1. Outcome Measures

Students trained in greenhouse gas monitoring

Not Reporting on this Outcome Measure

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

Brief Explanation

For outcomes 13, 14 and 15, the project associated with these outcomes has been deleted from the Plan of Work, the Principal Investigator has left the university.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For the portion of the program dealing with fertilizer specifications, workshop evaluations during the trainings indicated that growers were generally satisfied with the gained knowledge. However, a number of respondents requested additional in-depth information in the subject area. As a result of these evaluations a training module is being developed.
Evaluation measures of the economic-based research include the description and count of venues that the study and its findings reach stakeholders. The recorded number of stakeholders who have received the information and increased their knowledge through publication, conference and other presentations were measured suing surveys. Website exposure measures by the number of visits and views. Student numbers were obtained from enrollment analysis. Results from surveys indicate a satisfaction with knowledge gained, but a desire for a greater diversity of presentation venues. Increased venue diversity has been initiated.
For land use issues, feedback is gathered from participants at the end of training sessions. Exit surveys to gather initial opinions and information on immediate plans following the workshop were collected. The feedbacks entails that more intensive trainings in the area of GIS and decision-making tools related to land managements were requested.
The pathology aspect of this program is basic science research, its success is measured in the success of the techniques used. At all stages of the project, the ability of the extract to induce virulence of the pathogen has always been tested with bioassays using Pectobacterium carotovorum and measuring the levels of Pectate lyase (Pel) production in vitro. The levels of this enzyme correlates well with virulence of the pathogen. Thus, the presence of the inducer in the medium leads to the induction of virulence which is measured by the level of Pel production. The chemical identify of the inducer will be confirmed by comparison of induction with a synthetic analog of the inducer.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Sustainable Energy - new feedstocks and improved feedstock production

☑ 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
202	Plant Genetic Resources				30%
204	Plant Product Quality and Utility (Preharvest)				30%
213	Weeds Affecting Plants				10%
511	New and Improved Non-Food Products and Processes				30%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	9.5
Actual Paid	0.0	0.0	0.0	15.6
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	788525
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	788525
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Disseminate research findings to the scientific community, stakeholders, agricultural, environmental, life science industries.
Conduct agronomic and economic analysis.
Recruit and train students, incorporating research training into teaching and extension curricula.
Design and implement field and laboratory research.

2. Brief description of the target audience

State, local and federal agencies, small and limited-resource farmers, researchers, educators, policy makers, consumers and bioenergy companies.

3. How was eXtension used?

eXtension was promoted through workshops and factsheets to provide an additional resource to stakeholders; webinar presentations were made.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	160	2396	3	1030

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	5	6	11

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops and presentations concerning new or alternative biofuel feedstocks.

Year	Actual
2014	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Producers will have increased knowledge of production options available for growing bioenergy feedstocks (Increased knowledge and understanding of the biofuels supply chain).
2	An increasing number of producers will adopt production of bioenergy feedstocks (Implementation of sustainable biofuels systems).
3	Students will receive training in bioenergy production (Develop a diverse and educated workforce for a biofuels industry).
4	Protocols will be developed for mutagenesis and selection of herbicide resistant biofuel feedstock varieties (Increased knowledge and understanding of the biofuels supply chain).
5	Desirable biofuel feedstock varietal mutants will be recovered (Increased knowledge and understanding of the biofuels supply chain).
6	New varieties of biofuel feedstocks will be developed (Increased knowledge and understanding of the biofuels supply chain).
7	Producers will have knowledge of benefits:costs of production (from land preparation to final ethanol production) for two biofuel crops (Miscanthus and switchgrass) through the construction of benfit:cost analysis sheets.
8	Stakeholders will have knowledge of the energy efficiency of biofuel production from switchgrass and Miscanthus through the calculation of energy balance sheets for these crops, providing indicators of sustainability for biofuel production.
9	Farm specific factors responsible for improving technical efficiency of biofuel production will be determined to minimize inefficiency in current production.
10	Optimization of biofuel crop, i.e. switchgrass yields, to changing climatic conditions.

Outcome #1

1. Outcome Measures

Producers will have increased knowledge of production options available for growing bioenergy feedstocks (Increased knowledge and understanding of the biofuels supply chain).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	31

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bioenergy, and biofuels in particular, are a mainstream concept as an alternative to the security and environmental issues related to fossil fuels. Many producers may be understandably skeptical about growing biofuel crops because of the lack of information available to them and the fact that there is currently no major market available for them to sell these products. However, it is important to disseminate this assistance to these producers because once the infrastructure and markets are fully established, producers will have the optimal tools available to them to succeed.

What has been done
The established program of outreach of research data on the use of switchgrass or native-warm season grasses in general for forage and bioenergy (verbal, video, scientific meetings). Demonstrations using a mobile biodiesel demonstration purchased through USDA NIFA Capacity Building grant funds were conducted. One fact sheet was developed, published, and uploaded to the TSU Cooperative Extension website. A Twitter account (@TSUBioenergy) and website (http://www.tnstate.edu/faculty/jdekoff/) were maintained to provide information on the bioenergy program at TSU as well as other bioenergy-related topics.

Results
Based on survey results from outreach meetings:
79% of respondents increased their interest in growing native warm-season grasses
88% of respondents increased their knowledge in using native warm-season grasses for biofuel production.

4. Associated Knowledge Areas

KA Code	Knowledge Area

511 New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

An increasing number of producers will adopt production of bioenergy feedstocks (Implementation of sustainable biofuels systems).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	37

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bioenergy, and biofuels in particular, are a mainstream concept as an alternative to the security and environmental issues related to fossil fuels. Many producers may be understandably skeptical about growing biofuel crops because of the lack of information available to them and the fact that there is currently no major market available for them to sell these products. However, it is important to disseminate this assistance to these producers because once the infrastructure and markets are fully established, producers will have the optimal tools available to them to succeed.

What has been done
Demonstrations using a mobile biodiesel demonstration purchased through USDA NIFA Capacity Building grant funds were conducted. There were 5 different meetings in 5 different counties. Also, two local high schools requested demonstrations and were visited. The mobile biodiesel demonstration was also requested to be a part of the Tennessee State Fair Green Collar Exhibit in September 2014. Four fact sheets were developed, published, and uploaded to the TSU Cooperative Extension website (http://www.tnstate.edu/extension/publication_index.aspx). A Twitter account (@TSUBioenergy) and website (http://www.tnstate.edu/faculty/jdekoff/) were maintained to provide information on the bioenergy program at TSU as well as other bioenergy-related topics. A biofuel technology workshop was led through a different USDA NIFA Capacity Building grant to provide training on biofuels and biofuel production to middle school and high school students and teachers in June/July 2014.

