2013 North Carolina A&T State University and North Carolina State University Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

In North Carolina, a range of research and extension efforts are designed to better the lives of North Carolinians and make the state a better place in which to live. These efforts are the result of work at two institutions: North Carolina State University (NCSU) and North Carolina A&T State University (NCA&T). This report documents 2013 research and extension programs provided by these two universities.

Research and extension programs at the two institutions are housed largely in the College of Agriculture and Life Sciences (CALS) at NCSU and in the School of Agriculture and Environmental Sciences (SAES) at NCA&T.

The North Carolina Agricultural Research Service (NCARS) is the research arm within CALS at NCSU, while research at NCA&T is conducted through the Agricultural Research Program (ARP) within SAES. At both institutions, the research effort serves interests in agriculture, environmental, and biological or life sciences. In addition, research programs provide the scientific base for academic and extension programs delivered by the two universities.

The creation of a new College of Sciences (COS) at NC State in 2013 had significant impact on CALS. A number of CALS faculty members, notably those in biological sciences, microbiology, toxicology and genetics, moved to COS along with roughly half the CALS student population. Throughout the year, CALS worked with many stakeholders to develop a strategy for the future: for the college to maintain an enduring agriculture and life sciences research and outreach function based on its heritage of the land-grant mission. Launched in fall 2013, the CALS strategic plan is inclusive and dynamic, outlining strengths, priorities, and opportunities for long-term growth and success, while focusing on five core strategic themes.

The college's research arm, NCARS, conducts research at facilities on and off the NCSU campus. On-campus facilities include highly specialized laboratories (i.e., molecular imaging, soil analysis, and x-ray crystallography), greenhouses, the Phytotron controlled environment facility, the Biological Resources Center small animal facility, Pesticide Residue Laboratories, the Animal and Poultry Waste Management Center, Feed Mill, Structural Pest Training Center, Genomic Sciences Laboratory, Plant Transformation Laboratory, Bioinformatics Research Center, Food Rheology Lab, Nuclear Magnetic Resonance Facility, Plant Disease and Insect Clinic and Food Processing Pilot Plants. Off-campus facilities include eight field laboratories with extensive animal and crop research capability and facilities for agricultural and municipal waste management research; regional research and extension centers with resident research and extension faculty in both western and eastern North Carolina; and 18 agricultural research stations strategically located throughout the state, including the Center for Environmental Farming Systems in Goldsboro, NC, which specializes in sustainable agriculture research and extension.

During the reporting period, the Agricultural Program at NCA&T made significant contributions to agricultural research in all of NIFA's eight research priority areas. Much of NCA&T's research activity is sponsored by the U.S. Department of Agriculture. Research is conducted on the university farm, the Center for Environmental Farming Systems, the Center for Post-Harvest Technologies at Kannapolis, NC,

and in on-campus laboratories, where investigations include such disciplines as agricultural economics, animal science, plant science, landscape architecture and design, human nutrition, housing, food science, and animal health.

The knowledge and technology developed through research conducted in NCARS and ARP are made available to North Carolina citizens through North Carolina Cooperative Extension. Both the College of Agriculture and Life Sciences and School of Agriculture and Environmental Sciences work collaboratively to provide educational opportunities that are relevant and responsive to the needs of individuals, communities, counties, and the state. North Carolina Cooperative Extension is at the heart of this partnership and is the principal agency providing these educational opportunities.

Cooperative Extension's mission is to help people put research-based knowledge and technology to work to foster economic prosperity, environmental stewardship, and improve quality of life. To address ever-changing needs, Extension's statewide long-range plan changes as needs and circumstances dictate.

The plan focuses on three priorities:

- to strengthen the economy through profitable, sustainable and safe food, forest and green industry systems,
- to protect the environment and natural resources, and
- to empower youth and families to lead healthier lives and become community leaders.

To achieve the plan's objectives, extension specialists and researchers at the two land-grant universities work hand-in-hand with field faculty stationed in all 100 North Carolina counties and on the Cherokee Reservation in the state. To achieve relevance and value in its programs, Extension benefits from the input of a well-established statewide system of lay advisers, who represent the state's diverse population. Each county periodically conducts an environmental scan to determine emerging needs and appropriate educational responses. These scans give residents, advisers, commodity group representatives, volunteers, and other clients an opportunity to ensure that local programs meet local needs and priorities. Cooperative Extension also maintains a civil rights plan that includes computer monitoring of program participation by gender and race. This effort ensures that underserved and underrepresented audiences are among those included in program development and implementation. A permanent Diversity Task Force monitors programs, suggests policy, and develops and conducts training for the organization. Stakeholder input informs all Extension programs.

Cooperative Extension is currently engaged in a Strategic Vision & Planning Initiative to help map the organization's future. The organization's Visioning Team - made up of Extension employees, county government partners and volunteer leaders - gathered recently to review and synthesize input from 14 public listening sessions and online comments. This planning and reorganization process will strengthen Cooperative Extension and better align its priorities with the needs of North Carolinians as it prepares to celebrate its 100th year during mid-2014.

This report reflects impacts of the joint educational programming efforts of the NC Cooperative Extension Service of NCSU and the Cooperative Extension Program of NCA&T. This report also updates and highlights accomplishments and impacts of research conducted through NCARS and ARP, emphasizing high-priority areas in agriculture and life sciences for North Carolina now and in the near future. The research and extension programs documented here are helping North Carolina's population of nearly 10 million citizens address critical challenges facing them today and in the future.

NOTE: For the NC State University estimated FTEs/SYs entered into the table below, we are calculating our Extension FTEs differently than in the past. In the past, this parameter was defined as campus based extension faculty with some extension appointment. For 2015 forward, we will be

calculating this parameter to represent FTEs of extension campus and field faculty, funding for which comes from NC State University. Thus, if you compare to last year's numbers given for NC State University 1862 extension, there is about a 30% increase in FTE numbers for extension.

Following are examples of research and extension activities from both NCSU and NCA&T within each program area.

GLOBAL FOOD SECURITY - PLANT PRODUCTION SYSTEMS AND HEALTH

Increased sorghum acreage results in significant revenue for North Carolina: Soaring transportation costs and the rising price of fats and oils has made the current practice of importing large amounts of feed grains into North Carolina economically challenging to the state's poultry and swine industries. One promising solution is to increase sorghum production. Research and extension programs - including hybrid testing, crop management studies, grower sessions, online agent training, and field tours - contributed to the growth of sorghum acreage in North Carolina from 17,000 in 2011 to 100,000 in 2013. This translates into $33 million of additional revenue for the state.

Release of new peanut varieties could boost yields in a big way: Two new peanut cultivars, Sullivan and Wynne, were developed by NCSU and released for use by peanut producers in North Carolina, Virginia, and South Carolina. Both possess the patented high oleic fatty acid trait that extends the shelf life of those peanuts and products made from them.

Safer pesticide products curb adverse effects on human health, environment: Pest management studies were conducted by NC A&T researchers on cowpea, tomato, eggplant, and collards using sustainable and safe approaches. Safer and more effective pesticide products (Azadirachtin-derived biorational and Spinosad) were identified and are available for use on vegetable crops.

New crops present economic potential for North Carolina: With rising demand for stevia (an alternative plant sweetener) in North Carolina, more farmers are taking on this specialty crop but lack the knowledge of best production practices. Growers who attended Extension programs and an Organic Grain Field Day reported increased knowledge, and a number of farmers reported that they started growing stevia as a result of these programs. Hops and malting barley production also are taking off in North Carolina, with the recent boom in the number of craft breweries. In order to meet growers' needs, a research variety trial was developed at the Mountain Horticultural Crops Research Station in 2011, along with a website, blog and Facebook page. In 2013, the program advised growers on variety performance and cultivar selection and developed new guidelines pertinent to growing hops in this region. Fertility recommendations also were developed, and there is now a code for hops on soil sampling reports.

Post-production technology continues to result in fresher apples, increased revenue: The SmartFresh Quality System, developed and patented by NCSU, maintains apple flesh firmness and fruit acidity much longer after harvest. However, the application of this product requires an air-tight facility for 24 hours with the cost being based upon the volume of the facility. Many North Carolina growers do not have a suitable facility and would benefit from an economical facility to treat smaller quantities of apples that can fluctuate with the seasonal volume changes. Several workshops, educational programs at grower meetings, videos in production, and an instructional publication helped educate growers on how to purchase or build an adequate treatment facility and effectively use SmartFresh. As a result, a larger portion of the 2013 Southeast apple crop was treated with SmartFresh, resulting in a higher quality product for the consumer. The maintenance of fruit quality realized with SmartFresh resulting in increased sales and allowing apples to be sold in higher value markets could contribute 10% to the value of the approximate $25 million dollar apple industry, totaling more than $2 million annually.

GLOBAL FOOD SECURITY - ANIMALS AND THEIR SYSTEMS, PRODUCTION AND HEALTH

Increasing particle grind size of poultry feed enhances dietary nutrient utilization: Several NCSU studies were conducted in which particle size of soybean meal or corn was increased for a fraction of the complete diet. Improvements in feed conversion without adverse effects on growth performance, as well as reduced nitrogen excretion, were observed when a mean particle size was increased in the diet of broilers. Producers who have applied this technology have observed a 3% improvement in feed conversion, significantly improved nutrient utilization, reduced incidence of enteric help problems, and a reduction of ammonia emissions from poultry operations.

Research aims to help small ruminant producers stay profitable: Parasitic and inflammatory diseases are the number one cause for losses incurred by small ruminant producers. NC A&T lab and farm studies were conducted to understand targets for genetic improvement of animals through selection and immune-modulation to control inflammatory and parasitic diseases. Based on attendance at presentations, awareness of the project's goals will translate to on-farm practices and scientific strategies to reduce costs and lead to improvements in management practices and interventions.

Natural replacements for antibiotics in feed prove to be effective: Because of public pressure to discontinue the practice of including sub-therapeutic antibiotics in animal feed, U.S. pork producers are seeking natural, research-proven and affordable solutions for managing growth, preventing disease, and enhancing the overall health of pigs. NC A&T researchers conducted a series of experiments evaluating the effects that sow diets supplemented with oat or yeast culture and fed during gestation and lactation had on piglet intestinal health and growth. It was discovered that including oat in the diet of sows was beneficial to piglets; they weighed more at birth, lost the least amount of weight during a post weaning period of 14 days, and had decreased incidence of diarrhea.

New Farm Assessment Program designed to boost NC dairy industry: Dairy farm numbers in North Carolina have decreased over time, and the volume of fluid milk produced in North Carolina is currently less than half of the amount consumed by the state's citizens. To help revive the North Carolina dairy industry, a new Farm Assessment Program was developed as part of NC Dairy Advantage to provide a comprehensive measurement of a dairy farm's performance. Two farm assessments were conducted in 2012 and 2013, and two additional assessments were started in 2013, with completion expected in early 2014. This program will provide all North Carolina dairy producers with critical benchmarking data and management goals, which are anticipated to have broad financial impact across the state.

Improved methods of swine depopulation could stem impact of disease outbreak: In the event of a foreign animal disease outbreak in the United States, a rapid and humane method for on-farm swine depopulation will be required. Current methods relying on the handling and restraint of individual animals will prove much too slow to stem the spread of disease. A project is underway at NCSU to identify, evaluate, and disseminate efficient practical methods to mass depopulate swine on farms in the event of an emergency. This involves evaluating the application of CO2 supplied by bulk liquid CO2 tanker trucks as well as the possibility of generating CO2 on-site. In the event of a contagious swine disease outbreak in the North Carolina or elsewhere in the nation or world, this research will be of significant value in containing the disease and minimizing the consequences.

CLIMATE CHANGE

New precision application technology helps farmers avoid over-application: Two sensor systems have been deployed to measure plant response in real time and determine nitrogen requirements on the go. An algorithm to evaluate plant response and determine nitrogen requirements is being tested to

determine if it is suitable for use under North Carolina crop conditions. Real time assessment of nitrogen requirements can significantly reduce over-application of fertilizer, which ultimately will lead to reduced fertilizer cost and reduced environmental impact.

Field experiments evaluate effects of poultry waste compost: Southeastern U.S. soils have low soil organic matter content. Increasing soil organic matter content using animal waste compost amendments is a way to increase soil carbon sequestration and improve soil quality. The effects of poultry waste compost applications to soil on soil quality and carbon sequestration were evaluated by NC A&T researchers in 3-year field experiments located at the North Carolina piedmont and coastal plains topographical regions. At both locations, applying compost at a 10 ton/acre/year rate increased soil carbon content, soil water retention, and nutrient retention, and also reduced soil erodibility. Statewide, Extension worked with 1,350 producers implementing waste management plans, and more than 1.5 million tons of livestock and organic waste were used as fertilizer. At a value of $10/ton, this would represent $15 million in fertilizer value savings.

Study examines global warming gas emissions: Global warming caused by gases produced through agricultural and animal operation systems is strongly believed to be negatively impacting climate change. NC A&T scientists conducted a series of assessments to determine the type and quantity of global warming gases that are emitted from constructed wetlands established to treat swine wastewater at different seasons. It was discovered that global warming gas emissions were higher in summer months followed by fall and winter months.

Statewide storm water demonstration sites educate public, curb water quality problems: Storm water runoff in developed watersheds has become a major concern throughout North Carolina. In 2013, demonstration sites were installed in every eco-region of the state. These sites not only function to help mitigate water quality problems, but also to educate the public on what the practice is and how it works. This project has resulted in positive feedback from citizens and decision-makers as well as a greater understanding of structural storm water practice installation. Statewide, 451 program participants were involved in implementing community-based projects for environmental protection.

Waste management certification classes focus on best practices: North Carolina animal waste applicators are required to receive six hours of continuing education credit every three years. In Pitt County, Extension taught three certification classes providing 75 credit hours to 150 operators. Participants gained knowledge on managing spray fields for hay production, over-seeding with winter annuals and coping with wet application conditions. Statewide, 2,164 waste applicator certifications were obtained or maintained as a result of Extension training.

SUSTAINABLE ENERGY INCLUDING BIOTECHNOLOGY

Researchers explore new processes for conversion of miscanthus and switchgrass into biofuels: There is a need to develop efficient processes for converting low-value feedstocks like lignocellulosic biomass - that do not compete with the food needs of humans and animals and can be produced sustainably - to fuels and chemicals. Since lignin is highly recalcitrant to pretreatment, the lignin monomer distribution in miscanthus and switchgrass as impacted by alkaline pretreatment is being investigated. Utilization of renewable resources for production of transportation fuels like bioethanol and biodiesel can make the overall process sustainable. Additionally, employing environment-friendly conversion processes that are not energy intensive provides economic advantage while reducing processing waste.

Field experiments test fertilizer treatments for miscanthus: NC A&T scientists are investigating

nutrient management for optimal Giant Miscanthus production for uses as a feedstock source for biofuel. A field experiment was conducted with five fertilizer treatments in four replications; data collected and analyzed. Data analysis showed that the fertilizer treatment T3 with 120 kg N/ha produced significantly better growth results than the other treatment conditions.

Swine waste holds potential as energy source: Current animal waste management technologies emphasize waste treatment rather than waste utilization. An advanced biological system is being developed by NC A&T scientists to efficiently and economically treat swine wastes and recover materials and energy from the wastes. This work has resulted in: (1) a microalgal process for bioremediation of swine wastewater and production of multi-products; (2) a novel fermentation process to produce bioethanol and acetic acid from fresh microalgae; and (3) a novel hydrothermal process to extract lipid and produce biodiesel from wet microalgae.

Potential of algae as bioproduct is investigated: There is a need to develop and evaluate low-capital cost, low-maintenance cost and highly scalable cultivation systems for year-round production of algae. A process has been developed by NC A&T for microalgal strain isolation, screening and identification of algae with good biofuel production potential. This work resulted in a newly identified microalgal strain and the construction of two scaled-up algal photobioreactors.

Installation of energy saving strategies in tobacco barns cuts fuel costs for NC growers: Curing fuel represents one of the largest expenses in flue-cured tobacco production. Cooperative Extension in Wilson County has addressed this issue by promoting energy efficiency in curing tobacco through the use of automatic ventilation controls, additional insulation, replacing seals, and other methods. These efforts saved Wilson County growers an additional 36,864 gallons of LP gas this curing season, which translates into $51,610 in fuel. On a broader scale, the total energy performance of three different makes of new curing barns at the same on-farm location was evaluated during the 2013 season. Instrumentation was implemented to monitor fuel and electrical energy consumption each cure. Based on the results, if a grower can increase energy efficiency with the purchase of a new barn from a season average of 10 lb/gal LP to 14 lb/gal LP or higher, the result is a cost savings of approximately 3¢ or more per pound cured based on 2013 fuel prices.