Results
Based on survey results from the mobile biodiesel demonstration workshops:
Participants identified a significant increase in their knowledge, awareness, perceptions and

interest in biodiesel production. For example, prior to the workshops, participants were uncertain whether biodiesel production was too difficult or not economically feasible for farmers to produce. After the workshops, they disagreed that it was too difficult and they disagreed that it was not economically feasible. Following the workshops, they were also more likely to produce their own biodiesel in the next 5 years, discuss the information with other farmers and create a cooperative for biodiesel production.
Based on survey results from the biofuel technology workshop:
57% of teacher respondents identified an increase in knowledge related to biofuel production
84% of youth respondents identified an increase in knowledge related to biofuel production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

Students will receive training in bioenergy production (Develop a diverse and educated workforce for a biofuels industry).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bioenergy is a new, environmentally-focused field that encompasses a range of scientific disciplines. It has great impact on the environment due to its importance in maintaining the world's environmental and economic integrity. The U.S. has recently increased its focus in the area of bioenergy through federal mandates and funding for research, infrastructure and feedstock development, and education to enhance the nation's energy portfolio. This emphasis has created new opportunities in the 'green jobs' market which will require new efforts and new programs for training future professionals.

What has been done

Research has been conducted on optimal harvest timing of switchgrass for bioenergy production. This research has been performed with assistance from one graduate student. Two undergraduate students have also participated in different aspects of bioenergy research and extension.

Results
The graduate student presented her research during the University-Wide Research Symposium at Tennessee State University in 2014 and won 1st place in her division. One undergraduate participated in the National Biodiesel Conference and Expo in 2014. She was awarded a travel grant as part of the Next Generation Scientists for Biodiesel program with sponsorship from state soybean boards and the United Soybean Board.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #4

1. Outcome Measures

Protocols will be developed for mutagenesis and selection of herbicide resistant biofuel feedstock varieties (Increased knowledge and understanding of the biofuels supply chain).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Competition from weeds is one major cause for inferior switchgrass establishment under field conditions, presenting an increased risk and cost for the growers.

What has been done
1. One Ph.D. student is working on the issue;
2. We have 500 plants in the greenhouse that will be uses for treatment experiments;
3. We are collecting recently set seeds. Several seedlings and those from stolons did produce seeds at this season;
4. The student is developing protocols to isolate nucleus from leaf and root tissues.

Because we are only able to harvest a limited number of seeds, and those seeds have a very low germination rate, the major effort is to propagate those seeds and continue to observe those traits. Plants were subjected to herbicide screening.

Results
One protocol using non-selective organic herbicide spaying on seedlings with two true leaves. The spay killed 99.9% of seedlings, and the few left will be treated again, and observe the phenotype.

4. Associated Knowledge Areas

KA Code	Knowledge Area
213	Weeds Affecting Plants
511	New and Improved Non-Food Products and Processes

Outcome #5

1. Outcome Measures

Desirable biofuel feedstock varietal mutants will be recovered (Increased knowledge and understanding of the biofuels supply chain).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New sources of genetic variation are needed for biofuel feed stocks. Genetic improvement of switchgrass may lead to increased sustainability of biofuel production.

What has been done
Seeds of Panicum hallii as well as switchgrass were treated with sodium azide to evaluate for treatments with different types of stresses, to find more useful mutations.

Results
We have collected seeds from three different phenotype plants, and they are under observation for two seasons. But no molecular studies have been done to confirm they are true genetic mutants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
213	Weeds Affecting Plants
511	New and Improved Non-Food Products and Processes

Outcome #6

1. Outcome Measures

New varieties of biofuel feedstocks will be developed (Increased knowledge and understanding of the biofuels supply chain).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Tolerance to environmental stress including drought and salt and temperature are significant issues for biomass crop production in the face of climate changes.

What has been done
Testing of mutants for herbicide resistance and abiotic stress tolerance has continued, including Panicum hallii, which is a diploid and was sequenced. Genomic study of this species will be easier once mutants with phenotypes are selected.

Results
Continued evaluation of putative lines. There are still no final results to be provided this year because of the difficulties in propagating those plants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
213	Weeds Affecting Plants
511	New and Improved Non-Food Products and Processes

Outcome #7

1. Outcome Measures

Producers will have knowledge of benefits:costs of production (from land preparation to final ethanol production) for two biofuel crops (Miscanthus and switchgrass) through the construction of benfit:cost analysis sheets.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Since cellulose ethanol production is at relatively early stages, there is an information gap in feedstock production as well as processing. For example, producers are concern of risk and uncertainty associated with feedstock production and marketing. Producers need to have credible information on feedstock selection, various costs associated during production (i.e., input requirement, harvesting, transportation and storage costs), biomass harvest timing, pricing, etc. Information on reliable farm budgeting is essential to attract growers for energy crop farming. Since switchgrass and miscanthus are perennial grass species, producers needs to know the benefits of long term investment (benefits and costs over multiple year period).

What has been done
Benefit:cost analysis of long term investment (25 year project period) for switchgrass and miscanthus production and processing of these feedstocks to ethanol production; harvesting and hauling costs model and estimation for switchgrass; estimation of indicators such as break-even prices, feedstock cost per gallon, breakeven price of ethanol etc which is vital for decision making of feedstock producers as well as ethanol processors.

Results
Research results were communicated to producers through field day presentations, webinars, scientific manuscripts, conference proceedings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #8

1. Outcome Measures

Stakeholders will have knowledge of the energy efficiency of biofuel production from switchgrass and Miscanthus through the calculation of energy balance sheets for these crops, providing indicators of sustainability for biofuel production.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Stakeholders should aware of energy efficiency of biofuel production from switchgrass and Miscanthus through the calculation of energy balance sheets for these crops, providing indicators of sustainability for biofuel production. The information will helpful to identify major energy inputs and thereby to use these inputs in optimal manner to conserve energy use in farms.

What has been done
Estimation of energy input for various input categories in producing miscantus and switchgrass, estimate energy outputs of these two systems and calculate net energy balance of these two production systems.

Results
Two energy balance sheets were produced. Implications and application of the balance sheets were communicated to stakeholders through workshop presentations, field day exhibits and scientific publications and conference proceedings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #9

1. Outcome Measures

Farm specific factors responsible for improving technical efficiency of biofuel production will be determined to minimize inefficiency in current production.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Technical issues relating to data collection for this portion of this program have precluded completion of this outcome.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
511	New and Improved Non-Food Products and Processes

Outcome #10

1. Outcome Measures

Optimization of biofuel crop, i.e. switchgrass yields, to changing climatic conditions.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Production of bioenergy crops will be subject to the same climate-change challenges as other crops that other crops face. This program is examining how these challenges may specifically impact switchgrass production.

What has been done
As planned, five precipitation treatments were examined, including drought, ambient and wet treatments to switchgrass plants using the automatic precipitation control facility in 2014. Soil temperature and moisture were monitored and recorded every 15 minutes. Leaf photosynthesis, stomatal conductance, transpiration rates and soil respiration (CO2 emission) were measured bimonthly using a Li-6400 Portable Photosynthesis System. Plant height, number of tillers per plant and pot, biomass were also measured. One whole growing season data have been collected.

Results
One growing season data have been collected. Multiple seasons of data will be required to formulate conclusive results.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation studies are planned for future mobile biodiesel demonstration workshops and future biofuel technology workshops. These studies were performed for workshops in 2014 and the same questionnaires will be used to evaluate these programs in 2015. Results indicate 57% of teacher respondents identified an increase in knowledge related to biofuel production
84% of youth respondents identified an increase in knowledge related to biofuel production.
Adjustments to the program are being made to increase the adoption rate of research results.
In addition, the following items are being measured to assess the success of this program: increase in number of producers adopting production of bioenergy feedstocks; number of students receiving training in bioenergy production and number of new varieties of biofuel feedstocks developed.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Climate Change- low-impact alternatives for ornamental crop production

☑ 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
133	Pollution Prevention and Mitigation				10%
211	Insects, Mites, and Other Arthropods Affecting Plants				30%
212	Diseases and Nematodes Affecting Plants				30%
605	Natural Resource and Environmental Economics				30%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	14.2
Actual Paid	0.0	0.0	0.0	12.3
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	622698
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	622698
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

Identify new pesticide, biopesticide, and treatment methodologies for container and field-grown nursery stock to manage disease and insect problems.
Determine the lowest effective rates for synthetic petroleum-based pesticides and develop new reduced rate insecticide / biopesticide combinations.
Identify new biopesticides that can substitute for synthetic petroleum-based pesticides and reduce worker exposure risk and environmental impact.
Release phorid-decapitating flies in Tennessee to provide imported fire ant biological control.
Provide extension training and literature to producers on imported fire ant and Japanese beetle management and train students in pest management and research techniques.
Provide data to support new treatments in the Domestic Japanese Beetle Harmonization Plan and the Federal Imported Fire Ant Quarantine, as well as data to support new insecticide label amendments.
Conduct assessment of current and future energy use by greenhouse and nursery businesses.
Identify alternative energy sources for the greenhouse and nursery industry.
Hold focus group meetings with greenhouse and nursery business owners.

2. Brief description of the target audience

Nursery growers, extension specialists, consumers and policy makers.
Regulatory agencies (e.g., U.S. Environmental Protection Agency, USDA-APHIS, Tennessee Department of Agriculture).
Agrochemical manufacturers.

3. How was eXtension used?

Scientists in this program are members of the leadership in the eXtension Imported Fire Ant Community of Practice (IFA-COP) for the state of Tennessee and also regulatory and quarantine issues (http://www.extension.org/pages/12258/imported-fire-ants-leadership#.VMptanl0y70). Other involvement has included reviews of webpage content and contributions of content on the IFA-COP site. The State-Specific Information webpage on the eXtension IFA-COP for Tennessee (http://www.extension.org/pages/16159/links-to-other-websites-about-fire-ants#.VMpu8Hl0y72) links to the University of Tennessee Imported Fire Ant (UT-IFA) information website. The UT-IFA website includes multiple extension publications on fire ant management prepared by the University of Tennessee and Tennessee State University entomology programs (http://fireants.utk.edu/resources/publications.html). Consequently, extension publications for Tennessee also are linked to the eXtension IFA-COP.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1940	62291	701	5675

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	5	7	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Workshops to inform producers about alternative insect control methodologies.

Year	Actual
2014	7

Output #2

Output Measure

- Disease resistant cultivars developed.

Year	Actual
2014	0

Output #3

Output Measure

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

Year	Actual
2014	4

Output #4

Output Measure

- Workshops held to inform/encourage nursery producers about alternative energy use.

Year	Actual
2014	1

Output #5

Output Measure

- Extension publications to inform nursery and greenhouse growers about alternative energy options.

Year	Actual
2014	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Producers educated on proper management of invasive pests through presentations and workshops.
2	Producers educated on proper management of invasive pests through publications and factsheets.
3	New treatments for invasive pests.
4	New treatments for invasive pests approved by quarantine regulatory agencies.
5	Confirmed establishments of new invasive pest parasites.
6	Producers are informed about new or emerging diseases.
7	Producers are informed about new biological control treatments.
8	Producers that are informed about new sources of host resistance.
9	New cultivars exhibiting disease resistance available to growers.
10	Nursery/greenhouse operators utilizing alternative energy.
11	New alternative controls for insect pests.

Outcome #1

1. Outcome Measures

Producers educated on proper management of invasive pests through presentations and workshops.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	349

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Invasive pest species disrupt natural ecosystems and are detrimental to agriculture because they exhibit rapid population growth that can cause greater crop damage and harm to human health and welfare. Multiple invasive pests now impact the U.S. nursery industry. Many producers must manage multiple invasive pests simultaneously with limited, ineffective, and costly treatments, which threatens economic viability and undermines integrated pest management efforts. Producer education via workshops and other training outlets is essential for providing up to date information on rapidly evolving modifications to agro-ecosystems and guidance on successful and profitable control tactics.

What has been done
Research was conducted on the control of imported fire ant, Japanese beetle, granulate ambrosia beetle, camphor shot borer, blackstem borer, and walnut twig beetle. Producers and other agricultural stakeholders were trained at workshops, field day demonstrations, and educational venues on the latest management techniques developed from field research on invasive insects.

Results
Local and regional workshops provided producers and stakeholders with research results on management of invasive nursery pests. Total number of growers/stakeholders educated at workshop and field day trainings during this reporting period was about 339 (250 producers and 89 stakeholders). In addition, the project had about 12,079 producer and 51,683 stakeholder contacts outside of workshops, respectively, pertaining to information on pest management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

211 Insects, Mites, and Other Arthropods Affecting Plants

Outcome #2

1. Outcome Measures

Producers educated on proper management of invasive pests through publications and factsheets.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1031

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Due to time constraints with managing and running farm operations, as well as expense, some producers are not able to physically attend educational workshops to obtain information on management of invasive insects. As a result, publications, factsheets, and internet available materials are another route to indirectly reach these producers and stakeholders with guidance, training, and the latest successful measures for effective and sustainable pest management.

What has been done
Based on results from research conducted in this program, three new extension publications were developed, one online proceeding for the Imported Fire Ant and Invasive Ant Conference posted on the eXtension Imported Fire Ant Community of Practice, and six new online reports posted on the USDA-APHIS-PPQ Gulfport-Bioloxi Station Annual Reports. Producers also received educational handouts at workshops and several presentations given at workshops were converted into handouts in response to producer requests.

Results
Producers/stakeholders received research information to facilitate their management of invasive insects in nursery settings. These producers estimated savings of $6,812 due to knowledge gained and practices changed by the TMNP online program and an additional $7,375 change due to increased quality from the TMNP. It is estimated this project educated 1,031 producers and 937 stakeholders with information from website posted publications, information requests, or given at workshops.

4. Associated Knowledge Areas

KA Code	Knowledge Area

133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #3

1. Outcome Measures

New treatments for invasive pests.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Treatment methods for cleansing nursery stock of imported fire ant, Japanese beetle, and numerous non-indigenous ambrosia beetles are expensive, hazardous, impractical or ineffective, and often require shipping delays. Imported fire ant treatment methods like the Federal drench protocol are hazardous due to producer handling exposure and early site re-entries, labor intensive, and expensive. Most treatments for these pests rely on only a few active ingredients (i.e., chlorpyrifos, imidacloprid, or permethrin), providing producers with only limited alternatives. New biopesticide treatments that are under development may have a role in reducing climate change by offering producer alternatives for synthetic petroleum based agrochemical inputs. Invasive borers also have major impacts on forest systems and landscape plantings supplied by the nursery industry, which serve as important carbon-sinks, so improved treatments for borers may indirectly reduce climate change. It is also important that new treatments that are developed are made available to producers through modifications of federal and state regulations governing these quarantine pests.