CHILDHOOD OBESITY

Statewide project aims to implement policy changes that combat childhood obesity: Childhood obesity is a growing national problem, particularly in lower income and education communities. The issue is in both the availability of healthy food and places to be physically active and also in the consumer's food and activity choices. The NCSU AFRI project is an intensive research-to-action project to understand food choice and make healthy food more accessible and culturally desirable as well as increase consumer's knowledge about healthy foods. The final site local asset mapping workshop has been completed. From these workshops, the sites have developed community action groups which have begun a strategic planning process with integrated mini-grants for local small scale projects. The final goal of this project is to implement 150 environmental and policy changes locally to enhance consumption of fruits and vegetables and increase physical activity.

State 4-H program charges ahead on mission to help young people be healthy: In 2013, North Carolina 4-H's commitment to helping youth grow strong, both physically and mentally, continued with outstanding results. As a result of statewide 4-H programs:

- 26,817 youth increased their consumption of fruits and vegetables,
- 31,700 participants (youth and adults) increased their physical activity,

- 3,146 participants (youth and adults) reduced their BMI, and
- 9,513 participants (youth and adults) consumed less sodium in their diets.

Steps to Health program helps thousands of NC youth improve nutrition and physical activity: While obesity rates continue to rise nationally, they have increased the most among those in the lowest income levels. In North Carolina, 43% of low-income children are overweight or obese. In 2013, the Steps to Health program provided nutrition education with the ultimate goal of promoting positive behavior change related to nutrition and physical activity. Six distinct were provided at low-income sites across North Carolina. Steps to Health reached 5,901 participants (5,348 children and 553 adults) and made 46,810 educational contacts within 49 counties across North Carolina.

Nutrition curriculum changes perceptions of fast food and other health-related issues: There is a strong need to improve awareness of the dangers of fast food - and of overall healthy eating - among North Carolina youth. Forty-six minority students completed a nutrition curriculum with topics ranging from reading food labels to physical activity. Findings were significant for the "Eating on the Run" topic, which exhibits participants' awareness of the importance of reducing the consumption of fast food meals. Healthy eating and other approaches to weight control are strongly related to the entire family's attitude and approaches to eating. According to the state EFNEP web-based nutrition education evaluation and reporting system, 69% of youth participants in statewide Extension programs showed improvement in their ability to choose healthy foods, and 42% of youth statewide improved their physical activity practices, among other significant findings.

Thousands of NC youth respond to Extension programs by eating more fruits and vegetables: One of the goals of Cooperative Extension's statewide youth nutrition programming is to get young people to understand the implications of eating an unhealthy diet and to encourage them to eat more fruits and vegetables each day. Statewide, 26,817 youth participants in various healthy eating educational activities reported that they increased their fruit and vegetable consumption as a result of participation.

FOOD SAFETY - FOOD PRODUCTION SYSTEMS: DEVELOPMENT, PROCESSING AND QUALITY

ServSafe certifications keep people healthy, food service establishments thriving: The Centers for Disease Control and Prevention estimates that roughly 1 in 6 Americans (or 48 million people) get sick from a foodborne illness each year. Food safety education is believed to be an integral part in preventing foodborne illness outbreaks. In 2013, Cooperative Extension provided ServSafe training and certification to 1882 food service employees statewide. This program has potentially saved food establishments approximately $3.5 million in costs.

Breakthrough food processing technology continues to be commercial success: Continuous flow microwave sterilization and pasteurization for processing and aseptic packaging of fruit and vegetable products has been designed, developed, extensively tested, validated and commercialized. The NCSU-based technology has received several U.S. and multiple international patents and has been licensed to several start-up companies in North Carolina, including Yamco, Aseptia, and Wright Foods. Wright Foods, which was founded just one year ago, announced in July 2013 a $53 million expansion that is projected to triple the size of the plant, adding 120,000 square feet and more than 500 new jobs.

University/business partnership has potential to revive NC blue crab industry: Mechanical extraction of raw crabmeat results in 300 percent higher yield, with substantially less labor input, than the current industry process of cooking, cooling and hand-picking crabmeat. Recently a patented method for restructuring raw crabmeat was issued to Shure Foods Inc, a fledgling North Carolina-based company. NCSU researchers are partnered with Shure Foods to further develop and commercialize the technology. The expected outcomes should deliver technical solutions for insuring a robust, consistent process for

commercial production of high quality restructured crabmeat products, leading to full commercialization, and potentially the revival of the blue crab industry in eastern North Carolina and the mid-Atlantic United States.

Food safety infosheets used by NC food handlers soon to evolve into pilot certification program: It is estimated that up to 70% of foodborne illnesses come from food handlers making behavioral mistakes. In 2013, seven food safety infosheets were distributed to an estimated 10,000 individuals through various online methods. Several direct subscribers also were known to send infosheets to all of their organizations' outlets, reaching an estimated 15,000 additional food handlers. It is believed that if just one of the 25,000 food handlers changed his or her behavior, and a single major outbreak of foodborne illness was avoided through the posting of food safety infosheets, that the savings to that organization could be an estimated $500,000-$5 million in medical expenses, brand damage and loss of market. These infosheets have become the basis for a food manager certification program to be piloted in 2014.

Research uncovers method to maintain quality attributes of foods enriched with dietary fiber: Formulating dietary fiber-enriched foods using cereal bran presents challenges since they often adversely affect color, texture, flavor, and taste of the supplemented foods. NC A&T scientists established a protocol for processing wheat and corn brans using a microfluidization process to alter the physicochemical and antioxidant properties of wheat and corn brans. In addition, the effects of modified brans on product quality of bread and extruded corn cereal were investigated. This research revealed that bread and extruded corn grits enriched with microfluidized brans showed better quality attributes than those supplemented with ground bran at the same substitution level.

HUMAN AND COMMUNITY DEVELOPMENT - YOUTH DEVELOPMENT AND FAMILIES

Cooperative Extension helps families create budgets, plan for the future: Family and Consumer Science Agents collaborated with county and state partners to conduct workshops, conference and other educational events addressing the importance of basic money management skills. As a result of these efforts, 2,620 individuals and families implemented basic financial management strategies, and 6,896 people accessed programs and implemented strategies to support their family economic well-being. Additionally, as a result of Extension programs in retirement planning, 586 people accessed financial products and programs aimed at accumulating wealth.

New protocols developed to help community based organizations succeed: The success of efforts to involve local communities depends on the ability of local authorities to mobilize groups, cultivate partnerships that involve diverse people and organizations in leveraging, combining, and taking advantage of their complementary capabilities. A survey and listening sessions conducted by NC A&T resulted in the collection of critical data from 344 community based organizations (CBOs) in the Black Belt Region: Florida, Georgia, Texas, Tennessee, and South Carolina. The project developed a guide for facilitating collaboration between the university and CBOs, a protocol for facilitating collaboration among CBOs, and a database of CBOs active in implementing community development and poverty alleviation programs.

More in My Basket program helps limited-resource individuals and families: Guilford County ranks 4th in the nation of counties with food insecurities, based on USDA statistics. Many limited-resource senior citizens do not have enough money to buy adequate food for their families. To address this problem, More in My Basket (MIMB), a Supplemental Nutrition Assistance Program (SNAP) developed by NCSU, was implemented in Guilford County. The objective of MIMB is to help create awareness in senior citizens about SNAP and how to apply for benefits. Nine educational sessions were conducted in 2013, and 44% of participants reported that they planned to apply for SNAP benefits. The potential economic impact would be $37,584/year in additional food purchasing power for Guilford County residents.

Thousands of youth gain critical life skills through 4-H: North Carolina offers its youth and families a number of unique opportunities to discover the world through 4-H camp and educational programs, to learn 21st century skills, to serve their communities, to learn employment skills and to learn how to be citizen leaders. In 2013 more than 227,000 youth participated in 4-H day and residential camping, 4-H club activities, and school enrichment programs. The focus of the various activities included healthy eating, preparing youth for an employable future, building community volunteerism, developing life skills, and achieving academic and educational success.

Leadership and community development are focus of Extension training programs: Leadership development and engagement skills are critical for vibrant communities. Extension provided statewide training and education to adults to participate effectively in community engagement activities. More than 7,600 adults increased their skills to facilitate public engagement on community-based issues, 225 organizations increased or leveraged resources for community programs, and nearly 700 people participated in community disaster preparedness activities and/or adopted disaster preparedness and mitigation practices. Also as a result of Extension programs, 2,081 citizens statewide reported collaborating in community-wide planning for economic, social and environmental sustainability, and more than 2,000 people engaged in community-based public policy issues.

HUMAN HEALTH, NUTRITION AND WELL-BEING

Rosemary, wheat bran investigated for their "superfood" potential: In addition to essential nutrients, functional foods contain a variety of compounds possessing health-promoting activities. More in-depth research is needed to identify the active components in functional foods and to study the in vivo efficacy of bioactive food components and functional foods. NC A&T researchers investigated the effects of rosemary and its active components on metabolic syndromes and the effects of phytochemicals in wheat bran for colon cancer prevention. Results showed that carnosic acid was the active component in rosemary and that carnosic acid enriched rosemary extract might be developed as a dietary strategy for the prevention/treatment of obesity and related metabolic syndrome. Investigation of the chemical profile of wheat bran revealed three major active components to kill colon cancer cells.

Research, Extension program reduces negative impact of bio-contaminants in industrial settings: Insects and related pests can be bio-contaminants in industrial settings, especially in the food and pharmaceutical industries, where bio-contaminants may create deleterious effects in consumers, company liability and potential significant economic costs. Cases of actual or suspected bio-contamination require direct intervention by the scientist and may require up to five days of involvement, including: positive pest identification through the NCSU Plant Disease and Insect Clinic, site visits including facility and product inspections, and preparation of written documentation concerning the origin of such problems and then outlining a course of remedial and preventive action for this and similar problems. As a result of these efforts, industries experience fewer shipment rejections, maintain working relationships with their customers, and avoid situations that might result in contract losses.

Researchers study insulin gene to halt development of diabetes, treat pancreatic cancer: According to the North Carolina State Center for Health Statistics, the prevalence of diabetes in the state is 8.5% (higher than the 7.3% national average). The progression of Type 2 diabetes from pre-diabetes to diabetes is typically accompanied by damage to the insulin-producing pancreatic beta cells. NCSU researchers are working to understand how the insulin gene is regulated so they can learn to increase beta cell production of insulin, and even stimulate non-beta cells to make insulin. In addition, scientists have started investigating how proliferation of pancreatic cells is regulated. This work will contribute to the effort to stimulate insulin gene expression to prevent the progression of pre-diabetes to diabetes. This work also will contribute to treatment of pancreatic cancer.

Institute research and collaboration aims to bolster development of plant-based medications: In this era of diminishing returns for novel drug development and escalating costs for health care, plants and related natural products offer a final frontier for new drug and health product discoveries. Plant-based medications (including functional foods) can offer safe, time-tested, efficacious alternatives to drugs. Research taking place at NCSU's Plants for Human Health Institute (PHHI) focuses on elucidation of the natural, health-protective constituents inherent in edible plants, and exploiting these insights towards development of concentrated, efficacious, unprecedented, and cost effective functional food ingredients and phytopharmaceutical components. PHHI also is part of a global bioexploration initiative that has served as a launch pad for introduction of cost-effective, novel biofortified food ingredients into rural villages/impoverished communities which otherwise have no access to the bioactive phytochemicals produced in healthy fruits and vegetables.

Eat Smart, Move More, Weigh Less continues to improve health of NC citizens: North Carolina, like many other states, has a plan to prevent overweight, obesity and related chronic diseases. To achieve the goals of the state plan, accessible and affordable, family-based, culturally relevant, interdisciplinary weight management services for adults are needed. The Eat Smart, Move More, Weigh Less curriculum was created in response to this call for action. The objective of the program is to develop a comprehensive low-cost weight loss/weight maintenance curriculum for adults that could be widely implemented across the state by trained professionals. As of December 2013, a total of 185 Eat Smart, Move More, Weigh Less online classes with 3,520 participants enrolled have been completed. Data analysis of participants shows significant reduction in BMI, blood pressure and waist circumference.

Omega-3 fatty acid-enriched pork products could help combat human disease: The beneficial effects of omega-3 fatty acids on various human diseases such as obesity, osteoarthritis, diabetic nephropathy and coronary heart disease are well documented. Fish oil is a prominent natural source of omega-3 fatty acids derived from algae that fish consume. Because omega-3 rich algae are not grown commercially, the opportunity exists to enrich pork products by direct feeding of omega-3 enrich algae. NCSU researchers investigated the effects of dietary supplementation of docosahexaenoic acid (DHA) and &alpha-linolenic acid (ALA) on the accumulation of omega-3 fatty acids in pork. This research revealed that pork tissue content of n-3 fatty acids can be markedly enriched in as little as four weeks of supplementation during the late finisher phase.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	400.0	39.0	425.0	46.0
Actual	523.0	84.0	403.0	44.0

II. Merit Review Process

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

- Internal University Panel
- External University Panel
- Combined External and Internal University Panel

- Combined External and Internal University External Non-University Panel
- Expert Peer Review

2. Brief Explanation

For NCARS, a thorough scientific and merit review of each proposed new or revised research project is done at the departmental level prior to submission to the NCARS office. This departmental review consists of two parts: an informal review (PI's responsibility) and a formal review (Department Head's responsibility). Cooperative Extension's work is closely coordinated with NCARS efforts. In fact, about 100 of the 300 Extension faculty (144 FTEs) within the College of Agriculture and Life Sciences at North Carolina State University have joint appointments with NCARS. Extension on-campus faculty collaborate with over 600 state and county supported Extension agents, who plan and deliver educational programs across the state. This effort is further strengthened by the Extension programmatic efforts of NCA&T agents and faculty, who collaborate with NCA&T researchers. In addition to this alliance with research faculty at both institutions, Extension benefits from the input of a well-established statewide system of lay advisers representing the state's diverse population. Also, each county routinely conducts an environmental scan to determine emerging needs and appropriate education responses. These scans give residents, advisers, commodity group representatives, volunteers and other clients the opportunity to ensure that local programs meet local needs and priorities. Stakeholder input undergirds all of Extension's efforts.

The research director in SAES determines the need, priority, and scientific feasibility of proposed Evans-Allen projects and the development and implementation procedure for project documentation, merit review, and selection. The procedure assures that research proposals are scientifically sound, relevant to society's food and agricultural needs, and not duplicative of efforts undertaken elsewhere. Prior to proposal development, alignment of the research topic with the needs of the state and the direction of the eight program initiatives of SAES is determined. Upon agreement by the department chair, the associate dean for research, the research director, and the principal investigator, a proposal on the topic for submission through the Evans-Allen program is prepared. The merit review process includes a review by five peer reviewers from both within and outside the University who are knowledgeable of or familiar with the area of research. The principal investigator incorporates suggestions made by the reviewers and must give reasons for any substantive suggestions not included or addressed. The proposal is then reviewed by the associate dean for research, who determines if additional review and substantive revision is necessary. Upon acceptance by the associate dean for research and research director, the proposal is submitted for budgetary review by the Office of Agricultural Research and then transmitted to NIFA/USDA for approval.

III. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of selected individuals from the general public

Brief explanation.

Extension has an ongoing system of securing stakeholder input in program planning, implementation, and quality assessment has and continues to be a primary commitment for North Carolina Cooperative Extension. An Advisory Leadership System is functional in each of North Carolina's 100 counties. The system includes an Advisory Council and many specialized committees. The Advisory Council represents geographic, cultural and economic diversity within communities of the county. Its function is to provide overall programmatic review and conduct environmental scans and needs assessment for program direction. Council members represent the diversity of the respective county population to assure the inclusion of under-served populations. While the advisory council meets quarterly, the specialized committees meet at least annually to discuss accomplishments and needs still to be addressed. This system is monitored administratively to assure that stakeholders provide program input and actions. At the state level, a Statewide Advisory Council provides programmatic inputs, review, and guidance for the overall program functions of the North Carolina Cooperative Extension Service at N.C. State University. This group meets quarterly as well as for other special meetings to provide organizational review and input. This Council is made up of influential individuals who represent a broad scope of the diverse population in North Carolina and who have distinguished themselves as respected, responsible, and knowledgeable leaders who can provide local perspectives to a statewide organization. In addition to being an integral part of the overall State Advisory Council, the Extension Program at NCA&T State University is also guided by a cadre of citizens who make up the Strategic Planning Council.

The Strategic Planning Council includes community leaders, agribusiness persons, representatives from non-governmental organizations, representatives from the State Advisory Council, representatives from county-based specialized committees and elected officials. The Strategic Planning Council meets three times a year as a group. Networking and collaboration between the State Advisory Council and the Strategic Planning Council is facilitated by two members who serve on both Councils. Members of each Council periodically meet jointly. With these organized groups emphasizing and providing significant stakeholder input into program direction, a planned and proactive process is operational that assures that programs are reviewed and overall needs assessed on a continuous basis, but no less than once every two years, with greater frequency encouraged. However, the respective advisory groups provide more frequent stakeholder input, which means a continuous process of program review and adjustment is available to address changes in local needs. An environmental scanning process is implemented in each of the state's 100 counties. This scanning process helps to assure that a large amount of input is gained from the citizens whom the research and extension efforts are intended to serve.

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
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments

Brief explanation.

As indicated in the Plan of Work, a deliberate initiative is continuously underway by research and extension programs to meet, listen to, involve, and interact with any and all stakeholders. These

efforts are carried out in a highly proactive manner. In addition, commodity association members and representatives, county commissioners, state legislators and many other leaders and policy makers both at the local and statewide levels have varying degrees of influence and interaction regarding program direction, issues identification, budgets, staffing and developing plans of action. This is an on-going function that is ingrained in the program planning and implementation for both research and extension in North Carolina. It is our intent to involve and serve the citizens of the state in the most effective ways possible to enhance the quality of North Carolinian's lives and economic well-being.

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
- Survey of traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

Cooperative Extension uses mailed surveys, electronic/web surveys, telephone surveys, one-on- one interviews, focus groups, and community forums to collect stakeholder inputs for the needs assessment and program prioritization process. NCARS is committed to seeking, receiving and using input from all stakeholder groups, including under-represented groups and the general public. A significant portion of the input from individuals throughout the state comes from interactions of research scientists with county-based extension personnel and directly with producers, industry and other agribusiness representatives. Many research faculty also have extension appointments. These faculty are the primary day-to-day communication link between agribusiness, county extension centers and NCARS. Because research and extension activities are directed toward the development and implementation phase of new knowledge and technology, faculty members are constantly relating industry needs and suggestions to other researchers, whose emphasis is more in the discovery phase. In addition, faculty interact with county extension personnel in such a way that input from individual consumers is also effectively communicated to NCARS administration and faculty.

3. A statement of how the input will be considered

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

Brief explanation.

The environmental scanning process entails obtaining both secondary and primary data on key issues of concern, needs and assets in the community. Secondary data are used to assess the

analyzed needs (data and statistics) as well as needs identified/prescribed by experts. Primary data were collected by holding meetings, focus groups and/or interviews with key stakeholders such as extension advisory leaders and county government partners. These combined data and input were used to prioritize and target issues, needs and assets that serve to focus, guide and direct extension programming. For research, stakeholder input is especially used in determining research directions as well as for gaining program support and advocacy for research initiatives. For example, the commodity association boards provide information on high-priority research areas to be used in requests for proposals, and boards then decide which proposals to fund. This is the most targeted type of stakeholder input, having a direct effect on research activities. Also, leaders in the North Carolina Agricultural Foundation, N.C. Farm Bureau Federation, N.C. State Grange, N.C. Department of Agriculture and Consumer Services, N.C. Agribusiness Council and numerous other organizations not only provide insight on research needs and priorities but assist in program reviews as well as advocate for research by promoting the importance of agricultural and life science research.

Brief Explanation of what you learned from your Stakeholders

Many issues identified as key concerns by North Carolina citizens are addressed by Cooperative Extension programs. Agricultural preservation, sustainability and development, and nutrition and health were identified as key issues. Increasing economic opportunity, business development, and developing community leaders were other key issues. Environmental stewardship and natural resource management were identified across the state as well. A continued emphasis and concern about building strong families and developing responsible youth as well as educational opportunities for the state's citizens were all labeled key issues facing North Carolina. NCARS maintains close ties with 90 state agricultural industry associations, of which 24 provide funding to various research projects annually, usually on a competitive basis. In these cases, the association boards give NCARS information on high-priority research areas to be used in requests for proposals, and boards decide which proposals to fund. This is the most targeted type of stakeholder input, having a direct effect on research activities. Many of the departments within the College of Agriculture and Life Sciences have formal advisory groups with stakeholder members that meet on a regular basis to provide input and guidance into departmental research programs. In addition, there are formal centers within the college with industry advisory boards that meet at least twice per year, adding additional stakeholders providing input and direction for research programs. NCARS receives support annually from college-based foundations, including the Agricultural Foundation, Tobacco Foundation and Dairy Foundation. These foundations fund research projects and graduate students on a competitive basis across a wide range of areas. NCARS administration meets with the research and extension committees each fall to discuss priority areas for research in all aspects of agricultural production and agribusiness. In late winter, these committees meet again to select and approve research projects for funding, with provides another opportunity for input on research priorities. As greater emphasis is placed on integrated extension and research efforts, administrators and program personnel hold both research and extension appointments and duties. These personnel continuously interface on decisions for program prioritization, budgeting and staffing. These efforts help ensure a greater exchange of information from the state's citizens and that all audiences are identified and served to the extent possible given research and extension resources.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
10839021	3325571	7346392	3837652

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8194863	1809236	7010015	3357510
Actual Matching	8194863	770599	7010015	1433489
Actual All Other	31777965	1053706	51185002	3781841
Total Actual Expended	48167691	3633541	65205032	8572840

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	591904

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security - Plant Production Systems and Health

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	10%	10%	8%	20%
202	Plant Genetic Resources	10%	10%	10%	10%
204	Plant Product Quality and Utility (Preharvest)	5%	5%	5%	10%
205	Plant Management Systems	13%	20%	12%	20%
206	Basic Plant Biology	10%	10%	10%	20%
211	Insects, Mites, and Other Arthropods Affecting Plants	10%	10%	10%	10%
212	Pathogens and Nematodes Affecting Plants	10%	15%	10%	0%
213	Weeds Affecting Plants	12%	15%	10%	0%
216	Integrated Pest Management Systems	5%	5%	6%	10%
404	Instrumentation and Control Systems	1%	0%	3%	0%
511	New and Improved Non-Food Products and Processes	1%	0%	2%	0%
512	Quality Maintenance in Storing and Marketing Non-Food Products	1%	0%	2%	0%
601	Economics of Agricultural Production and Farm Management	3%	0%	4%	0%
602	Business Management, Finance, and Taxation	3%	0%	4%	0%
604	Marketing and Distribution Practices	6%	0%	4%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	102.0	9.0	160.0	7.0

Actual Paid Professional	133.0	21.0	155.0	8.8
Actual Volunteer	70.0	0.0	70.0	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**
2083495	432247	2696052	884593
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2083495	262374	2696052	235055
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
8090604	274134	19685752	67858

V(D). Planned Program (Activity)

1. Brief description of the Activity

•Conduct discovery research on plants and plant systems using tools genomics, metabolomics, and proteomics

- Develop improved crop varieties using traditional and genomic approaches
- Introduce/discover new plants for food use and the green industry
- Develop systems for production of plants for biofuels
- Seek new uses for plants and plant byproducts
- Develop production systems for organic farmers
- Develop diagnostic techniques for indigenous and introduced pathogens
- Partner with industry
- Develop sustainable production systems for both large scale and limited resource farmers
- Enhance IPM programs through new techniques and strategies
- Set up applied research/demonstration plots
- Write papers for scientific community
- Prepare publications for grower and homeowner audiences
- Develop web sites to deliver information to grower and homeowner audiences
- Conduct workshops, meetings, and other focused educational programs for farmers, commodity groups, and industry.

2. Brief description of the target audience

- The scientific community
- Regulatory agencies
- Agricultural chemical companies
- Agribusiness
- Commercial and limited resource farmers
- New and Part-time farmers
- Homeowners
- Consultants
- News media
- General public
- Non-governmental organizations

- Other public agency staff

3. How was eXtension used?

Communities of Practice are available in eXtension for an array of field, horticultural and ornamental crops and related areas that provide a resource for producers, handlers, processors and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	555000	1900000	0	0

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

Patent Applications Submitted

Year:	2013
Actual:	33

Patents listed

Micropropagation of Alexandrian Laurel. Yang, G. and Z. Lu. U.S. Utility Patent Application No. 13/838,725

Compositions and Methods for Minimizing Nornicotine Synthesis in Tobacco Appl # 13/521,766 US; also filed in Indonesia, Eurasia, Korea, Brazil, Hong Kong

Novel, Fast Acting Herbicide Produced From Plants
Appl # 13/575,553 US

Deutzia 'NCDX1' Appl #Dec-48 Canada

Callicarpa 'NCCX1' Appl #Dec-47 Canada

Hypericum calycinum 'NCHC1' Appl # Dec-49 Canada

NCORNSP-016SCBG Ornamental Sweetpotato "Black Galaxy"
Appl # 2012/2594 Europe

NCORNSP-017SCC Ornamental Sweetpotato
Appl # 2012/2595 Europe

Alteration of tobacco alkaloid content through modification of specific cytochrome p450 genes Appl # 12199188.9 Europe

Peanut (Arachis hypogaea) N03081T Proposed name: Bailey
Appl # 201000265 US

Root-knot nematodes encode diverse families of secreted peptides (12-50 residues) which mimic plant peptide hormones to elicit developmental responses in their host.
Appl # PCT/AU2013/000022 International

Crop Resistance to Nematodes by Disrupting Host Plant Receptors of Cyst Nematode Secreted CLE Peptides
Appl # 13/814,591

Transciption Factors (TFs) that Regulate Nicotine Biosynthesis in Tobacco Appl # 61/771,526 US

Burley Tobacco Inbred Lines and Hybrids TN90 SRC, Cms TN90 SRC, TN86 SRC, Cms TN86 SRC, NC7 SRC, NC775 SRC, NC645 SRC, NCBH129 SRC, NC638 SRC, Ky 14 x L8 SRC, Ky14 SRC, L8 SRC
Appl # 61/772,786 US

Burley Tobacco Inbred Lines and Hybrids TN90 SRC, Cms TN90 SRC, TN86 SRC, Cms TN86 SRC, NC7 SRC, NC775 SRC, NC645 SRC, NCBH129 SRC, NC638 SRC, Ky 14 x L8 SRC, Ky14 SRC, L8 SRC
Appl # 61/772,788 US

Burley Tobacco Inbred Lines and Hybrids TN90 SRC, Cms TN90 SRC, TN86 SRC, Cms TN86 SRC, NC7 SRC, NC775 SRC, NC645 SRC, NCBH129 SRC, NC638 SRC, Ky 14 x L8 SRC, Ky14 SRC, L8 SRC
Appl # 61/772,792 US

Burley Tobacco Inbred Lines and Hybrids TN90 SRC, Cms TN90 SRC, TN86 SRC, Cms TN86 SRC, NC7 SRC, NC775 SRC, NC645 SRC, NCBH129 SRC, NC638 SRC, Ky 14 x L8 SRC, Ky14 SRC, L8 SRC

Appl # 61/772797 US

Methods and Compositions for Plant Pest Control
Appl # 61/780,395 US

Nanotechnology System for Agricultural Applications
PCT/US2013/36746 International

Compositions and Methods for Blocking Ethylene Response in Plants Using 3-Cycloproyl -1 -Enyl-Propanoic Acid Salt
Appl # 12/669,600 US

Compounds Inactivating the Ethylene Receptor by Application in a Volatile or Non-volatile Form
Appl # 1-2013-500814 Philippine

Use of a bio-pesticide for control of dollar spot and anthracnose in turfgrasses
Appl # 13/906,498 US

NCTG-61 SRC, NC1562-1 SRC, NC196 SRC, K326 SRC, K346 SRC Flue-Cured Tobacco Lines and Hybrids
Appl # 61/830,908 US

Release of NCPUR06-020, a purple-fleshed sweetpotato for the natural colorant industry.
Appl # 13/986,824 US

Transgenic Plants Expressing Chloroplast Targeted Pyrococcus furiosus Superoxide Reductase
Appl # 13/925,340 US

Methods and composition for improvement in seed yield
Appl # 61/838,789

Compounds Amine Compounds Appl # 13/688,570

Transgenic Expression of Archaea Superoxide Reductase
Appl # 61/838,817 US

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	27	272	299

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Studies conducted to identify new germplasm and develop new and improved varieties of crops and ornamentals

Year	Actual
2013	36

Output #2

Output Measure

- Clients to receive plant information via printed publications, fax, e-mails, phone and other contacts via known non-face to face delivery means.

Year	Actual
2013	1900000

Output #3

Output Measure

- Educate growers and other clientele through highly focused non-degree credit workshops and other formalized group educational sessions.

Year	Actual
2013	110359

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased Income as a Result of Production of New or Alternative Crops/Enterprises
2	Increased profit through the adoption of improved nutrient management practices
3	Number of releases of germplasm and varieties with improved yield potential and other qualities
4	New techniques and products developed and released that can be commercialized
5	Increased profit through the adoption of new production practices
6	More informed growers through highly focused non-degree credit workshops and other formalized group educational sessions.
7	Increased acreage of organic crops and specialty crops.
8	Number of discoveries of mechanisms that regulate the productivity of plants and the microorganisms that interact with them
9	Increased profit through the adoption of new production practices *and marketing locally*
10	New organic, farmers and agritourism markets established by individual entrepreneurs
11	Growers Adopting Improved Business Management Practices

Outcome #1

1. Outcome Measures

Increased Income as a Result of Production of New or Alternative Crops/Enterprises

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	33000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasing transportation costs and the rising price of fats and oils have made the current practice of importing large amounts of feed grains into North Carolina economically challenging to the state's poultry and swine industries.

What has been done
While increasing corn and wheat production, another promising solution is to increase sorghum production on marginal soils and to replace double-cropped soybean with double-cropped sorghum. Hybrid testing programs were conducted by NCSU researchers at six sites in North Carolina in 2013 along with crop management research conducted at three locations. Fourteen extension programs were conducted across NC, VA, and SC to provide growers with information on sorghum production and management. Five online agent training sessions were conducted to help train agents to assist first-time growers. At the end of the growing season five field tours were conducted to showcase hybrids and sorghum management practices that were resulting in maximum yield.

Results
Sorghum acres in North Carolina increased from 17,000 in 2011 to 100,000 in 2013. The result was 7 million bushels of grain sorghum produced in North Carolina in 2013. Assuming 75% of these bushels were the result of this program at the average sorghum price for 2013 of $6.30 per bushel, this means that in sorghum income alone this program resulted in $33.1 million dollars of additional revenue for the state.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Increased profit through the adoption of improved nutrient management practices

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	15000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Educating farmers about optimum fertilizer management and production practices improves farm profitability and reduces the likelihood of runoff in state waterways. New fertilizer materials need to be evaluated for efficacy in commercial farms. And new large-scale processing facilities and farms represent major regional environmental concerns.

What has been done
Four research publications and corresponding training materials have been developed that provide information on everything from granular fertilizer spreader distribution pattern accuracy to drainage water management alternatives. Collaboration with various state agencies is ongoing to promote calibration of fertilizer and litter spreaders and more intensive management of water

control structures, as well as to offer crop problem diagnosis training for Extension agents.

Results

Nitrogen fertilizer in the Tidewater region is predominantly applied to corn, wheat, cotton, and Irish potato; which account for approximately 29% of the statewide corn, 26% of the statewide wheat, 13% of the statewide cotton, and 95% of the statewide Irish potato acreages. If 50% of this area adopted best management practices (BMPs) such as nutrient management planning, then total Nitrogen runoff would be reduced by approximately 25%. If Nitrogen fertilizer use was reduced by even 10% on these farms, this would directly save farmers approximately 6.6 million pounds of Nitrogen, or $3.3 million per year. Statewide, in excess of 1.3 million acres were documented under nutrient management plans to increase nutrient use efficiency and reduce nutrient losses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #3

1. Outcome Measures

Number of releases of germplasm and varieties with improved yield potential and other qualities

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	22

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Profitability for peanut growers is difficult to assess.

What has been done
New cultivars have been developed and released for use by peanut producers in North Carolina, Virginia, and South Carolina.

Results
Approximately 87% of the peanuts grown in North Carolina in 2013 were of three cultivars: Bailey, Sugg, and CHAMPS. Bailey and Sugg, two NC State cultivars, were released in 2008 and 2009. Bailey was the most commonly grown seed peanut in North Carolina in 2013 (53% of total certified peanut acres), followed by Sugg (26% of the total). In 2013, Bailey alone generated $452,000 in royalties. Two new cultivars, Sullivan and Wynne, were released by the project in 2013. Both possess the patented high oleic fatty acid trait that extends the shelf life of those peanuts and products made from them.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #4

1. Outcome Measures

New techniques and products developed and released that can be commercialized

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a need for new technologies to maximize the quality and nutrient retention of shelf stable fruit and vegetable products and make such products economically viable in both retail and commercial (institutional) markets.

What has been done
Continuous flow microwave sterilization and pasteurization for processing and aseptic packaging of fruit and vegetable products has been designed, developed, extensively tested, validated and commercialized.