What has been done
First, research reported in the last period with a new in-field chemigation treatment for imported fire ant (IFA) and Japanese beetle (JB) larvae utilizing common grower accessible items has been repeated for a third field season. Second, biopesticides and conventional pesticides were again evaluated in combination with a pesticide synergist to lower the rates of pesticides applied as dips and to enhance the treatment efficacy against JB larvae. Third, an IFA nursery study evaluating the combination of broadcast bait treatments, targeted mound injections with bifenthrin, and a bifenthrin band application was completed during spring 2014. The completed bait-injection-band test was the final fourth testing season of this treatment. Fourth, a test to evaluate longevity of imidacloprid activity against JB larvae when applied as a banded application is being repeated for

the third and final field season. Data are continuing to also be shared with decision-making regulatory agencies, including the USDA-APHIS (i.e., Anne-Marie Callcott; Entomologist and Biloxi Station Coordinator) and the U.S. Domestic JB Harmonization Plan (JBHP) Regulatory Treatment Review Committee for consideration as new treatments. A flatheaded borer multi-rate imidacloprid test examining insecticide interaction with herbicides reported in the last period is still being monitored for the second season with the planned test termination in year three.

Results

As in 2013, the results of 2014 testing with in-field chemigation drenches and dip treatments combined with Exponent demonstrated that rates of many insecticides and one biopesticide could be lowered for JB control without loss of efficacy. The in-field chemigation drench has proven to be an excellent method of applying pesticide treatments. The results of the third and final field season testing of these treatments will not be available until March 2015, but we expect similar high efficacy control of larval JB. Chemigation treatments with bifenthrin are also providing long residual IFA control. The fourth and final season of bait-injection-band testing against IFA demonstrated again that it is possible to maintain field-grown nursery rows IFA free for 6 to 7 months post-treatment. It is planned to publish the results of the new bait-injection-band treatment and to recommend approval of the treatment by USDA for the Federal IFA Quarantine. It also was determined during this reporting period that longevity of imidacloprid residues was sufficient to allow a quarter rate in the second field season, without loss of treatment efficacy against JB. The quarter rate in the second season will allow growers to use less insecticide, while still providing the same level of quarantine management. The repeat evaluation of this imidacloprid longevity test will be completed in fall 2015. Lastly, the on-going flatheaded borer test at a field-grown nursery has been yielding similar results to a previous test. The unexpected results are that herbicide-treated trees actually have higher frequencies of flatheaded borer attacks at all rate levels of imidacloprid when compared to non-herbicide treated trees. These borer results will eventually be used to recommend new management strategies for commercial nursery growers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #4

1. Outcome Measures

New treatments for invasive pests approved by quarantine regulatory agencies.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Imported fire ants (IFA) have expanded their range into multiple nursery production systems in the southern United States. Currently, only three IFA quarantine treatments are approved for fieldgrown nurseries. All treatments are expensive, rely on one active ingredient (chlorpyrifos), and the post-harvest treatments are hazardous. More options are available for Japanese beetle quarantines than IFA quarantines, but treatments are still expensive for producers due to the limited number of options.

What has been done
Imported fire ant (IFA) and Japanese beetle (JB) research data related to new quarantine options are continuing to be shared with USDA-APHIS-PPQ, the JB Regulatory Treatment Review Committee of the U.S. Domestic JB Harmonization Plan, and the Tennessee Department of Agriculture. During the last reporting period, data shared led to the approval of three new imidacloprid products as nursery band treatments for JB.

Results
Research to develop new pre-harvest band treatments enabled the U.S. Domestic JB Harmonization Plan (JBHP) Regulatory Treatment Review Committee to approve 3 new lower cost generic imidacloprid nursery treatments (Mallet 2F, Quali-Pro 2F, and Lada 2F) in JBHP reported during the last AR 2013 report. The data have subsequently been used by the JBHP Treatment Review Committee to also approve Quali-Pro 2F and Lada 2F as new commercial sod treatments in the JBHP.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #5

1. Outcome Measures

Confirmed establishments of new invasive pest parasites.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Imported fire ants (IFA) infest over 325 million acres in North America and are continuing to expand their range. IFA cause billions of dollars in damage in the United States each provide region-wide sustainable suppression of IFA populations, the USDA has an on-going classical biocontrol program to establish phorid-decapitating fly parasitoids (Pseudacteon spp.) of IFA from South America into the United States. There are about 20 species of Pseudacteon flies in South America, which exhibit niche partitioning of IFA by worker size, species, activity (foraging, mating flights), and time of the day. Therefore, to effectively manage IFA with Pseudacteon flies, it will likely require introductions of a suite of fly species.

What has been done
During fall 2014, a total of 22,656 Pseudacteon cultellatus and 2,039 Pseudacteon obtusus were released in Davidson Co., TN. The P. cultellatus species has not been previously released in the state. These releases supplement the 44,118 P. obtusus released between 2009-2013, 8,840 P. curvatus Formosan biotype between 2004-2008, 18,000 P. curvatus Los Flores biotype between 2000-2003, 2,856 mixtures of P. curvatus biotypes between 2011-2012, and 10,812 P. tricuspis between 1999-2006 and 2011-2012. Surveys were done by placing sticky traps either on top of or 1-meter from fire ant mounds. Traps were baited with sugar baits to attract adult fire ants, which in turn attracted adult phorid flies. Four trap replicates were operated once during each month from May to August in Davidson, Franklin, and Sequatchie Counties in Tennessee.

Results
Only P. curvatus phorid fly have been recovered. Survey efforts during the summer of 2014 yielded only P. curvatus recoveries, including 6 in Davidson Co., 39 in Franklin Co., and 149 in Sequatchie Co. Since P. cultellatus releases just began during fall 2014, it is definitely too early to expect recoveries of this species. It is still possible P. obtusus may be recovered in the state in coming years, but it is likely P. tricuspis releases have been unsuccessful due to the long period of time since releases began and the absence of subsequent fly recoveries. The P. obtusus release in fall 2014 was performed at a site infested with red imported fire ant (RIFA), while all previous releases were done at hybrid imported fire ant (HIFA) sites. P. obtusus prefers RIFA over HIFA or black imported fire ant, which may improve the success rate of the 2014 release.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

211 Insects, Mites, and Other Arthropods Affecting Plants

Outcome #6

1. Outcome Measures

Producers are informed about new or emerging diseases.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nursery growers need to be informed about new and emerging diseases so that they can be prepared for the disease by taking preventive measures and minimize the potential economic impact of the disease.

What has been done
Workshops and presentations on new and emerging diseases.

Results
Presentations provided information to growers on how to recognize the new emerging diseases.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
212	Diseases and Nematodes Affecting Plants

Outcome #7

1. Outcome Measures

Producers are informed about new biological control treatments.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nursery production systems use high rates of chemical fungicides to control powdery mildew of dogwood; this is detrimental to the environment and grower income by increasing dogwood production costs. Alternatives to chemical fungicides would be desirable.

What has been done
Microorganisms selected for superior efficacy against powdery mildew of dogwood were evaluated for bioactivity against other fungal pathogens. Interactions between the biocontrol agents were evaluated to determine which microbes can be combined to enhance biological control.