Results
The developed technology has received several U.S. and multiple international patents and has been licensed to several start-up companies in North Carolina, including Yamco, Aseptia, and Wright Foods. Continuous flow microwave processing of foods and biomaterials initiated by the program has emerged as one of the leading advanced thermal processing technologies in the world, and has been the first among microwave food sterilization technologies to be inspected and accepted by the FDA and commercialized by a North Carolina company.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #5

1. Outcome Measures

Increased profit through the adoption of new production practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	30000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The SmartFresh Quality System, developed and patented by NC State, maintains apple flesh firmness and fruit acidity much longer after harvest. However, the application of this product requires an air-tight facility for 24 hours with the cost being based upon the volume of the facility. Many North Carolina growers do not have a suitable facility and would benefit from an economical facility to treat smaller quantities of apples that can fluctuate with the seasonal volume changes.

What has been done

Because of work conducted at NC State in cooperation with the manufacturer and a blimp factory in Statesville, N.C., smaller retail growers now have the technology and research-based information to treat smaller quantities of fruit. Several workshops have been held in addition to educational programs at grower meetings, videos in production, and an instructional publication to educate growers on how to purchase or build an adequate treatment facility and effectively use SmartFresh.

Results

In 2013 a larger portion of the Southeast apple crop was treated with SmartFresh, resulting in a higher quality product for the consumer. In addition, the research-based educational material developed by NC State is now being used and distributed by the company nationally. Educational programs, grower trials and demonstrations across the state continued in 2013. The number of growers commercially using the product is increasing, and in 2014 the use in NC is expected to be much greater due to the number of facilities being constructed. The maintenance of fruit quality realized with SmartFresh resulting in increased sales and allowing apples to be sold in higher value markets could contribute 10% to the value of the approximate $25 million dollar apple industry totaling more than $2 million annually.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

More informed growers through highly focused non-degree credit workshops and other formalized group educational sessions.

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	183932

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small-scale produce farmers are constantly searching for new methods and varieties to extend the growing season and maximize profit. High-tunnel greenhouses and plastic mulch are used to extend the growing season, increase crop yields, improve quality, and generated additional net farm income. The greenhouses will also continue to help these farmers expand their produce operations.

What has been done
To assist these farmers, Bladen, Duplin, Sampson, and Robeson County Cooperative Extension provided an educational workshop showcasing the benefits of high-tunnel greenhouses and plastic mulch.

Results
A total of 28 participants attended the workshop. Evaluations revealed 90% of participants expressed an interest in high tunnels or will install a greenhouse on their farm. Since the completion of the workshop, nine participants have installed high-tunnel greenhouses, which will generate approximately $18,430 combined extra income in year one. Statewide, more than 2,300 growers enhanced marketing of farm products locally, resulting in more than $3 million in additional income.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #7

1. Outcome Measures

Increased acreage of organic crops and specialty crops.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With rising demand for stevia production (an alternative plant sweetener) in North Carolina, more farmers are taking on this specialty crop but lack the knowledge of best production practices.

What has been done
A workshop on stevia production took place in Merry Hill, N.C., in July 2013. This workshop was attended by 43 farmers, Extension personnel, and other farm advisers. The university?s Organic Grain Field Day also highlighted stevia production and included a tour of the stevia research trial.

Results
More than half of the participants who were evaluated after the workshop said they plan to grow stevia, and all said they learned new information during the workshop. At least three farmers are growing stevia because of this project, producing approximately 113,094 kg of stevia (leaf and stem) valued at $68,135.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #8

1. Outcome Measures

Number of discoveries of mechanisms that regulate the productivity of plants and the microorganisms that interact with them

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Pesticide contamination from both insecticides and herbicides can have very adverse effects on the environment and human health, especially for rural communities that depend on wells for their domestic and agricultural water supply.

What has been done
Management of vegetable pests of cowpea, tomato, eggplant, collards using sustainable and safe approaches included biorational pesticides (Agroneem, Azatin, Neemix, Spinosad) and a low risk synthetic neonicotinoid, imidacloprid (Pravado)thiamethoxam (Actara) was evaluated for their effectiveness and impact on natural enemies.

Results
Safer and more effective pesticide products (Azadirachtin-derived biorational and Spinosad) were identified and are available for use on vegetable crops. The best management practice for multiple pests on collards was found to be a mixture of spinosad (good for caterpillars) and Actara (good for sucking pests except mites).

4. Associated Knowledge Areas

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

204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #9

1. Outcome Measures

Increased profit through the adoption of new production practices *and marketing locally*

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The long-term success of North Carolina's local food movement is dependent upon an influx of new and transitioning farmers.

What has been done
The Center for Environmental Farming Systems (CEFS), through the Bringing New Farmers to the Table project's Incubator Farm Project, worked closely with four community organizations throughout North Carolina, providing planning and technical assistance as they design and implement new incubator farms to support new farm enterprise development. Through the Bringing New Farmers to the Table project in 2013, CEFS has also engaged with ten other North Carolina-based and national communities/organizations interested in supporting new and beginning farmers.

Results
The project has supported development of new opportunities for access to land and training resources for new farmers in North Carolina and is enabling entrepreneurial farmers to overcome barriers to business development. Through CEFS' planning support, two new NC incubator farms were implemented in 2013: the Onslow County Incubator Farm and the LINC Urban Farm. The Hines Chapel Preserve Incubator Farm received final county approval for use of public land and is moving toward implementation. The Town of Robbins Incubator Farm made significant strides in planning and feasibility evaluation in 2013 and will continue with planning in 2014. Statewide, Extension programs documented almost 60,000 people who reported growing food for home

consumption, producing food valued at $6.25 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #10

1. Outcome Measures

New organic, farmers and agritourism markets established by individual entrepreneurs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1147

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The state of North Carolina has seen a recent boom in the number of craft brewery establishments and along with it, a rising demand for locally grown hops.

What has been done
In order to meet the demand of growers and answer important questions about varieties, growing conditions, pest and disease issues, fertility and general hop production, a research variety trial was developed at the Mountain Horticultural Crops Research Station in 2011. A website, blog and Facebook page also were created to support the program, which also advised growers on variety performance and cultivar selection and developed new guidelines pertinent to growing hops in this region. Fertility recommendations have been developed, and there is now a code for hops on soil sampling reports.

Results
Local growers have benefited from the research at NC State as one of the only sources of information in our area, and they continue to depend on the information we generate. The number of breweries across the state continues to increase, and three large, national breweries recently expanded to establish operations in the mountains of western North Carolina. The number of hops growers also continues to rise. On a different front, programs in organic grain production

systems have supported a number of growers to begin producing malting barley.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

Outcome #11

1. Outcome Measures

Growers Adopting Improved Business Management Practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	16000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Increasingly, fresh produce buyers are requiring growers to obtain Good Agricultural Practices (GAPs) certification. Growers who have not obtained GAPs certification face a limited market and potentially diminished profitability.

What has been done

In order to assist growers in becoming GAPs certified, a targeted training program was developed to give fresh produce growers the information and skills they need to implement Good Agricultural Practices on their farm, navigate the USDA GAPs audit process, and provide hands-on assistant in developing a food safety plan.

Results

Eight workshops were presented in 2013, reaching a total of 122 participants. As part of beta testing, online trainings were released to 65 of the workshop attendees. Equipped with the skill set needed to complete the GAPs certification process, growers will have the capability to open markets previously closed to them, thus potentially increasing net farm income. Statewide, a total of 1,084 individuals were certified in GAPs or GHPs and/or developed food safety plans.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Rapidly changing environmental and economic conditions (weather extremes, economic climate) influence producers' abilities to adapt to change while ensuring sustainable production systems. Continued effects of the economy on federal, state and local support for research and extension programs continue to challenge our research and extension enterprises. Likewise, regulatory and other governmental policies and rules influence the educational and research capacities of our programs and present challenges to producers, processors and marketers to comply with new and often expensive regulations. And in an environment of reduced funding, the program competion for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension oppportunitites that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental, social and quality of life benefits.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Outcomes and impacts determined from our research and extension programs support the principle that our programs engage a wide array of users across the state, help support enterprise and marketing change (feed grains initiative), involve integration of research and extension efforts, and create significant economic value to the state in terms of added value from innovations in agricultural production, costs saved and enhanced marketing approaches. In addition, our research and extension enterprises represent productive environments in which our faculty are productive in terms of peer reviewed

publications and creation of intellectual properties.

Key Items of Evaluation

We are continually challenged to keep evaluation principles and tools aligned with plans of work, program implementation practices in the field, and outcome observations so that we can effectively report the results of our efforts.

We are proud of the many accomplishments of this program. A couple examples:

The swine industry, NCSU, NC Department of Agriculture, NC Biotech Center collaboration that spent around $750,000 for research and education to stimulate feed grain production. Not counting increased corn and wheat production, additional grain from sorghum, which was promoted in the program, in just one year was worth an estimated $33 million.

Our plant breeding programs for sweet potatoes and peanuts have a record or generating new varieties that become the predominant varieties used by the industry in a matter of just a few years after release. 'Covington' sweet potato and 'Bailey' peanut are two notable cultivars.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Global Food Security - Animals and Their Systems, Production and Health

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	15%	20%	20%	30%
302	Nutrient Utilization in Animals	15%	20%	20%	20%
303	Genetic Improvement of Animals	15%	17%	17%	20%
307	Animal Management Systems	15%	18%	18%	0%
311	Animal Diseases	5%	10%	10%	20%
312	External Parasites and Pests of Animals	5%	5%	5%	0%
313	Internal Parasites in Animals	2%	5%	5%	0%
315	Animal Welfare/Well-Being and Protection	5%	2%	2%	7%
404	Instrumentation and Control Systems	5%	0%	0%	0%
511	New and Improved Non-Food Products and Processes	3%	0%	0%	0%
512	Quality Maintenance in Storing and Marketing Non-Food Products	5%	0%	0%	0%
601	Economics of Agricultural Production and Farm Management	4%	1%	1%	1%
602	Business Management, Finance, and Taxation	3%	1%	1%	1%
604	Marketing and Distribution Practices	3%	1%	1%	1%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	60.0	3.0	105.0	8.0
Actual Paid Professional	78.0	9.0	100.0	9.7
Actual Volunteer	50.0	0.0	50.0	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**
1229229	192110	1739185	777852
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1229229	116610	1739185	423723
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4761695	121839	12698999	197323

V(D). Planned Program (Activity)

1. Brief description of the Activity

This plan of work includes broad and extensive research and extension programs. NC Agricultural Research Service scientists will conduct research projects to study methods to improve the efficiency of animal production. Research will focus on methods to improve reproductive performance, nutrient utilization, and genetic influence on growth and reproduction. Scientists will also work to improve animal management systems, decrease the incidence of animal diseases and parasites (external and internal) and improve the management of animal and agricultural pests. Species and commodity groups included in this plan of work are also very broad and include poultry such as turkeys, broiler chickens, and table-egg chickens. The plan of work also includes swine, fish such as flounder, and cattle such as beef and dairy, and numerous pests such as house flies. Research will include many phases of commodity production such as meat and dairy goats, chicken breeders (both broiler and table egg birds), commercial broilers (commercial refers to those animals produced for meat), breeder turkeys, commercial turkeys, swine breeders, commercial swine, all phases of aquaculture and beef and dairy production. Disciplines that will be involved include nutrition, physiology, reproductive physiology, genetics, virology, bacteriology, microbiology, mycology, entomology, and many animal management systems such as grazing and forage management programs, hatchery management, feeding and drinking water systems, litter and bedding management, lighting programs, and breeder selection and management. A very important part of this plan of work is to transfer technology and knowledge to our stake-holders and clientele. Therefore, an extensive outreach effort through Cooperative Extension will be conducted by field and campus based faculty who are based on-site as well as being located across the state and based in local communities. Stakeholders and clientele will be directly engaged in many ways including workshops, conferences, discussion groups, one-on-one teaching, demonstrations, field days, short-courses, continuing education classes, and scientific meetings. Indirect methods to reach stake-holders and clientele will include long-distance education, newsletters, web sites, newspaper releases, television and radio programs, trade journals, scientific journals, and popular press articles. Participants and programs will be evaluated at least annually for success, progress, and effectiveness. Special educational programs focused on limited resource farmers will continue to be a priority for NCA&T focused Extension efforts in pasture based production systems, aquaculture and alternative breeds.

2. Brief description of the target audience

The target audience will be primarily aquaculture, poultry, livestock producers, small-scale limited resource, beginningand underserved growers and agribusiness personnel in North Carolina. However, since North Carolina producers are some of the best in the world, ultimately, producers and agribusiness personnel across the country and around the world will be the primary audience. In addition, the audience will include personnel in other state and federal agencies, local, state and federal politicians, and other stakeholders including the general public.

3. How was eXtension used?

A number of animal systems Communities of Practice are available in eXtension, providing a valuable resource for production practices, animal health and management, and marketing. These resources are available to extensionists, producers and others supporting the food animal industries.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	200000	900000	42000	45000

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

Patent Applications Submitted

Year: 2013
Actual: 1

Patents listed
Livestock Insect-Removal System and Related Methods
Appl # 13/668,215 US

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	18	163	181

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Highly focused non-degree credit group training activities to be conducted

Year	Actual
2013	1656

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2013	110

Output #3

Output Measure

- Local, Area, Regional, and State Conferences to be Conducted

Year	Actual
2013	20

Output #4

Output Measure

- Local, Area, Regional, and State Educational Tours to be Conducted

Year	Actual
2013	30

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Additional income gained by animal producers improved planning, marketing, and financial practices
2	Net income increased by producers improving animal husbandry practices
3	Number of animal producers adopting improved animal husbandry practices
4	Number Livestock Producers Adopting and Applying Improved Planning and Financial Management Practices
5	Number of new technologies developed to prevent/treat animal diseases
6	New organic, farmers and agritourism markets established by individual entrepreneurs
7	Growers Adopting Improved Business Management Practices

Outcome #1

1. Outcome Measures

Additional income gained by animal producers improved planning, marketing, and financial practices

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	16000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sustaining economic viability of animal and poultry producers.

What has been done
A wide array of educational programs and demonstrations provided Extension recommendations for husbandry best management, improved production planning, marketing and financial management. These programs were provided for all groups of livestock producers, poultry producers and aquaculture.

Results
Statewide, 9,756 adopted husbandry, production planning, marketing, and financial management practices to improve profitability and sustainability. These and other growers reports benefiting from these practices with additional profit over $16 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals

302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
313	Internal Parasites in Animals
315	Animal Welfare/Well-Being and Protection

Outcome #2

1. Outcome Measures

Net income increased by producers improving animal husbandry practices

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	16000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Enhancement of dietary nutrient utilization by increasing particle grind size of soybean meal or corn.

What has been done
Several studies were conducted in which particle size of soybean meal or corn was increased for a fraction of the complete diet. Increasing about 25-50% of the corn or soybean meal to about 1,500 microns improved the digestibility of the complete diet, especially when the diet contains poorly digestible protein or carbohydrates. Improvements in feed conversion without adverse effects on growth performance, as well as reduced nitrogen excretion was observed when a mean particle size was increased in the diet of broilers.

Results
Over the past 2 years, most of the integrated poultry production companies in North Carolina

have realized the benefit of increasing the particle grind size of a portion of the pelleted feed for poultry. Those who have applied this technology have observed a 3% improvement in feed conversion, significantly improved nutrient utilization, reduced incidence of enteric help problems, and a reduction of ammonia emissions from poultry operations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
313	Internal Parasites in Animals
315	Animal Welfare/Well-Being and Protection

Outcome #3

1. Outcome Measures

Number of animal producers adopting improved animal husbandry practices

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	9756

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Because of public pressure to discontinue the practice of including sub-therapeutic antibiotics in animal feed, U.S. pork producers are seeking natural, research-proven and affordable solutions for managing growth, preventing disease, and enhancing the overall health of pigs, particularly during the time surrounding weaning.

What has been done
NC A&T scientists conducted a series of experiments evaluating the effects that sow diets supplemented with oat or yeast culture and fed during gestation and lactation had on piglet intestinal health and growth.

Results
It was discovered that including oat in the diet of sows was beneficial to piglets. In these experiments, piglets born from sows given oat supplemented diets weighed more at birth, lost the least amount of weight during a post weaning period of 14 days, and had decreased incidence of diarrhea.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
313	Internal Parasites in Animals
315	Animal Welfare/Well-Being and Protection

Outcome #4

1. Outcome Measures

Number Livestock Producers Adopting and Applying Improved Planning and Financial Management Practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a need for an alternative to weekly cattle auctions in order to increase profitability of feeder cattle.