Results
Results confirmed previous observations on microbial bioactivity against powdery mildew; improved plant growth, and showed bioactivity against other pathogens. Preliminary studies showed that the biological control agents secreted some compounds that may be involved in controlling the fungal pathogens.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
212	Diseases and Nematodes Affecting Plants

Outcome #8

1. Outcome Measures

Producers that are informed about new sources of host resistance.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers need to know about the availability of powdery mildew resistance that will grow better without requiring routine fungicide applications.

What has been done
Research focused on powdery mildew host resistance inheritance to provide information that can facilitate breeding efforts. Identification of molecular markers and morphological markers for powdery mildew resistance will facilitate marker assisted breeding. New plants that display powdery mildew resistance were also generated.

Results
Narrow sense heritability and broad sense heritability were determined. Identification of molecular markers and morphological markers for powdery mildew resistance to assist breeding efforts are in progress. New plants that displayed powdery mildew resistance need resistance confirmation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
212	Diseases and Nematodes Affecting Plants

Outcome #9

1. Outcome Measures

New cultivars exhibiting disease resistance available to growers.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Disease resistance is the best method for disease control by farmers. New generation of cultivars that are resistant to powdery mildew would be a great contribution to nursery growers in that they would not require routine fungicide applications.

What has been done
Genetic characterization of the resistance in the two cultivars.

Results
Genetic information that can be used for advanced breeding purposes has been generated.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
212	Diseases and Nematodes Affecting Plants

Outcome #10

1. Outcome Measures

Nursery/greenhouse operators utilizing alternative energy.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Exploring alternative sources of energy is needed to identify lower cost sources. Such sources range from bioenergy operated by an individual operator to others available through institutions in the energy business. There are various stakeholders including the State Department of Agriculture who provided the latest data base of certified growers used to conduct the mail survey. There are also others such as the Nursery Research Center located in McMinnville, other public and private sector organizations and policy makers.

What has been done
This project introduced research in an important emerging area. It can promote efficient and cost effective management practices that can overcome some of the challenges faced by the nursery/greenhouse growers. It was also able to strengthen collaboration among various groups that have stake in the issue of alternative energy sources and use. The project also generated data that two graduate students-one on energy use by greenhouse and nursery growers and another on marketing of nursery and greenhouse products have been able to use for writing their theses. Knowledge about alternative sources of energy by growers is in itself an important result.

Results
Results show that in addition to the few already utilizing alternative sources of energy, majority of the respondents to our survey indicated that they will consider adopting alternative energy sources. The results are robust and have both direct and indirect benefits. The young and more educated group appear to be more willing to consider adopting alternative sources of energy. This suggests that effort by the above group should be encouraged by extension agents, researchers, government bodies such as the Tennessee Valley Authority. Results of this study can provide some input for such effort.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #11

1. **Outcome Measures**

New alternative controls for insect pests.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Research impact and relevance was measured by one-on-one interaction with nursery growers in meetings and at field research sites, tablulating the number of requests from producers for research-related information or assistance, and surveying producers at workshops and meetings for impact and content relevance. One-on-one interactions with producers and regulatory stakeholders has indicated our research objectives are addressing their critical needs and our outcomes are reducing their costs. Direct requests from producers or related stakeholders for research-related information during the 2013 to 2014 reporting period totaled 1,735, indicating a need within the nursery community of interest for our research results. A survey taken by the eight nursery growers that completed the new online Tennessee Master Nursery Program indicated an average savings of $6,812 per grower due to knowledge gained and practices changed and an additional $7,375 per grower in increased quality. For future evaluations, this program will continue to obtain direct feedback from producers during workshops and one-on-one interactions to determine value of programs, impact of research, and costs-benefits.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Climate Change- improving the quality of water runoff from agricultural production

☑ 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
112	Watershed Protection and Management				50%
133	Pollution Prevention and Mitigation				50%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	6.6
Actual Paid	0.0	0.0	0.0	3.3
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	165827
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	165827
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

Conduct research in water quality monitoring.
Develop outreach materials.

Communicate findings to producers/end users.
Train students.

2. Brief description of the target audience

Agricultural producers, environmental scientists, environmental regulatory agencies.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	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:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	1	1

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Workshops to communicate research findings to stakeholders.

Year	Actual
2014	1

Output #2

Output Measure

- Workshops to educate producers in the target population on how to reduce sediment load to surface water.

Year	Actual
2014	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Nursery producers in the target population will be aware of non-point source pollution from field production of specialty crops.
2	Students will be trained in water quality monitoring.
3	Producers in the target population will have increased knowledge of the relationship between land cultivation practices and sediment load to surface water.
4	Graduate students will have increased knowledge regarding advanced large-scale environmental modeling techniques that would identify significant changes in the variability explained in Southeast total phosphorus SPARROW models.
5	Local, state, and/or federal agencies will have increased knowledge regarding non-point source and land-to-water linkages between land cover, riparian stream buffers, and climate to predict and monitor phosphorus at the southeast regional scale.
6	Stakeholders will adopt use of new data gained from the identification of non-point source and land-to-water linkages between land cover, riparian stream buffers, and climate to reduce the quantity of total phosphorus loadings in watersheds at the southeast regional scale.

Outcome #1

1. Outcome Measures

Nursery producers in the target population will be aware of non-point source pollution from field production of specialty crops.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
During storm events, a large volume of sediment can be added to creeks from surface runoff, especially in field plots where the landscape has been disturbed (plowed or disked). Nursery crop growers are not aware of the impact of this management practices on surface water. Water managers and residents that live in the Collins River sub-watershed and the State regulatory agency (Tennessee Department of Environment & Conservation, TDEC) are concerned about this issue because plowing, liming and fertilization of nursery fields can result in the runoff of tons of soil and essential crop nutrient such as phosphorus to inflow creeks (tributaries) of the Collins River. Phosphorus, metals and many organics adsorb to fine silt and clay, resulting in increased potential for surface water contamination. Fine silt and clay are some component of sediments.

What has been done
2014 was the last year of the project. We monitored Hills Creek and Mountain Creek in Warren County Tennessee in the spring and summer of 2014 for water quality impairment. As previously stated in earlier years, these creeks are major tributaries of the Collins River. Water samples were collected mostly during base flow (normal stream flow) and in very few instances after rainstorm events. The creeks were monitored for the following water quality parameters: Turbidity (because of the strong correlation between turbidity and sediment), Specific conductance, Total dissolved solids, Dissolved oxygen, pH and Temperature. Nitrogen, Phosphorous, Calcium, Magnesium and Potassium were also monitored in the creek water samples.

Results
While growers may be viewed as contributors to surface water quality degradation, our data for the last three years have been consistent and indicate otherwise. We found during base flow that essential crop nutrients like phosphorus (P) and Nitrogen (N) were relatively low in the creeks monitored. For example, the dissolved P in the creeks monitored were less than 0.02 ppm in Mountain Creek and less than 0.10 ppm in Hills Creek. It is worth mentioning that these nutrients

have the tendency to support eutrophication in surface water. However there was no visual evidence of eutrophication in either creek.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #2

1. Outcome Measures

Students will be trained in water quality monitoring.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is the need to train future workforce (students) to meet the need of water resource issues,especially in the area of surface and ground water quality assessment and monitoring.

What has been done
Three students (one graduate student and two undergraduate students) hired as student workers were involved in the project; they gained both research and extension experiential training. The graduate student developed and completed a thesis on one of the primary objectives of the project.

Results
The students assisted in instrument calibration; the analyses of stream water quality parameters and data entry. The graduate student completed an MS thesis.

4. Associated Knowledge Areas

KA Code	Knowledge Area

112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #3

1. Outcome Measures

Producers in the target population will have increased knowledge of the relationship between land cultivation practices and sediment load to surface water.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nursery crop production activities can contribute to both point and non-point source pollution. While the majority of ornamental plants in the sub-watershed are field grown, plowing, liming and fertilization of nursery fields can result in the runoff of soil and essential crop nutrients at a watershed scale. There is a strong correlation between surface water quality and land use within a watershed. The residents, including nursery growers, in the Collins River watershed care about the water quality of the water bodies that drain the watershed.

What has been done
Results of our findings have been shared with some nursery crop growers and county agents in forums such as field days and in an organized workshop.

Results
While turbidity values were used as a surrogate for sediment load. As expected, turbidity values were found to be relatively high (greater than 20 ntu) during storm events. Concentrations of essential crop nutrients such as phosphorus were also found to be low in the creeks monitored; suggesting efficient use of fertilizers by growers. Seven (7) growers in the sub-watershed indicated an increase in knowledge concerning land use and water quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area

112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #4

1. Outcome Measures

Graduate students will have increased knowledge regarding advanced large-scale environmental modeling techniques that would identify significant changes in the variability explained in Southeast total phosphorus SPARROW models.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Not Reporting on this Outcome Measure. The PI for this portion of the program has left the university; this portion of the program is being re-structured.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #5

1. Outcome Measures

Local, state, and/or federal agencies will have increased knowledge regarding non-point source and land-to-water linkages between land cover, riparian stream buffers, and climate to predict and monitor phosphorus at the southeast regional scale.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Not Reporting on this Outcome Measure. The PI for this portion of the program has left the university; this portion of the program is being re-structured.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #6

1. Outcome Measures

Stakeholders will adopt use of new data gained from the identification of non-point source and land-to-water linkages between land cover, riparian stream buffers, and climate to reduce the quantity of total phosphorus loadings in watersheds at the southeast regional scale.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Not Reporting on this Outcome Measure. The PI for this portion of the program has left the university; this portion of the program is being re-structured.

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Government Regulations
- Competing Public priorities

Brief Explanation

For outcomes 4, 5 and 6, the PI for this portion of the program has left the university; this portion of the program is being re-structured.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The effectiveness of the project was determined by a) the heightened local awareness of surface water quality problems and solutions associated with field nursery production; b) best management practices (BMPs) adopted by growers for individual nursery fields; c) demand by growers for better and efficient fertilizers that are not prone to excessive surface runoff during storm events and d) better trained students in the environmental protection and enhancement area.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Safety - contaminant-free, healthier foods

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources				50%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins				50%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	8.6
Actual Paid	0.0	0.0	0.0	5.0
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	253817
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	253817
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

Identify risk factors for cross contamination by investigating storage practices of refrigerated foods.
Determine the likelihood and mechanisms of cross contamination by mapping the genetic fingerprints of bacteria strains from the same refrigerator.
Change potentially unsafe consumer practices through effective intervention strategies.
Characterize, analyze, and identify antibiotic-resistant bacteria in the farm environment (animal manure, soil) and irrigation water.
Train students on isolation and characterization techniques for foodborne pathogens in fresh produce and the farm environment.
Develop and deliver educational materials on hygienic agricultural practices needed to reduce the use of antibiotics and safe fresh produce handling practices.
The development, maintenance, and revision of an educational website and brochure on safe fresh produce handling practices and judicious use of antibiotic in agriculture.

2. Brief description of the target audience

Fresh produce farmers, consumers, food scientists, food production industry, households in the metropolitan Nashville area.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	35	55	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	1	1	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Website developed to educate consumers on antibiotic resistant pathogens on fresh produce.

Year	Actual
2014	1

Output #2

Output Measure

- Database of characterized antibiotic resistant microorganisms isolated from animal manure.

Year	Actual
2014	1

Output #3

Output Measure

- Database of characterized antibiotic resistant microorganisms isolated from irrigation water and watersheds.

Year	Actual
2014	1

Output #4

Output Measure

- Factsheets on improvement of kitchen cleanliness and prevention of cross-contamination.

Year	Actual
2014	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Consumers will be educated via booklets on the occurrence and prevention of antibiotic resistant pathogens on fresh produce (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels.)
2	Producers will practice judicious use of antibiotics on farms through improved agricultural practices (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels).
3	Consumers will practice safe fresh produce handling practices via food safety education (Increase adoption of recommended safe food handling practices at the individual, family,community, production, and supply system levels).
4	Consumers will have increased knowledge of improved kitchen cleanliness (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels).
5	Consumers will have increased knowledge of means to reduce the chance of cross contamination (Increase adoption of recommended safe food handling practices at the individual, family,community, production, and supply system levels).
6	Consumers will adopt safer food storage practices (Increase adoption of recommended safe food handling practices at the individual, family,community, production, and supply system levels).
7	Consumers will adopt improved cleaning skills (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels).

Outcome #1

1. Outcome Measures

Consumers will be educated via booklets on the occurrence and prevention of antibiotic resistant pathogens on fresh produce (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels.)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A majority of consumers have become increasingly aware of the risks of foodborne pathogens associated with fresh produce; more concern especially if the pathogens were antibiotic resistant. Data obtained in this study will be used to educate on risks of using contaminated irrigation water, animal manure, and safe handling practices. Consumers, who adopt to food safety practices, reduce the risks of cross contaminating their fresh produce.

What has been done
Research was conducted to determine current practices of produce production, manure application, waste management, source of irrigation water, personal hygiene, and water testing for pathogens, harvesting containers, and produce handling and storage. Individual farms were analyzed for water quality for irrigation, harvesting containers, sanitizing and harvesting equipment, personal hygiene/hand washing/toilet. Produce growers were also trained on pre- and post- harvesting handling procedures, manure management, and recording keeping of farm operation and log sheets for daily activities.

Results
Results provided valuable information to support food safety on the farm, as well as educational efforts to increase awareness and knowledge of possible bacterial contamination of fresh produce. A follow up on analysis revealed that 80% of the farms had records to show farm activities. Produce growers showed increased knowledge on how to limit contamination of produce during harvesting and the significance of using composted manure on the farms. Growers indicated that they were also having their irrigation water tested for microbial contamination.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Producers will practice judicious use of antibiotics on farms through improved agricultural practices (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Antibiotic resistant foodborne pathogens in fresh produce may cause personal distress, preventable death, and avoidable economic burden. Profiles of antibiotic resistant bacteria obtained from animal manure and irrigation water is applied to educate growers the importance of judicious use of antibiotics in the fields. This contributes to the efforts in reducing the prevalence of antibiotic resistant bacteria in farms.