What has been done
In Wilkes County, N.C., Cooperative Extension established the Feeder Cattle Marketing Program. The program is designed to increase profitability of feeder cattle primarily from smaller producers by commingling and grouping cattle in uniform lots. This allows producers to obtain premium prices that they could not obtain on the average weekly auction market. All cattle sold through these sales are graded by trained personnel. Cattle are grouped in lots based on grade, sex and breed, and penned with similar cattle. Another important factor influencing selling price is weighing condition. Graded sale?s cattle are sold on a weigh-in basis whereas with weekly auctions, cattle are sold on a weigh-out basis.

Results
Approximately 68 area beef cattle producers participated in the April 2013 Feeder Cattle Marketing Program, marketing 672 head of cattle. With average premiums being $0.05 per pound and average calf weights being 605 pounds, this amounts to an extra $30.25 per animal, for a total additional income of $20,328 for area beef cattle producers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
315	Animal Welfare/Well-Being and Protection

Outcome #5

1. Outcome Measures

Number of new technologies developed to prevent/treat animal diseases

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the event of a foreign animal disease outbreak in the United States, a rapid and humane method for on-farm swine depopulation will be required. Given the extraordinary number of animals potentially involved, and the design of current swine confinement buildings, methods relying on the handling and restraint of individual animals will prove much too slow to stem the spread of disease.

What has been done
An NCSU project is underway is to identify, evaluate, and disseminate efficient practical methods to mass depopulate swine on farms in a local, regional, or national emergency. This involves evaluating the application of CO2 supplied by a bulk liquid CO2 tanker trucks as well as the possibility of generating CO2 on-site. In this effort, the use of Computational Fluid Dynamics (CFD) has proved to be a very powerful tool for evaluating transient CO2 concentrations during wash-in and wash-out period in the truck beds used for animal loading, treatment, and disposal.

Results
This work pertains to national emergency preparedness, and in the event of a contagious swine disease outbreak in the North Carolina or elsewhere in the nation or world, this research will be of significant value in containing the disease and minimizing the consequences.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #6

1. Outcome Measures

New organic, farmers and agritourism markets established by individual entrepreneurs

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Growers Adopting Improved Business Management Practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dairy farm numbers in North Carolina have decreased over time, and the volume of fluid milk produced in North Carolina is currently less than half of the amount consumed by the people of North Carolina. The ongoing decline of the North Carolina dairy industry must be slowed or reversed in order to ensure the availability of milk and dairy products to the state?s population.

What has been done
As part of NC Dairy Advantage, a new Farm Assessment Program was developed to provide a comprehensive measurement of a dairy farm's performance. Each aspect of the dairy farming operation is analyzed, from milk quality to record-keeping, and goals, strengths, and weaknesses also are assessed. In 2012 and 2013, NC Dairy Advantage conducted two farm assessments to pilot the new program and to evaluate the surveys and data collection methods that had been developed. Two additional assessments were started in 2013, with completion expected in early 2014.

Results
Collecting and reporting data that measure the impacts of the NC Dairy Advantage Farm Assessment program will provide all North Carolina dairy producers with benchmarking data and management goals, which are anticipated to have broad financial impact across the state.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation

604 Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Constantly changing environmental and economic conditions (weather, economic climate, feed prices, regulatory climate) influence producers' abilities to accommodate change and innovation, while ensuring the sustainability of their enterprises. Economic pressures continue to influence federal, state and local support for research and extension activities. Regulatory and other governmental policies influence the educational and research capacities of our programs and present challenges to producers, processors, and marketers of animal products to comply with emerging and often expensive regulations. And in an environment of reduced appropriated funding, the program competition for existing funds becomes greater. Nevertheless, emphasis is placed on those research and extension opportunities which will have enduring benefits to farmers, their families, businesses, communities and their industries, in terms of economic, environmental, social and quality of life considerations.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of faculty activity reports, intellectual property creation (invention disclosures), peer reviewed journal articles, and data from our Extension Reporting System shows that our research and extension efforts in this planned program area are successful in engaging a wide array of animal agriculture producers, processors and marketers. The data indicate that delivery of relevant research information and research backed production best management practices are associated with significant improvement in profitability of livestock and poultry operations. Faculty are successful in influencing individual producers as well as production companies that our research findings can generate additional profitability in their operations, sometimes with added environmental benefit. The information also demonstrates the the research and extension programs at our institutions are creative environments for our faculty to be productive in making new discoveries, publishing in quality journals, and creating new business opportunities.

Key Items of Evaluation

Qualitative and quantitative data collected show that our efforts in this planned program area are having signicant benefit to users and to the state. Nevertheless, we are

challenged to keep our evaluation tool kit in lockstep with the regularly changing research and extension needs. We will continue to refine our reporting and data collection system to most effectively collect data that represent the real world situation with respect to the impacts of our programs.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Climate Change

☑ 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%	20%	20%	20%
111	Conservation and Efficient Use of Water	5%	5%	5%	5%
112	Watershed Protection and Management	15%	20%	10%	10%
133	Pollution Prevention and Mitigation	10%	5%	10%	10%
141	Air Resource Protection and Management	5%	15%	5%	5%
401	Structures, Facilities, and General Purpose Farm Supplies	5%	5%	5%	5%
402	Engineering Systems and Equipment	5%	5%	5%	5%
403	Waste Disposal, Recycling, and Reuse	10%	5%	10%	10%
404	Instrumentation and Control Systems	5%	5%	5%	5%
405	Drainage and Irrigation Systems and Facilities	5%	5%	5%	5%
605	Natural Resource and Environmental Economics	15%	10%	20%	20%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	55.0	4.0	25.0	6.0
Actual Paid Professional	72.0	3.0	24.0	1.5
Actual Volunteer	5.0	0.0	5.0	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**
1130891	56033	417797	197161
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1130891	34011	417797	149829
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4385359	35405	3050626	19500

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research will focus on creating new knowledge and solutions from basic research (e.g., nutshell-based activated carbons), to agricultural production systems research, to natural resource pollution prevention strategies, to examining people's attitudes and concerns about environmental issues and policies, including economic considerations. With this research information in hand, improved management, technological solutions and policies to environmental and natural resource utilization problems will be proposed and evaluated with farmers, businesses, stakeholders and communities. Technology transfer will occur through demonstrations, workshops, and various media from Cooperative Extension in concert with researchers.

2. Brief description of the target audience

Agricultural producers, environmental and governmental agencies, news media, general public, limited resource audiences, rural appraisers, commodity associations

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	29000	33000	0	0

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

Patent Applications Submitted

Year:	2013
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	4	82	86

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Waste Management Certification Programs

Year	Actual
2013	4

Output #2

Output Measure

- Number research project completed on environmental/natural resource issues

Year	Actual
2013	95

Output #3

Output Measure

- Number of non-degree credit environmental activities conducted

Year	Actual
2013	336

Output #4

Output Measure

- Enrollees for Natural Resources Leadership Institutes training

Year	Actual
2013	26

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of farms utilizing precision application technologies
2	Number farms implementing best management practices for animal waste management
3	Number urban households/small farms with low-literacy individuals implementing or adopting best management practices to enhance water quality
4	Number waste management certifications gained or maintained
5	Number acres where proper waste analysis was used for proper land application
6	Number growers implementing stream protection practices
7	Number storm water systems installing BMPs
8	Number farms adopting use of biofuels
9	Number growers implementing improved irrigation and drainage systems

Outcome #1

1. Outcome Measures

Number of farms utilizing precision application technologies

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number farms implementing best management practices for animal waste management

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1350

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Southeastern U.S. soils have low soil organic matter content. Increasing soil organic matter content using animal waste compost amendments is a way to increase soil carbon sequestration and improve soil quality.

What has been done
The effects of poultry waste compost applications to soil on soil quality and carbon sequestration were evaluated by NC A&T scientists in 3-year field experiments located at the North Carolina piedmont and coastal plains topographical regions.

Results
At both locations, applying compost at a 10 ton/acre/year rate increased soil carbon content, soil water retention, and nutrient retention, and also reduced soil erodibility. Statewide, Extension

documented working with 1,350 producers implementing waste management plans; more than 1.5 million tons of livestock and organic waste used as fertilizer. At a value of $10/ton, this would represent $15 million in fertilizer value savings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management

Outcome #3

1. Outcome Measures

Number urban households/small farms with low-literacy individuals implementing or adopting best management practices to enhance water quality

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	320

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In a continuing partnership among the land grant universities, local stakeholders, and the science faculty of ten public high and middle schools in Guilford and Durham counties, thousands of students have increased their knowledge and understanding of the science behind drinking water quality protection in urbanizing areas in North Carolina.

What has been done
A total of twelve urban stormwater control demonstration practices have been installed to date that effectively treat stormwater runoff from over 36,000 square feet of rooftop area in the Jordan Lake Watershed.

Results
Together, these practices collect and treat more than one million gallons of urban stormwater each year, reducing pollution from nitrogen and phosphorus by up to 45% and 15%, respectively. Connecting students to the science of drinking water quality protection is important as they become tomorrow's consumers, homeowners and community leaders.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #4

1. Outcome Measures

Number waste management certifications gained or maintained

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	313

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina animal waste applicators are required to receive six hours of continuing education credit every three years.

What has been done
In Pitt County, Extension taught three certification classes providing 75 credit hours to 150 operators.

Results

Participants gained knowledge on managing spray fields for hay production, over-seeding with winter annuals and coping with wet application conditions. Participating applicators valued maintaining their legal compliance and improving their knowledge of environmentally appropriate manure application at $1,875. Statewide, 2,164 waster applicator certifications were obtained or maintained as a result of waste applicator training.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management

Outcome #5

1. Outcome Measures

Number acres where proper waste analysis was used for proper land application

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3465

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nonpoint source pollution continues to negatively impact North Carolina?s water resources. The primary pollutants of concern are sediment, nutrients, pathogens, and toxins. Water quality improvements are best approached by a watershed approach.

What has been done

Regional Training Centers under the Soil and Water Environmental Technology Center (SWETC) are being further developed throughout North Carolina.

Results

SWETC has developed, evaluated, and demonstrated innovative technologies related to soil and water resources, waste management, land use, and ecosystem restoration that address societal needs for environmental protection and enhancement. Watershed citizens, local agencies, and state agencies in North Carolina are better poised to effectively identify pollutant sources and management strategies to improve water quality.Extension recommended waste analyses were used for proper land application BMPs on approximately 1.25 million acres.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #6

1. Outcome Measures

Number growers implementing stream protection practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	137

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The North Carolina Division of Water Quality included Beaverdam Creek in Western North Carolina on its Clean Water Act Section 303(d) list of impaired streams in 2008. Biological

pollutants, sediment or high water temperatures can cause an impaired designation.

What has been done

Cooperative Extension helped develop a watershed rehabilitation plan for Beaverdam Creek. The first year was dedicated to developing a plan, communicating with the community, documenting conditions in the watershed, and identifying areas that would benefit most from rehabilitation efforts.

Results

Installing best management practices on eight private properties stabilized almost 5,000 linear feet of stream and reduced approximately 78 tons of sediment per year. Statewide, growers or landowners installed 137 stream protection BMPs and 344 landowners developed a management plan for their property.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems
405	Drainage and Irrigation Systems and Facilities

Outcome #7

1. Outcome Measures

Number storm water systems installing BMPs

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2013 451

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Stormwater runoff in developed watersheds has become a major concern to citizens and leaders throughout North Carolina.

What has been done
Throughout 2013, demonstration sites have been installed throughout North Carolina, covering every eco-region. These sites not only function to help mitigate water quality problems, but also to educate the public on what the practice is and how it works. The technologies that have been installed include everything from bioretention cells to permeable pavement parking surfaces.

Results
The field research projects embarked on in 2013 are seen statewide, and have resulted in positive feedback from citizens to decision makers as well as a greater understanding of structural storm water practice installation. The input NCSU has provided on the stormwater technical review workgroups affects how legislation on stormwater is implemented in this state, which affects the developmental community and North Carolina's overall economy. Statewide, 451 program participants were involved in implementing community-based projects for environmental protection.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems
405	Drainage and Irrigation Systems and Facilities

Outcome #8

1. Outcome Measures

Number farms adopting use of biofuels

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	18

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dependence on foreign oil and the increasing cost of energy have led to an increase in research for alternative and renewable fuels. The Southeastern United States and North Carolina in particular is uniquely situated in a climate zone adaptable to multiple crops suitable for bioenergy synthesis. Research in production and conversion of biomass to renewable energy can provide new opportunities and jobs for the region.

What has been done
North Carolina State University, in conjunction with the University of Kentucky, has initiated research in on-farm biomass processing working towards an integrated high solid transporting/storage/processing system. Work has begun to provide production and processing practices for growing and conversion of biomass feedstock?s into renewable energy. Using previous design and testing knowledge new gasification systems are being developed to better utilize biomass that is consumed during the integrated conversion process. In addition, pre-gasification processing of the biomass residues is being developed and equipment is being acquired.

Results
If this program is successful, growers in North Carolina and the southeastern United States could potentially utilize more dynamic crop production rotations as well as bring underperforming or marginal lands into biomass to biofuel production. Additionally, technology transfer licensure of integrated systems that are designed may be possible. Statewide, 18 producers increased or implemented bioenergy production, creating product with a value over $300,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies

Outcome #9

1. **Outcome Measures**

Number growers implementing improved irrigation and drainage systems

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
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Rapidly changing economic and environmental conditions influence producers' and communities capacities to adapt to change and at the same time, sustain their operations. Water supplies for irrigation, high cost of fuels, and harsh weather systems present significant challenges all too often. Changing federal, state local funding commitments for research and extension programs are challenged regularly. And regulatory and other governmental policies challenge the entire community, which our research and extension programs serve. Nevertheless, we are committed to ensuring that programs that endure are those that will have significant economic, environmental, social and quality of life benefits to our stakeholders.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Examination of the outcomes and impacts in this program area indicate significant progress and benefit in the areas of waste management, nutrient capture and utilization, and water quality protection, along with some of the economic benefits that accrue to those outcomes. As pressures increase for access to large quantities of irrigation water, it is anticipated that our research and extension programs will need to play a greater role in providing technology and systems to manage that water efficiently to optimize crop and food production, use nutrients efficiently and conserve water.

Key Items of Evaluation

Our strong programs in water quality and animal waste management and utilization continue. Our evaluation approaches are not collecting sufficient data and information on outcomes and impacts from our research and extension on irrigation and drainage systems and their benefits to farmers, communities and other land managers. We will strive to make changes in our evaluation tools to capture that information.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Sustainable Energy including Biotechnology

☑ 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	15%	0%	15%	20%
205	Plant Management Systems	15%	0%	20%	20%
401	Structures, Facilities, and General Purpose Farm Supplies	5%	0%	5%	0%
402	Engineering Systems and Equipment	20%	0%	20%	20%
403	Waste Disposal, Recycling, and Reuse	20%	0%	15%	20%
404	Instrumentation and Control Systems	10%	0%	10%	0%
511	New and Improved Non-Food Products and Processes	15%	0%	15%	20%
	Total	100%	0%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	7.0	2.0	10.0	5.0
Actual Paid Professional	9.0	0.0	9.0	4.6
Actual Volunteer	1.0	0.0	0.0	7.7

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
147508	0	156323	607851
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
147508	0	156323	347881
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
572003	0	1141426	2386188

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Developing productive efficient systems to profitably produce a variety of crop and forestry based substrates for biofuels production
• Developing engineering solutions and systems to efficiently convert raw materials into useable fuels
• Exploit bioprocessing systems to produce a variety of compounds thatmight have utility in processing and manufacturing processes
• Advance or knowledge of energy use and conservation in human, agricultural, animal and processing environments
• Communicate solutions and systems to users through extension education and demonstration activities
• Further study of cattails as a feedstock for biofuels

2. Brief description of the target audience

Scientists, commercial and limited resource farmers, regulatory entities, homeowners, general public, agribusinesses

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1000	5000	0	0

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

Patent Applications Submitted

Year:	2013
Actual:	2

Patents listed

Process for Conversion of Biomass to Fuel Appl # 13/709,878 US, Malaysia

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	5	48	53

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Studies on producing agricultural and forestry substrates for biofuel production

Year	Actual
2013	10

Output #2

Output Measure

- Studies on engineering conversion processes for biofuels and other components

Year	Actual
2013	16

Output #3

Output Measure

- Educating homeowners, growers and processors through workshops and other group educational approaches on sustainable energy topics

Year	Actual
2013	182

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	New crops or other biofuels substrates identified
2	New bioprocessing technologies developed
3	New bioproducts identified
4	Number of households improving energy conservation measures
5	Installation of energy saving strategies on animal and crop production facilities

Outcome #1

1. Outcome Measures

New crops or other biofuels substrates identified

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nutrient management for optimal Giant Miscanthus production for uses as a feedstock source for biofuel.