What has been done
Data on profiles and patterns of antibiotic resistant bacteria from fresh produce and the farm environment was collected. A graduate student was recruited and trained to analyze antibiotic resistant bacteria contaminating fresh produce. Farmers were educated on prudent use of antibiotics on farms and how bacteria resistance is attributed to the overuse and misuse of antibiotics in animal agriculture.

Results
Bacteria isolated from the farm environment showed resistance to the following: antibiotics ciprofloxacin, colistin, streptomycin,and tetracycline. One graduate student became more versed with the food safety issues relating to fresh produce and had hand-on experience in characterizing antibiotic resistant bacteria form farm environment. A significant percentage of

producers farmers indicated they only administered antibiotic treatment only when it was needed and as directed by a veterinarian.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #3

1. Outcome Measures

Consumers will practice safe fresh produce handling practices via food safety education (Increase adoption of recommended safe food handling practices at the individual, family,community, production, and supply system levels).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Contaminated produce is a risk to the public. This is an increased concern now, because more consumers have increased consumption of raw greens in their diets due to increased knowledge of the health benefits of consumption of raw greens.

What has been done
Research information on how to reduce/limit contamination during food preparation was delivered to extension personnel. The focus of the information was the handling of raw meats and fresh produce during food preparation.

Results
Analyses indicated positive consumer behaviors when handling fresh produce and raw meats.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #4

1. Outcome Measures

Consumers will have increased knowledge of improved kitchen cleanliness (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Cross-contamination during food handling, preparation, and storage is one of the major contributing factors in the transmission of foodborne diseases at home. Improving the effectiveness of microbiological control measures in home kitchens is crucial in preventing foodborne diseases.

What has been done
Research was conducted on microbiological evaluation of swab samples collected from consumer home refrigerators. Information on consumer cleaning practices was collected through analysis of data obtained form in-person interviews and in-home observations. The importance and effective procedures of cleaning refrigerator to control microbiological contamination in home refrigerators were discussed with target consumers during home visits.

Results
Results indicate that consumers who clean their refrigerators regularly had significantly lower bacteria contamination on the refrigerator shelves. Target consumers have learned proper cleaning methods to improve refrigerator cleanliness.

4. Associated Knowledge Areas

KA Code	Knowledge Area

711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Consumers will have increased knowledge of means to reduce the chance of cross contamination (Increase adoption of recommended safe food handling practices at the individual, family,community, production, and supply system levels).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Home refrigerators can harbor pathogenic bacteria that pose a potential to contaminate stored foods. Consumers should be informed about safe handling of refrigerated foods to reduce the risk of food contamination.

What has been done
Analysis of in-home research observations were conducted to determine situations that may cause contamination of stored foods. Research results concerning proper storage of refrigerated foods was discussed with the target consumers during home visits.

Results
Research data collected informed consumers of potential issues in their refrigerators that may cause contamination to the foods and the proper storage of refrigerated foods to reduce the chances of cross contamination.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Consumers will adopt safer food storage practices (Increase adoption of recommended safe food handling practices at the individual, family,community, production, and supply system levels).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	27

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Cross-contamination during food preparation and storage is one of the major contributing factors in the transmission of foodborne diseases. Many foods, such as raw poultry, meat, eggs, fish, shellfish, fruits and vegetables have been cited as the potential contamination sources of foodborne pathogens. Proper food handling and storage practices by consumers will reduce the risk of foodborne illness at home.

What has been done
Follow-up analyses were conducted with the consumers who had participated in the prior in-home food storage data collections. Data pertaining to the adoption of the recommended food storage practices were collected.

Results
Improvement of refrigeration storage was assessed by the follow-up analysis. Results indicated that most (88%) of the target consumers reported improvements in their storage practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #7

1. Outcome Measures

Consumers will adopt improved cleaning skills (Increase adoption of recommended safe food handling practices at the individual, family, community, production, and supply system levels).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	23

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Consumer hygiene practices have been frequently reported to be inefficient in controlling bacterial growth and survival in the kitchen environment. Practice of effective cleaning methods by consumers will reduce microbial contamination in home kitchens.

What has been done
Follow-up analyses were conducted by phone with the consumers who had participated in the prior data collections. Data were gathered regarding the adoption of the recommended cleaning practices.

Results
The improvement of refrigeration cleaning practices by consumers was assessed by the follow-up interviews. Results indicate that almost all (92%) of the target consumers reported improvements in their cleaning practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The success of this project was tracked by:

- Increased number of produce growers and farmers in knowledge gained on how to avoid cross contamination during planting and harvesting periods,
- Understanding concepts on the implementation of farm record keeping in individual farms. The farmers indicated that they only administered antibiotic treatment only when it was needed and as directed by a veterinarian. Four farms implemented farm record keeping.
- Number of target consumers adopting safer food storage practices
- Number of target consumers adopting improved cleaning skills
- Number of students trained in research.

Produce growers and consumers were reluctant to participate in the surveys and frequently felt that farm and household information should be confidential and they did not want to share. Produce growers were also reluctant to allow the researchers visit their farm to collect samples for microbial analysis.

This program influenced consumers on safe handling practices of fresh produce during meal preparations at home. Produce growers were educated on how to reduce/control antimicrobial on their farms. This ensures food safety and quality for fresh fruits and vegetables in farms.

Of the target consumers, 88% reported taking safety measures to prevent cross contamination when storing raw meat and poultry in their refrigerators; and 92% reported an increase of frequency in cleaning refrigerator and checking refrigerator temperature. Two students were trained in performing the analytical procedures and have gained knowledge and experiences in performing food safety interview and observation.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Childhood Obesity - youth active and media savvy

☑ 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
703	Nutrition Education and Behavior				40%
724	Healthy Lifestyle				40%
806	Youth Development				20%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	6.1
Actual Paid	0.0	0.0	0.0	3.4
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	169211
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	169211
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

Media literacy research and education
Nutrition education
Nutrition perception research
Physical activity programs
Field trips

2. Brief description of the target audience

African American children, ages 8 to 14 years, living in Davidson County, Tennessee.

3. How was eXtension used?

Rita Fleming, Assistant Professor of Health Education and co-PI, helped facilitate the camp implementation and curriculum training. Fleming also conducted a kitchen hygiene and safety tutorial, as well as supervised meal preparations within the kitchen.
Dr. Tyrone Miller, Leadership Specialist, provided leadership training to camp facilitators and peer educators and oversaw the challenge course field trip activities designed to build the esteem and skills of campers. He also conducted debriefing sessions after the camp and oversaw team-building activities at the TSU Agricultural Research and Education Center's Challenge and Ropes Course.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	62	11	71	19

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	1	0	1

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2014	0

Output #2

Output Measure

- Number of summer camp sessions held to collect data and educate youth in healthy eating and physical activities

Year	Actual
2014	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Target youth attending summer camp sessions (Children Engage in Healthy Levels of Physical Activity).
2	Following intervention, youth will intend to limit television viewing, internet surfing and video games to less than one hour per day each (Children Engaging in Healthy Levels of Physical Activity).
3	Target youth will intend to increase fruit and vegetable intake (Children Practicing Healthy Eating).
4	Target youth will intend to increase level of daily physical activity (Children Engaging in Healthy Levels of Physical Activity).
5	Youth will intend to limit fast food meals to fewer than four per month (Children Practicing Healthy Eating).
6	Target youth will increase self-efficacy and self-esteem.
7	Target youth will maintain healthy behaviors 12 months post-intervention (Children Engaging in Healthy Levels of Physical Activity, Children Practicing Healthy Eating).
8	Increase in daily fiber intake by through the development of soy-fortified breads and incorporation of soy bread into diets.