What has been done
A field experiment was conducted by NC A&T researchers with 5 fertilizer treatments (five rates of nitrogen were: 0, 60, 120, 180 and 240 lbs/acre) in 4 replications; data collected and analyzed.

Results
Data analysis showed that the fertilizer treatment T3 with 120 kg N/ha produced significantly better growth results than the other treatment conditions.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

New bioprocessing technologies developed

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Current animal waste management technologies emphasize waste treatment rather than waste utilization.

What has been done
An advanced biological system is being developed by NC A&T scientists to efficiently and economically treat swine wastes and recover materials and energy from the wastes. Researchers have optimized the microalgal process for bioremediation of swine wastewater, established a novel biological process to directly make ethanol and acetic acid from wet microalgae, and developed a novel thermochemical process to make biodiesel from wet microalgae.

Results
(1) A microalgal process for bioremediation of swine wastewater and production of multi-products; (2) a novel fermentation process to produce bioethanol and acetic acid from fresh microalgae; and (3) a novel hydrothermal process to extract lipid and produce biodiesel from wet microalgae.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

New bioproducts identified

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a need to develop and evaluate low-capital cost, low-maintenance cost and highly scalable cultivation systems for year-round production of algae.

What has been done
A process has been developed by NC A&T for microalgal strain isolation, screening and identification of algae with good biofuel production potential.

Results
(1) A newly identified microalgal strain, Chlamydomonas debaryana AT24, with high lipid production and bioremediation; (2) two scaled-up algal photobioreactors were constructed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #4

1. Outcome Measures

Number of households improving energy conservation measures

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	577

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many limited-resource individuals are poorly informed or unaware of the advantages of energy efficient products for their homes.

What has been done
Cooperative Extension in Guilford County partnered with the High Point Housing Authority by providing eight energy conservation programs in 2013 to address this need.

Results
Seventy-seven percent of the participants increased their knowledge, benefited from various energy conservation strategies to help them save energy and money, and used at least one recommended energy technique. Nearly half of the participants reported installing Energy Star appliances/products in their homes. Statewide, 577 program participants reported using energy conserving BMPs to reduce energy consumption in homes and other structures.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

Outcome #5

1. Outcome Measures

Installation of energy saving strategies on animal and crop production facilities

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Curing fuel represents one of the largest expenses in flue-cured tobacco production.

What has been done
Cooperative Extension in Wilson County has addressed this issue by promoting energy efficiency in curing tobacco through the use of automatic ventilation controls, additional insulation, replacing seals, and other methods.

Results
Survey results of tobacco growers in 2013 indicated that there are 662 automatic ventilation controllers in use in the county, which represents 76 percent of the tobacco curing barns. There were 96 new automatic ventilation controllers installed in 2013. These new controllers that were installed helped growers save an additional 36,864 gallons of LP gas this curing season. At an average price of $1.40 per gallon, these efforts saved Wilson County tobacco growers $51,610 in fuel. On a broader scale, the total energy performance of three different make of new curing barns at the same on-farm location was evaluated during the 2013 season. Instrumentation was implemented to monitor fuel and electrical energy consumption each cure. Based on the results, if a grower can increase energy efficiency with the purchase of a new barn from a season average of 10 lb/gal LP to 14 lb/gal LP or higher, the result is a cost savings of approximately 3¢ or more per pound cured based on 2013 fuel prices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Economic and environmental considerations related to energy use, sources and conservation continue to present challenges to both producers and users of energy. North Carolina's bioenergy research efforts have focused on developing biomass sources and processes suitable for capturing biofuels from those materials. That has been a slow process, even though plant breeders and agronmists continue to work toward prolific and productive plants to produce biomass. Energy conservation in homes and business continues to get some emphasis, especially as it relates to solar energy. And some of our research and engineering efforts have targeted energy use in both cooling and heating livestock and poultry buildings, with some success with solar approaches for heat and geothermal processes for cooling. Considerable opportunities may exist for continued impact in these areas.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Our research support base is modest, but nevertheless, our scientists and extension workers in this area have demonstrated the capacity to acquire external grants, publish their work in peer reviewed journals, and generate new processes and products. Plant breeders and agronomists have been successful in developing new cultivars of biomass producing grasses for potential biofuels production. Process engineers have made progress in solving some of the challenges to producing cellulosic ethanol, though commercial applications are not in operation in the state. One recent challenge was defunding by the state of the North Carolina Biofuels Center, which provided significant funding for biofuels research, although a portion of the funding was restored through another agency. Continued opportunities may exist for exploiting this area, particularly in research of producing biomass and discovering processes to make production of cellulosic ethanol efficient..

Key Items of Evaluation

Tools to fully capture accomplishments in this field of science to to be revised as we have indicated in other program areas.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Childhood Obesity

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components	20%	10%	50%	0%
703	Nutrition Education and Behavior	30%	50%	30%	50%
724	Healthy Lifestyle	50%	40%	20%	50%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	35.0	3.0	12.0	3.0
Actual Paid Professional	46.0	14.0	8.0	2.6
Actual Volunteer	85.0	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
712953	312721	139499	141911
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
712953	88078	139499	66007
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2760683	169403	1018581	76713

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Childhood Obesity Planned Program will provide science-based educational and experiential learning opportunities that focus on children, but actively engage an array of audiences--regardless of gender, income, age or race/ethnicity--because of the influence that these groups in society have on the health and well-being of themselves and their children. Programs developed and provided by NC Cooperative Extension in the area of healthy weight for children and adults is part of the larger initiative Eat Smart, Move More North Carolina. As a founding member of the movement, our programs are part of a larger effort to educate and change environments so that all North Carolinians have the opportunity to eat smart and move more. Important program activities include: **EFNEP**, the Expanded Food and Nutrition Education Program, is a federally funded educational program administered in North Carolina through NC State University and NCA&T State University. For more than three decades, EFNEP has been helping limited resource youth and families with children learn how to eat healthier meals and snacks, stretch their food dollars and reduce the risk of food-borne illnesses. The Supplemental Nutrition Assistance Program-Education (**SNAP-Ed**) serves limited resource families across North Carolina to assist those eligible for food assistance to eat smart and move more. SNAP-Ed works to help participants make healthy choices within a limited budget and choose physically active lifestyles. NC State University's SNAP-Ed Program is Steps to Health, which works with preschoolers, kindergarteners, 2nd grade students, 3rd grade students, and high school students. **Color Me Healthy**is a program developedto reach limited resource children ages four and five. Color MeHealthy uses color, music, and explorationof the senses to teach children that healthyfood and physical activity are fun. Agents train child care providers in the use of the program in their setting. **Faithful Families Eating Smart and Moving More** is a program that helpsfaith communities in North Carolina make and sustain changes that promote healthy eating and physical activity. **Eat Smart, Move More Weigh Less**(ESMMWL) is a weight-management program for adults. This 15-week evidence-based program includes strategies proven to work to achieve and maintain a healthy weight and encourages small changes that can be sustained over time. The program includes a family component to influence the eating and physical activity of all family members. **Cook Smart, Eat Smart** is a program that teaches simple, basic cooking for teens and adults. Eating more meals at home is an important strategy for eating a healthy diet. Cook Smart, Eat Smart provides hands on education on how to plan, shop, fix and eat healthy family meals.In addition to the methods mentioned earlier, social media tools will be used by researchers as a means of helping to reinforce information about healthy eating and physical activity behaviors among adolescents.

2. Brief description of the target audience

Intended audiences include children of all ages, youth, their adult family members, child-care providers, Head Start workers, food banks, food stamp and WIC recipients and community coalitions. No time is more critical than childhood to promote healthy eating and sound health practices. Children do not consume sufficient fruits or vegetables and have diets that are low in fiber and higher in fat than recommended. Children need quality nutrition education to help positively influence their food choices. For nutrition education efforts to be effective, they must also include parents and care givers. Helping families make informed decisions about their nutrition will help ensure that North Carolina's children grow to reach their full mental and physical potential. Overweight in children continues to rise. Treatment of overweight and obesity is difficult. Prevention of overweight and obesity in children is essential to address this issue. Demographic changes in the state's population continue to impact nutrition and health issues. The fastest growing age group is the 65 years and older segment, and the elderly have disproportionate risk of malnutrition and poverty, as well as poor overall health, and in many cases they are either care-givers or influence the care of children. Because of the influence that adults have with different age groups, and because of their own health concerns, healthy nutrition and well-being educational programs are important for adults as well. Programs addressed to young adults and middle-aged consumers will continue to impact the health of the population as it ages, but including children as well. Women are employed outside the home in greater numbers, and many of them are among the

working poor. Over 80% of women who had school-aged children were working outside the home; 67% of women with the youngest child under six years were in the labor force. For working parents with very limited resources, lack of after-school and summer programs for youth is a major concern, as it relates to nutrition, health, and obesity as well as other developmental needs of children.

3. How was eXtension used?

The Families Food and Fitness CoP of eXtension offers frequently asked questions, articles, online learning activities, and interactive tools on families, food and fitness topics. The CoP's aim is to become a source of reearch-based information for families as they work to eat smart, move more and achieve a healthy weight.

The Families Food and Fitness CoP provides education and skills to help families make informed decisions about healthy eating and physical activity by providing them with science-based information and learning opportunties through eXtension.

Families Food and Fitness is organized around three goals:
-improved diets
-increased physical activity
-maintenance of body weight in a healthy range and avoidance of excess weight gain

The website content is focused on six key behaviors that have been identified in the literature to be associated with maintaining and achieving a healthy body weight:
-move more everyday
-tame the tube
-control portion size
-enjoy more fruits and vegetables
-prepare more meals at home
-re-think your drink

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	157000	280000	97000	97000

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

Patent Applications Submitted

Year:	2013
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	3	3

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Non-degree credit group activities conducted on Foods and Nutrition and Childhood Obesity Education

Year	Actual
2013	4020

Output #2

Output Measure

- Targeted audiences participate in workshops on Food, Nutrition and Childhood Obesity

Year	Actual
2013	134372

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Program participants increase knowledge that will promote a healthier diet
2	Program participants increase skills that will promote a healthier diet
3	Education program participants make one or more positive dietary changes
4	Program participant decrease body weight
5	Program participants decrease blood pressure
6	Program participants increase physical activity
7	Program participants increase their fruit and vegetable consumption by at least one serving

Outcome #1

1. Outcome Measures

Program participants increase knowledge that will promote a healthier diet

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Program participants increase skills that will promote a healthier diet

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Education program participants make one or more positive dietary changes

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	50000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a strong need to improve awareness of the dangers of fast food, and of overall healthy eating, among limited resource North Carolina youth.

What has been done

Forty-six minority students completed a nutrition curriculum with topics related to: reading food labels, sugar, fat, eating on the run, culture foods, snack options, physical activity and nutrition. Participants were provided education on each of the nine lessons and allowed to ask questions about topics they were unsure of as well as elaborate on topics they found interesting.

Results

The findings were significant for the Eating on the Run topic, which exhibits participants' awareness of the importance of reducing the consumption of fast food meals. Healthy eating and other approaches to weight control are strongly related to the entire family's attitude and approaches to eating. According to the state EFNEP web-based nutrition education evaluation and reporting system, 69% of youth participants in statewide Extension programs showed improvement in their ability to choose healthy foods, and 42% of youth statewide improved their physical activity practices, among other significant findings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #4

1. Outcome Measures

Program participant decrease body weight

2. Associated Institution Types

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

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3146

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Residents of target county had 4th highest obesity rate in North Carolina.

What has been done
Provided health and wellness tips for children and adults; administered nutritional, health and dietary assessments.

Results
Actual body weight was not calculated but participants reported being more consciousness of food intake and weight. Similarly, statewide adult education programs focus on weight reduction and related benefits. In 2013, 3,146 program participants reported reducing their BMI.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Program participants decrease blood pressure

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1238

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The obesity and overweight rate for children in Robeson County is approximately 40%. Obesity in children increases the likelihood they will experience health problems later in life such as diabetes, high blood pressure and heart disease.

What has been done
To address this need, Robeson County Cooperative Extension partnered with the public schools

to offer ?Steps to Health? nutrition education to 186 second graders in three schools.

Results

Teacher surveys indicated the Steps to Health program was beneficial to 100% of the students. All teachers had observed positive changes in eating and physical activity among students. The survey also noted students are trying new fruits and vegetables at lunch and practicing good hand washing procedures. Several teachers observed students at lunch discussing the benefits of drinking water. Based on the success of ?Steps to Health?, this program will be offered in other elementary schools. In related programs for adults targeting blood pressure reduction, 1,238 adults reported reducing blood pressure after involvement in programs, and 9,513 reported consuming less sodium in their diets.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Program participants increase physical activity

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	31700

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

While obesity rates continue to rise nationally, they have increased the most among those in the lowest income levels. In North Carolina, 43% of low-income children are overweight or obese.

What has been done

In 2013, the Steps to Health program provided nutrition education with the ultimate goal of promoting positive behavior change related to nutrition and physical activity. Six distinct programs targeting preschool/kindergarten students, 2nd graders, and 3rd graders, adults, older adults and Latino/Hispanic families were provided at low-income sites in counties across North Carolina.

Results

Steps to Health reached 5,901 participants (5,348 children and 553 adults) and made 46,810 educational contacts within 49 counties across North Carolina. It was a successful year for Steps to Health, with the six programs meeting or exceeding 18 of the 20 overall objectives.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Program participants increase their fruit and vegetable consumption by at least one serving

2. Associated Institution Types

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	43000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

According to studies completed by the Graham County school system and the local health department, 40% of youth in Graham County are overweight or are at risk of becoming overweight.

What has been done

Graham County Cooperative Extension and Robbinsville Elementary School partnered to provide a healthy eating program for kindergarten classes. The goal of the program was to get youth to understand the implications of eating an unhealthy diet and to encourage them to eat more fruits and vegetables each day.

Results

After a period of seven weeks, youth were seen again and given an oral survey. Ninety-two of the 103 students reported eating more fruits and vegetables. These youth are now better prepared to improve the quality of their lives through healthier eating habits, and experience reduced medical costs in the future. Statewide, 26,817 youth participants in various healthy eating educational activities reported that they increased their fruit and vegetable consumption.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Many factors affect individuals' decisions and abilities to practice positive behaviors with respect to healthy eating and physical activity. These factors include the physical and social environment of families, communities, and organizations; the policies, practices and norms within the social and work settings; and access to reliable information. Lasting changes in healthy behaviors require physical environments and social systems that support positive lifestyle habits. In order for individuals (adults and children) to make positive lifestyle changes with respect to healthy eating and physical activity, changes need to be made in the surrounding organizational, community, social and physical environments. WIthout these changes, successful health behavior change is difficult to achieve and sustain. Confidence in adopting and maintaining a behavior may be strenghtened when the physical and social environment supports the new behavior. Policy and environmental interventions can improve the health of all people, not just small groups of motivated or high-risk individuals. NC Cooperative Extension continues to work using the multilevel model or socioecological model for behavior change. It is within that context

that we provide education to participants while working at the county and state levels to make systems, policy, and environmental changes. These changes are systemic and societal, thus do not happen quickly. Slow changes in policy and environments that support healthy eating and physical activity continue to challenge our ability to make improvements in eating and physical activity patterns.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In 2013,adults and youth alike made incremental changes in a number of health enhancing eating behaviors as well as physical activity (detailed in the state defined outcomes above). The educational programs supporting these changes are continuing, as additional opportunities exist for further advances in these lifestyle changes. The program will continue to stress that those individuals who make healthy food choices and are physically active are more likely to achieve and maintain a healthy weight and reduce incidence of chronic disease. Ultimately, this will lead to a reduction in health care costs, increased longevity, greater productivity and improved quality of life.