Outcome #1

1. Outcome Measures

Target youth attending summer camp sessions (Children Engage in Healthy Levels of Physical Activity).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
African-Americans have disproportionately higher rates of obesity and reportedly watch more television than other Americans. Although many social, cultural, and environmental factors influence childhood and adolescent risk for obesity, marketing may have an especially powerful impact on food and beverage consumption. Using a summer camp setting, YAMS was developed to combat the influences of media, insufficient nutrient intake and excess caloric consumption, and inactivity on childhood obesity through media literacy, nutrition education, and physical activity, respectively.

What has been done
Three, 2-week long camps were held with a total of 54 participants attending. Campers received journals to record thoughts regarding their awareness, attitudes and behaviors regarding the daily media, diet and physical activity lessons. Camp participants were instructed using activities adopted from the Media Smart Youth© and Nutrition Detective© curricula. Recipes, nutrition lessons, and cooking were planned, prepared, and taught by a Registered Dietitian. Participants prepared their lunches after receiving food safety preparation lessons beforehand. Each day, campers were involved in 60-minutes of physical activity. Campers participated in cultural and self-esteem empowering activities in gender specific social circles daily. Field trips taken include a trip to a grocery store, the local farmers market, Fisk University's campus radio station (WFSK), Wave Country Water Park, and the Challenge Course at the Agriculture Research and Education Center in Ashland City.

Results
Youth created and presented various forms of media and artistic expressions (i.e. posters, songs, raps, poems and videography) concerning deceitful food marketing, healthy habits, the YAMS camp, and positive self-images of their culture. Observations and self-reports from camp participants and their parents/guardians affirm that campers were motivated to implement and

share healthier food alternatives at home.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
806	Youth Development

Outcome #2

1. Outcome Measures

Following intervention, youth will intend to limit television viewing, internet surfing and video games to less than one hour per day each (Children Engaging in Healthy Levels of Physical Activity).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	37

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Media usage contributes to childhood obesity by reducing the amount of daily physical activity and by encouraging the consumption of high calorie foods via advertising and marketing of primarily candy, cereal and fast food.

What has been done
Twenty-five media literacy lessons were given using Media Smart curriculum. Camp participants learned to: 1) analyze and recognize marketing techniques used to gain viewers' attention; 2) evaluate obvious and subtle messages for accuracy and consistency with what they learned is healthy; 3) expressed their thoughts by developing their own messages. Campers visited the local public television station and a for-profit local radio station to see the differences in marketing strategies.

Results
Campers created audio (radio clips) and video productions (commercials) using resources facilitated and provided by camp counselors. The youth also created and presented various forms of media and artistic expressions including posters, songs, raps, and poems about advertising,

healthy habits, YAMS, and positive self-esteem affirmations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

Outcome #3

1. Outcome Measures

Target youth will intend to increase fruit and vegetable intake (Children Practicing Healthy Eating).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	37

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overweight and obesity of youth are forms of malnutrition that are linked to low consumption of fruits and vegetables. Fruits and vegetables are high in nutrients, such as antioxidants, and low in calories. At least five servings are recommended daily for good health and to prevent cancer.

What has been done
Delivered twenty-five healthy cooking lessons using Nutrition Detective© that include food and kitchen safety information. Lessons and meals emphasized increasing consumption of fruit, vegetable, whole grains, and food sources of calcium and vitamin A. Nutrition lessons encouraged limiting added sugar, fats and salt, controlling portion sizes, reading a nutrition label, and eating whole (unprocessed) food. Daily meals included three to five servings of fruit and vegetables. Youth prepared thirty healthy lunches, one daily. Delivered healthy breakfast and snacks daily.

Results
Youth, including camp facilitators and peer educators increased consumption of water, fruits and vegetables. Youth expressed intent to limit portion sizes of meals, soda, and high calorie snacks. Campers and parents reported preparing the recipes and meals served at home, as well as making more informed decisions on what to consume based off the ingredient list on the nutrition

label.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #4

1. Outcome Measures

Target youth will intend to increase level of daily physical activity (Children Engaging in Healthy Levels of Physical Activity).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	62

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Lack of physical activity is linked to overweight and obesity.

What has been done
Participants learned the importance of physical activity in promoting health and participated in daily physical activities for a minimum of 60 minutes.

Results
The youth committed to increase their daily physical activity after the week of camp.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

Outcome #5

1. Outcome Measures

Youth will intend to limit fast food meals to fewer than four per month (Children Practicing Healthy Eating).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	44

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Eating fast food contributes to childhood obesity by increasing the amount and type of calories consumed. It is recommended that children limit their consumption of high fat/high calorie foods which are typically served at fast food restaurants.

What has been done
Participants read calories tables of fast food menus to learn about the amount of calories from fat and sugar in their favorite fast foods. Participants watched documentaries and short news clips about how fast food meat products are manufactured. Campers also learned about the importance of portion sizes and limiting soft drink intake.

Results
Youth indicated they understood the benefits of reducing fast-food consumption. Children reported reading the food labels while shopping with parents and food items in their parents have in the home.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #6

1. Outcome Measures

Target youth will increase self-efficacy and self-esteem.

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	62

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Self-esteem is important to building self-efficacy needed to read food labels, prepare healthy meals, etc.

What has been done
Delivered thirty sessions that involved cultural and self-esteem empowering activities in gender-specific groups according to and influenced by, the principles of Kwanzaa (unity, self-determination, collective work and responsibility, cooperative economics, purpose, creativity, faith, legacy/heritage, beauty and/or personal hygiene, respect).

Results
It is too early to determine if their understanding of the issues will translate in to sustained action.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #7

1. Outcome Measures

Target youth will maintain healthy behaviors 12 months post-intervention (Children Engaging in Healthy Levels of Physical Activity, Children Practicing Healthy Eating).

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Target youth maintaining healthy behaviors 12 months post-intervention (Children Engage in Healthy Levels of Physical Activity).

What has been done
A 12 month post-intervention has not been captured.

Results
A 12 month post-intervention has not been captured.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
806	Youth Development

Outcome #8

1. **Outcome Measures**

Increase in daily fiber intake by through the development of soy-fortified breads and incorporation of soy bread into diets.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Overall, youth enjoyed the YAMS camp curriculum that included modifications to the Media Smart media literacy lessons. The adaptation of the Media Smart Youth© curriculum and inclusion of some Nutrition Detective© educational material improved delivery of nutrition, physical activity and media literacy information. Recently, updates have been made to the Media Smart curriculum. There are plans to have a two YAMS camp sessions this summer. We will continue to update and customize the YAMS' nutrition, media and health curriculum using cultural and self-empowering activities that address the social, cultural, and gender-specific needs of the target demographic. These activities, such as the Bro Code and Sister Circle sessions, were the most well-received components of the camp.

Key Items of Evaluation

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
44	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
54	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
37	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.