Key Items of Evaluation

Eat Smart, Move More, Weigh Less is a weight-management program that uses research-based strategies for weight-loss/weight maintenance. This 15-week program informs, empowers and motivates participants to live mindfully as they make choices about eating and physical activity. The program provides opportunties for participants to track their progress and keep a journal of healthy eating and physical activity behaviors.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Safety - Food Production Systems: Development, Processing and Quality

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	15%	0%	20%	25%
502	New and Improved Food Products	15%	0%	15%	30%
503	Quality Maintenance in Storing and Marketing Food Products	10%	25%	10%	20%
504	Home and Commercial Food Service	10%	25%	5%	0%
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%	25%	10%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	40%	25%	40%	25%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	54.0	2.0	55.0	6.0
Actual Paid Professional	71.0	16.0	52.0	4.2
Actual Volunteer	5.0	0.0	5.0	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**
1106307	342000	904292	250028
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1106307	135989	904292	61881
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4290025	196088	6602865	237560

V(D). Planned Program (Activity)

1. Brief description of the Activity

Multiple research and educational outreach programs will be conducted under the umbrella of improving the quality, safety, security, and nutrition of food products produced in North Carolina. Specific research projects will identify effective nutritional control strategies for replacement of growth-promoting antibiotics for improving gut function and reducing intestinal colonization and shedding of Salmonella; assessing the incidence, populations, serotypes, genotypes, and antibiotic susceptibility of Salmonella and Campylobacter fecal isolates as a function of farm, bird age, season, management practices, and strategic processing of commercial broiler, turkey, and layer farms; assessing novel antimicrobial strategies for use in reducing foodborne pathogens and biofilm formation on food processing contact surfaces; employing the antimicrobial properties of eggshell membranes for reducing the heat resistance of foodborne pathogens; development of Salmonella-specific inhibitory nanoparticles for preventing intestinal colonization; development of alternative layer molting diets for reducing the risk of Salmonella contamination of shell eggs; characterization of Campylobacter respiratory chain genes for use in developing rational drugs for controlling infection of food animals; conduct ecotoxicological studies to identify chemical pollutant sources that contaminate aquatic human foods; development of a high hydrostatic pressure system for reducing toxigenic histamine-forming bacteria in scombroid fish and vacuum and MAP packaged fresh tuna; develop a more efficient means of producing a high-gelling protein isolate from underutilized fish species and other meat sources that could replace surimi manufacture and improve the quality, sensory and yield characteristics of new and existing muscle food products; development of a Vienna sausage product without casings via an in-tube focused microwave field heating technology; improving the texture and yield of canned/pouched Albacore tuna by controlling precook proteolysis and injection of a tuna-derived protein isolate; application of continuous flow processing of foods and biomaterials using advanced focused microwave technology; and development and testing of tools, methods and devices for rapid sterilization and production of high quality vegetable and fruit purees; isolating, identifying and characterizing bioactive compounds from peanuts skin, sweet potato peels/flesh, pokeweed roots and rosehip fruits and wine grapes skins /seeds; developing value-added products incorporating bioactive compounds from select extracts and evaluating them for consumer acceptability; exploring industry partnerships for commercial utilization of prototyped products incorporating bioactive extracts; and isolating the most active fractions from pokeweed and rose hip that show strong antiproliferative and apoptosis activity against breast, colon, and cervical cancer cells. A very important aspect of this plan of work is to transfer technology and knowledge to our stakeholders and clientele, including efforts of the Plants for Human Health Institute's NC Market Ready and NC Fresh Produce Safety Task Force.

2. Brief description of the target audience

Primary food producers, food processors, foodservice operators, county extension agents, state and federal regulatory agencies, commodity associations, news media and consumers. The primary audience will be in North Carolina but will also extend to audiences in other states (state and federal agencies, local, state and federal politicians and other stakeholders).

3. How was eXtension used?

eXtension provides an array of plant and animal systems Communities of Practice that provide relevant information and strategies for producers, processors and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	40000	70000	0	0

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

Patent Applications Submitted

Year:	2013
Actual:	3

Patents listed

Microfluidzation of Cereal Brans and the Use Thereof in Foods.

The Use of a Sodium Bentonite Clay, Astra-BenTM, as a Processing Aid to Significantly Reduce or Eliminate the Aflatoxin from Aqueous Defatted Peanut Meal Dispersions for the Production of Defatted Peanut Meal Protein Concentrates or Isolates Appl # 13/734,264 US

Methods and Apparatuses for Thermal Treatment of Foods and other Biomaterials and Products Obtained Thereby (...For Expense Purposes Technology Numbers 04131, 03070, and 03016 are Tracked in 05013..) Appl # 2,812,925 Canada

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	5	101	106

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Highly focused non-degree credit group training activities to be conducted

Year	Actual
2013	478

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2013	61

Output #3

Output Measure

- Local, area, regional and state conferences to be conducted

Year	Actual
2013	49

Output #4

Output Measure

- Number of firms adopting quality and safety strategies
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- # Presentations at professional meetings
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- # Media occurrences reporting research findings
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of program participants who successfully pass the food safety certification examination
2	Number of participants completing National Seafood HACCP Alliance Education and other food safety HACCP workshops
3	Number of companies adopting new technologies
4	Number of new companies in food manufacturing
5	Number of food industry companies undergoing equipment and food safety audits
6	Number of new food products that industry can manufacture to improve health

Outcome #1

1. Outcome Measures

Number of program participants who successfully pass the food safety certification examination

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1882

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Centers for Disease Control and Prevention (CDC) estimates that roughly 1 in 6 Americans (or 48 million people) get sick from a foodborne illness each year. Food safety education is believed to be an integral part in preventing foodborne illness outbreaks.

What has been done
Cooperative Extension in cooperation with local health departments provided ServSafe training courses to food service managers throughout North Carolina.

Results
Statewide, 1882 food service employees received servsafe training and certification. ServSafe training has potentially saved food establishments approximately $3,535,000 in costs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
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

Number of participants completing National Seafood HACCP Alliance Education and other food safety HACCP workshops

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	89

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Food safety of fish and fishery products continues to be a concern of the U.S. Food and Drug Administration and consumers. Demand for HACCP training continues to be strong due to new business start-ups, turnover in personnel and the need to assist industry with interpretation and implementation of the preventive controls measures.

What has been done
NCSU has participated at the local, state and national levels in development and delivery of seafood HACCP workshops for the past 16 years. Most recently, we have helped to update the training curriculum (5th Edition) and develop a Trainers' Guide for use in Train-the-Trainers workshops that were offered across the nation. The basic curriculum has served a need but growing interest by participants indicates that advanced topics such as how to undertake a process validation and how to perform environmental sampling are needed. We shall pursue this opportunity in cooperation with other specialists with interest in the food safety field.

Results
Seafood processors in North Carolina and across the nation received certificates of course completion issued by the Association of Food and Drug Officials. This non-degree certificate program meets the training requirements in the FDA seafood HACCP regulation. In addition, seafood companies were given a better understanding of the expectations of FDA and improved their ability to conduct their own hazard analysis and develop and implement a HACCP plan. Firms needing additional assistance are given follow up consultation to review and help guide them through the regulatory process. Statewide, 89 program participants completed the national seafood HACCP alliance and other food safety HACCP programs, and overall, 94 people were

actually certified in HACCP.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Outcome #3

1. Outcome Measures

Number of companies adopting new technologies

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a need for new technologies to maximize the quality and nutrient retention of shelf stable fruit and vegetable products and make such products economically viable in both retail and commercial (institutional) markets.

What has been done
Continuous flow microwave sterilization and pasteurization for processing and aseptic packaging of fruit and vegetable products has been designed, developed, extensively tested, validated and commercialized.

Results
The developed technology has received several U.S. and multiple international patents and has been licensed to several start-up companies in North Carolina, including Yamco, Aseptia, and Wright Foods. Wright Foods, which was founded in 2012 in Troy, N.C., announced in July 2013 a $53 million expansion that is projected to triple the size of the plant, adding 120,000 square feet and more than 500 new jobs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
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

Number of new companies in food manufacturing

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mechanical extraction of raw crabmeat results in 300 percent higher yield, with substantially less labor input, than the current industry process of cooking, cooling and hand-picking crabmeat. Recently a patented method for restructuring raw crabmeat was issued to Shure Foods Inc, a fledgling North Carolina-based company.

What has been done
NCSU researchers are partnered with Shure Foods to further develop and commercialize the technology and help the company transition from R&D to a sustainable business.

Results
The expected outcomes should deliver technical solutions for insuring a robust, consistent process for commercial production of high quality restructured crabmeat products, leading to full commercialization, and thus revival of the blue crab industry in eastern North Carolina and the mid-Atlantic region of the United States.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
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

Number of food industry companies undergoing equipment and food safety audits

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	334

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Acidified GMP and BPCS workshops are required for operating supervisors of aseptic and conventionally canned processing and packaging systems in food processing establishments. It

qualifies individuals to be commercial operators of plants producing aseptic and conventionally foods canned to meet the requirements of the umbrella GMP, the specific GMP for acidified foods and the specific GMP for Low Acid Canned Foods.

What has been done

Six industry workshops were conducted, resulting in the certification of 164 individuals. NCSU also earned two grants totaling $1.7 million in the past year, focusing on closing research gaps and developing training curriculum for all acidified manufacturers, large and small as well as the regulatory bodies that regulate them. The curriculum for inspectors was completed and delivered three times, certifying 120 inspectors. During 2013, an NCSU researcher also became the process authority for approximately 52 products per month totaling 656 products.

Results

The average cost of a private process authority consultant is $1,500 per diem, which without university assistance, these small businesses would have had to pay. This NC State assistance program has saved North Carolina entrepreneurs a minimum of $939,000 in 2013, if each product would have only required one day of services from a consultant.

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

Number of new food products that industry can manufacture to improve health

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Formulating dietary fiber-enriched foods using cereal bran presents challenges since they often adversely affect color, texture, flavor, and taste of the supplemented foods.

What has been done

NC A&T scientists established a protocol for processing wheat and corn brans using a microfluidization process to alter the physicochemical and antioxidant properties of wheat and corn brans. In addition, the effects of modified brans on product quality of bread and extruded corn cereal were investigated.

Results

Based on discoveries that resulted from this research, bread and extruded corn grits enriched with microfluidized brans showed better quality attributes than those supplemented with ground bran at the same substitution level.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (National public health problem)

Brief Explanation

Rapidly changing environmental and economic conditions influence producers' and food businesses' abilites to adapt to change while ensuring sustainable production systems and environments. Continued effects of the economy on federal, state and local support for research and extension programs challenge our research and extension enterprises. Likewise, regulatory and other governmental policies and rules influence the educational and research capacities of our programs and present challenges to producers, processors and marketers to comply with new and often expensive regulations. And in an environment of reduced funding, the program competition for existing funds becames a greater challenge. Nevetheless, emphasis is placed on those research and extension opportunties that have the greatest effect on sustainability of farms, families and businesses.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The evidence of outcomes and impacts of this program area reported herein are derived from our Extension Reporting System, faculty activity reports and impact statements, and Office of Technology Transfer. The data indicate that our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that benefits their businesses. Based on the impact statements, publication records, intellectual property created, and effective outreach, especially with various food safety training and certification programs, the food supply continues to both safe and one that's evolving with new process and products. We continue to foster and lead change in this program.

Key Items of Evaluation

Note the role that faculty in this program area have in helping keep the state's population of food handlers and servers trained and certified.

The tools to capture additional outcomes and impacts from this program area need some revision to realize the fuller benefit of this program to the interests of both food safety and innovations in food products and manufacturing.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Human and Community Development- Youth Development and Families

☑ 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
607	Consumer Economics	10%	20%	20%	0%
801	Individual and Family Resource Management	15%	20%	5%	0%
802	Human Development and Family Well-Being	25%	20%	5%	25%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	10%	10%	20%	25%
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	10%	0%	30%	25%
805	Community Institutions, Health, and Social Services	10%	5%	0%	25%
806	Youth Development	20%	25%	20%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	77.0	12.0	8.0	5.0
Actual Paid Professional	101.0	21.0	8.0	3.8
Actual Volunteer	155.0	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**
1579609	474125	139499	260840
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1579609	133537	139499	98447
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
6123147	256837	1018582	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The family-focused goals of this program will be addressed primarily through a series of workshops that focus on developing family resource management, investment in healthy housing practices, and effective parenting. The goals will be to teach consumers:

1. Family resource management, debt reduction, developing budgets and saving plans
2. To be inclusive of low to moderate income families and families headed by women
3. About reducing home hazards
4. Disseminate of research findings related to agencies/organizations serving limited resource families

Youth impact will be achieved by developing and testing an educational curriculum designed to help youth develop characteristics associated with positive youth development. This will be achieved through a collaborative process of teams of campus/field based youth development educators, 4-H and other community professionals and volunteers, and youth. Each team builds youth development professional practices and expands the impact of evaluations as they: 1) scan the environment and identify emerging focus areas representing educational needs; 2) design and deliver programs responsive to those needs; and 3) design and implement outcome and impact evaluation tools to report successes into the Extension Reporting System. Along with the development of the these programs and its curricula, an additional focus will be to develop strategies to increase access to 4-H programs in local communities, with the intent to build strong networks of individuals who can address the unique needs of the targeted audience.

Contributions to community development will be achieved through a series of research activities including: (1) a study to determine the challenges of new manufactured home owners in the site installation of the units and develop recommendations to the industry for improving the installation process; (2) development of a database of community-based organizations (CBOs) by location, program priorities, capacity and method of operation to encourage collaboration among CBOs, policymakers, businesses and development agencies; and (3) a study to define the critical factors that impact leadership development in rural areas that could lead to new or improved programs for developing future leaders and contributing to the sustainability of rural communities.

2. Brief description of the target audience

The target audience for the activities of this program includes individuals/family consumers, working poor, low to moderate income, minorities, women, homeowners, families with young children, limited resource parents, caregivers, court-mandated or DSS referred parents, and grandparents raising

grandchildren in North Carolina. Other audiences include youth, volunteers, stakeholders and youth development professionals "to create helping relationships, to enable youths to become responsible, productive citizens."

Stakeholders for this program include advocates of underserved populations, representatives of rural communities, policy makers, community based organizations, and the scientific community.

3. How was eXtension used?

Relevant eXtension Communities of Practice include: Family Caregiving, Financial Security for All, Better Kid Care, Military Families, and Home Energy. These sources provide valuable information for educators, volunteers, children and their families. The sites offer frequently asked questions, articles, online learning activities, interactive tools and webinars in the various subject matter areas.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	525000	1000000	227782	0

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

Patent Applications Submitted

Year:	2013
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	4	8	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Develop and conduct Family Resource Management training and workshops.

Year	Actual

2013	380

Output #2

Output Measure

- Educational workshops for consumers related to family resource management, debt reduction, developing budgets and savings plans.

Year	Actual
2013	380

Output #3

Output Measure

- Conduct educational workshops for consumers related to parenting and family life.

Year	Actual
2013	425

Output #4

Output Measure

- Conduct Healthy Homes training for health and housing professionals.
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Parents mandated by the court and agency referred parents consistently using positive parenting strategies.

Year	Actual
2013	4725

Output #6

Output Measure

- Develop and conduct financial education workshops for community based financial educators.
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Conduct educational workshops related to energy efficiency and conservation.

Year	Actual
2013	20

Output #8

Output Measure

- Healthy Eating, Physical Activity and Chronic Disease Risk Reduction

Year	Actual
2013	90491

Output #9

Output Measure

- Preparing Youth for an Employable Future and Economic Success

Year	Actual
2013	103113

Output #10

Output Measure

- Building Community through Volunteerism

Year	Actual
2013	2050

Output #11

Output Measure

- Building Citizen Leaders

Year	Actual
2013	6837

Output #12

Output Measure

- Developing Life Skills

Year	Actual
2013	103113

Output #13

Output Measure

- K-12 Academic Achievement and Educational Success

Year	Actual
2013	15000

Output #14

Output Measure

- # presentations at professional meetings
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Parents adopting appropriate guidance/supervision practices
2	Individuals and families will follow a household budget
3	Individuals and families will increase savings
4	Individuals and families will reduce debt
5	Individuals/families will participate in retirement planning
6	Individuals, businesses, industries and governments engaging in best management practices related to energy use/conservation
7	Individuals participating in the Healthy Homes Specialist certification exam
8	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Healthy eating, physical activity and chronic disease risk reduction
9	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Preparing youth for an employable future and economic success
10	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Building community through volunteerism
11	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Building citizen leaders
12	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Developing life skills
13	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps K-12 Academic Achievement and Educational Success
14	% improved leadership development in rural communities
15	Tax preparers gain needed knowledge for return preparation by attending workshops conducted throughout North Carolina
16	# organizations accessing and using database of community-based organizations
17	# policy makers using data to change policies affecting individuals, families and communities

Outcome #1

1. Outcome Measures

Parents adopting appropriate guidance/supervision practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	4725

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Basic skills, socialization and educational motivation are first taught in the home. Many youth, however, grow up in environments that lack parental supervision and support. Quality time with parents is essential to building trusting relationships. The consequence of these circumstances is that youth may display anti-social behavior, disruptive behavior, school dropout and substance abuse.

What has been done
Family and Consumer Science agents are assisting in building strong families by educating citizens about positive parenting practices. Agents direct educational workshops, conferences, camping experiences, and other outreach efforts focused on developing parenting skills. These efforts address the importance of family time and identify real life concerns and issues facing parents.

Results
As a result of educational programs 4,837 youth and adults used effective life skills; 3,944 adults increased their use of identified community resources; 4,347 professionals used best practices with children, youth and older adults; and 4,439 professionals earned CEU's or other work-volunteer related credentials.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Individuals and families will follow a household budget

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	4425

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The seriousness of today's economic climate has highlighted the importance of basic money management skills. Unfortunately, individuals and families often lack basic financial decision-making skills. Budgeting and record keeping are essential skills for individuals and families to master in order to begin forming a secure financial future. Programs focused on these areas help equip individuals and families with tools to better manage economic change that will occur throughout their lives.

What has been done
Family and Consumer Science Agents collaborated with county and state partners to conduct workshops, conference and other educational events addressing the importance of basic money management skills such as record keeping and budgeting. These outreach efforts are designed to equip individuals and families with the tools they need to better manage economic change throughout their lifespan.

Results
As a result of efforts, 2,620 individuals and families implemented basic financial management strategies and 6,896 people accessed programs and implemented strategies to support their family economic well-being.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #3

1. Outcome Measures

Individuals and families will increase savings

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	586

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In Guilford County, 19.2% of residents are food insecure. Guilford ranks 4th in the nation of counties with food insecurities based on U.S. Department of Agriculture statistics. Many limited-resource senior citizens do not have enough money to buy adequate food for their families.

What has been done
To address this problem, More in My Basket (MIMB), a Supplemental Nutrition Assistance Program (SNAP) ? Outreach Program developed by North Carolina State University was implemented in Guilford County. The objective of MIMB is to help create awareness in senior citizens about SNAP and how to apply for benefits. Nine MIMB sessions were conducted during summer 2013.

Results
Two hundred and one limited-resource senior citizens participated in these sessions. After learning about the MIMB program 44% of individuals responding to the survey indicated they planned to apply for SNAP benefits. If all 36 apply and receive benefits, the potential economic impact would be $3,132 a month, which totals $37,584 per year in additional food purchasing power for Guilford County residents. Also, it is estimated that every $5 in SNAP benefits generates up to $9 in economic activity. Guilford County could recognize a $67,651 impact in economic activity due to More in My Basket.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

802 Human Development and Family Well-Being

Outcome #4

1. Outcome Measures

Individuals and families will reduce debt

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	4015

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

Outcome #5

1. Outcome Measures

Individuals/families will participate in retirement planning

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	586

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Inadequate or absence of retirement planning.

What has been done
Educational programs focused on equipping participants with access and understand strategies for accumulating wealth for retirement.

Results
586 people accessed financial products and programs aimed at accumulating wealth.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #6

1. Outcome Measures

Individuals, businesses, industries and governments engaging in best management practices related to energy use/conservation

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	577

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Energy consumption in North Carolina for transportation and industrial, commercial, and residential uses will continue to grow as the population of North Carolina continues to increase. Continued economic development of the state will depend in part on development of state-based sustainably-produced renewable energy while improving energy efficiency and conservation to conserve all sources of energy to curb demand.

What has been done
Family and Consumer Science agents collaborate with state, county and local partners to conduct residential energy education programs through the E-Conservation Program. Agents use workshops, educational products and conferences to provide education, as well as provide consumer energy kits and energy assessments (using local auditors) to help reduce energy consumption in the home.

Results
As a result of efforts, 576 participants increased their knowledge about best management practices related to energy use and energy efficiency. More than 500 individuals used best management practices to reduce energy use and increase energy efficiency in their homes, business, agricultural industries or government.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #7

1. Outcome Measures

Individuals participating in the Healthy Homes Specialist certification exam

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Healthy eating, physical activity and chronic disease risk reduction

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	227782

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #9

1. Outcome Measures

Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Preparing youth for an employable future and economic success

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	185266

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #10

1. Outcome Measures

Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Building community through volunteerism

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	60094

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #11

1. Outcome Measures

Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Building citizen leaders

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	60094

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #12

1. Outcome Measures

Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps
Developing life skills

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	103113

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #13

1. Outcome Measures

Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps K-12
Academic Achievement and Educational Success

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	185266

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina offers its youth and families a number of unique opportunities to discover the world through 4-H camp and educational programs, to learn 21st century skills, to serve their communities, to learn employment skills and to learn how to be citizen leaders.

What has been done
In 2013 more than 227,000 youth participated in 4-H day and residential camping, 4-H club activities, and school enrichment programs.

Results
In 2013, 29,273 youth were involved in 4-H Clubs, 165,271 youth participated in school enrichment programs, 83,909 were active in special interest activities, and 14,349 attended 4-H camping programs. The focus of the various activities included Healthy Eating, Preparing Youth for an Employable Future, Building Community Volunteerism, Developing Life Skills, and Achieving Academic and Educational Success.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #14

1. Outcome Measures

% improved leadership development in rural communities

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	60094

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Graham County Advisory Committee has identified providing leadership opportunities for youth as a critical need. Many youth in Graham County have the potential to become successful, but lack the skills and resources to do so. Likewise, adult leadership development and engagement are critical for vibrant communities.

What has been done
To remedy this problem, Cooperative Extension and 4-H offered leadership workshops for youth in the 6th, 7th, and 8th grades. Youth learned to manage time, work as a team, facilitate meetings and produce informative lessons to younger peers. These youth met once each month to learn, practice and evaluate lessons for the following club meeting. Students were taught from 4-H curriculum with lesson activities in science and technology. Similarly, extension provided training and education to adults to participate effectively in community engagement activities.

Results
As a direct result, youth leaders were able to successfully plan and provide educational activities to younger peers. Participants reported feeling more confident when speaking before others; and they also reported that they wanted to join this club when they became old enough. Throughout North Carolina, more than 7,600 adults increased their skills to facilitate public engagement on community-based issues, 225 organizations increased or leveraged resources for community programs (funding, in-kind support or volunteers), and almost 700 people participated in community disaster preparedness activities and/or adopted disaster preparedness and mitigation practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services

Outcome #15

1. Outcome Measures

Tax preparers gain needed knowledge for return preparation by attending workshops conducted throughout North Carolina

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Demand among tax preparers, farmers and others to update and educate on tax law changes and impacts, especially for income and estate taxes for North Carolina residents.

What has been done
Presentations were made at 19 county meetings on tax management, tax law changes, farm management issues, estate planning, conservation easement tax implications and timber tax questions. Four registered tax return preparer exam prep courses were taught, along with four intermediate income tax workshops and 10 ag tax workshops.

Results
Tax preparers, advisers and payers are more informed on a variety of income and estate tax issues. In addition, this program and staff advise the IRS for improvements in the farmer's tax guide and are engaged with the Land Grant University Tax Education Foundation, Inc, to provide tax education. Tax education programs developed at NC State have been adopted for use in at least eight other states.

4. Associated Knowledge Areas

KA Code	Knowledge Area
607	Consumer Economics
801	Individual and Family Resource Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #16

1. Outcome Measures

organizations accessing and using database of community-based organizations

Not Reporting on this Outcome Measure

Outcome #17

1. Outcome Measures

policy makers using data to change policies affecting individuals, families and communities

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A limited resource community in Kannapolis, N.C., continues to struggle to get more residents involved and attending monthly meetings.

What has been done
The local Extension community development program developed a survey to determine needs of residents in issues related to confidence in leadership, education and basic demographics since the last survey in 2009. Community officers, local government personnel and Cooperative Extension canvassed door to door with written documents. The written responses were collected and are compiled by the Cabarrus Cooperative Extension Service for continuity and professionalism.

Results
The entire process has empowered and encouraged newly elected officers to continue their work by creating better working relationships among residents and neighboring community leaders. As

a result, the monthly community meeting increased by 10 percent. Educational programs are added to monthly meetings to increase knowledge of residents about personal health, safety and economic development. Statewide, 2,081 citizens reported collaborating in community-wide planning for economic, social and environmental sustainability, and more than 2,000 people engaged in public dialog or decision-making on community-based public policy issues.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures
805	Community Institutions, Health, and Social Services

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

North Carolina does not report youth activites under subject matter categories for camps, special interests, school enrichment and 4-H clubs. Instead all are aggregrated to result in one number of total particpants for these categories.

The national budget crisis and its trickle down impact on the state of North Carolina have affected some of the program efforts, impacts and outcomes. Until the economy rebounds more robustly, communities and families stay closer to home and are less inclined to particpate in educational programs. Despite Extension's footing in communities, when parents struggle with family finances and employment, their youth are impacted.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of largely Extension Reporting System data indicate that significant numbers of youth as well as adults engage with educational activities in this program area.

One challenge in reporting on this planned program is that a number of the outcome indicators are conflicted with one another. For example the same group of youth

participants that are aggregated as indicated above may be associated with different outcomes such as volunteerism, building citizen leaders and gaining life skills. Many of the particpants benefit from multiple programs, so similar or identical numbers of participants may be reported for different outcomes.

Nevertheless, it is clear that nearly a quarter million million youth are documented, and likely more, as being engaged with the youth programs and receiving quality education and mentoring from their involvement.

Key Items of Evaluation

Note aggegation of participant data for different 4-H and youth activities. This program can benefit from more clearly capturing well-defined impact statements, as well as some revision in the Extension Reporting System's ability to capture outcomes and impacts.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Human Health, Nutrition and Well-being

☑ 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	5%	0%	15%	25%
206	Basic Plant Biology	5%	0%	15%	0%
502	New and Improved Food Products	10%	0%	15%	25%
701	Nutrient Composition of Food	10%	0%	10%	25%
702	Requirements and Function of Nutrients and Other Food Components	10%	0%	10%	25%
703	Nutrition Education and Behavior	15%	0%	0%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%	0%	5%	0%
721	Insects and Other Pests Affecting Humans	10%	0%	10%	0%
722	Zoonotic Diseases and Parasites Affecting Humans	5%	0%	10%	0%
724	Healthy Lifestyle	10%	0%	10%	0%
802	Human Development and Family Well-Being	10%	0%	0%	0%
	Total	100%	0%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	4.0	50.0	6.0
Actual Paid Professional	13.0	0.0	47.0	5.7
Actual Volunteer	15.0	0.0	15.0	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**
204871	0	817368	237274
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
204871	0	817368	50666
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
794449	0	5968171	796699

V(D). Planned Program (Activity)

1. Brief description of the Activity

Human nutrition, health and well-being research and outreach programs will include, but not be limited to, the concepts listed below:

The Plants for Human Health Institute at Kannapolis, NC aims to enhance the nutritional value of fruits and vegetables and related compounds to improve human health and prevent disease. One of their first major accomplishments, collaborating with the David H. Murdock Research Institute and a nationwide consortium, is the sequencing of the blueberry genome, a major fruit when fresh fruit consumption and antioxidants for health are considered. Associated with the Institute, the NC Market Ready outreach program will provide information to growers and marketers for business management, marketing, safety and production management to facilitate the introduction and production of new crops evolving from the Institute's research efforts. Studies examine ways to identify and control tick species that vector Rocky Mountain Spotted Fever. A novel approach involved an all-natural botanical insect repellant for both ticks and mosquitoes. Biochemical research is developing technologies to produce effective vaccines against insect vectored diseases. Biochemists are seeking to understand ribosomal RNA targets for antibiotics in an effort to understand why antibiotics lose their effectiveness, ways to enhance the effectiveness of existing materials and possibly find new antibiotics with enhanced effectiveness or new modes of action. Also researchers are looking at the various potential uses of biofilms associated with bacterial masses, including the possibility of inactivating biofilms associated with disease causing organisms, making them susceptible to existing or new antibiotics or other antibacterial compounds. Geneticists are seeking to understand relationships between genetic makeups of animals and based on that, how environmental influences (chemicals, toxicants, food compounds) might influence cancer development. Outreach with partner and interested life sciences communities, the food and pharmaceutical industries and peer scientific communities provides new technologies and scientific information which may become the basis of startup or existing manufacturing companies.

2. Brief description of the target audience

- Peer researchers and collaborators, including health care providers
- Food processors and manufacturers
- Farmers and growers
- Consumers
- Allied technical service providers and consultants to growers, processors and marketers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	160000	250000	0	0

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

Patent Applications Submitted

Year: 2013

Actual: 7

Patents listed

Novel Aspirin Derivatives as Chemotherapeutic or Chemopreventative Agent, Sang, S.U.S.Patent No. 2013/0338120

Use of [6] Shogaol metabolites in the treatment of cancer, Sang, S. Filed 12/19/13

Modulation of BfmR by Imidazole-based Anti-biofilm Agents
Appl # 13/871,259 US

Mitigation of Colon Cancer by Gram Positive Lactic Acid Bacteria Deficient in Lipoteichoic Acid
Appl # PCT/US2012/070322 International

Recombinant Lactobacillus with Decreased Lipoteichoic Acid to Reduce Inflammatory Responses Appl # 13/805,037 US

Targeted Delivery of Biotherapeutics to the Gastrointestinal Tract via Bile Sensitive Lactic Acid Bacteria
Appl # 13/697,860 US

Inhibition of Biofilms in Living Plants by Use of Imidazole Derivatives Appl # 12/600,968 US

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	15	87	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Non-degree credit group activities conducted related to human health, nutrition and well-being

Year	Actual
2013	2400

Output #2

Output Measure

- Targeted audiences participate in workshops and demonstrations on human health, nutrition and well-being

Year	Actual
2013	134372

Output #3

Output Measure

- Conduct research projects related to human health, nutrition and well-being

Year	Actual
2013	39

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Identify and develop new food constituents or compounds that can benefit human health or nutrition
2	Create new plant materials (germ plasm, breeding lines, cultivars) that contain health benefiting compounds
3	Research projects generate findings that impact the knowledge of and control of vectors that impact human health and safety
4	Research projects generate findings that impact the knowledge of prevention or curing of diseases influenced by interactions of genetics and the environment

Outcome #1

1. Outcome Measures

Identify and develop new food constituents or compounds that can benefit human health or nutrition

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Healthy foods (also called functional foods) are receiving increasing interest from consumers and food manufacturers. In addition to essential nutrients, functional foods contain a variety of compounds possessing health-promoting activities. More in-depth research is needed to identify the active components in functional foods and to study the in vivo efficacy of bioactive food components and functional foods.

What has been done
NC A&T researchers investigated the effects of rosemary and its active components on metabolic syndromes and the effects of phytochemicals in wheat bran for colon cancer prevention.

Results
The efficacy of different carnosic acid enriched rosemary extracts in a high-fat diet-induced metabolic syndrome in mice was assessed. Results showed that carnosic acid was the active component in rosemary and that carnosic acid enriched rosemary extract might be developed as a dietary strategy for the prevention/treatment of obesity and related metabolic syndrome. We have also studied the chemical profile of wheat bran and identified alkylresorcinols, sphingolipids and sterols as the major active components to kill colon cancer cells.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology
502	New and Improved Food Products
701	Nutrient Composition of Food

724 Healthy Lifestyle

Outcome #2

1. Outcome Measures

Create new plant materials (germ plasm, breeding lines, cultivars) that contain health benefiting compounds

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In this era of diminishing returns for novel drug development and escalating costs for health care, plants and related natural products offer a "final frontier" for new drug and health product discoveries. Plant-based medications (including functional foods) can offer safe, time-tested, efficacious alternatives to drugs, so that proactive consumers can take charge of health maintenance. Plant-derived bioactives, featuring multiple molecular modes of action, are far less likely to be overcome by a microbe's ability to build up immunity, and they can provide a broad-spectrum potency unavailable through synthetic drugs.

What has been done
Research taking place at NCSU's Plants for Human Health Institute focuses on elucidation of the natural, health-protective constituents inherent in edible plants, and exploiting these insights towards development of concentrated, efficacious, unprecedented, and cost effective functional food ingredients and phytopharmaceutical components. NCSU is one of the original partner institutions of the Global Institute for BioExploration (GIBEX),a global research and development network that promotes ethical, natural product-based pharmacological bioexploration to benefit human health and the environment in developing countries. Recently, the GIBEX network has served as a launchpad for introduction of cost-effective, novel biofortified food ingredients into rural villages/impoverished communities which otherwise have no access to the bioactive phytochemicals produced in healthy fruits and vegetables.

Results
The Bioexploration initiatives have opened up collaborations with African, Asian, and South American universities and with Crown Research Institutes in New Zealand. Government partnerships have been forged, and agreements/Memoranda of Understanding have been executed. The initiative has had strong immediate economic impact with the partnering groups in

that the federal funding has brought tangible resources into the schools and communities (infrastructure, teaching lab instrumentation for local schools, computers, etc.). In addition, the impact of the programs can be measured in the sustained support garnered within many of the partnering countries.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
206	Basic Plant Biology
502	New and Improved Food Products

Outcome #3

1. Outcome Measures

Research projects generate findings that impact the knowledge of and control of vectors that impact human health and safety

2. Associated Institution Types

- 1862 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Insects and related pests as bio-contaminants in industrial settings, especially in the food and pharmaceutical industries, where bio-contaminants may create deleterious effects in consumers, company liability and potential significant economic costs.

What has been done
Cases of actual or suspected bio-contamination require direct intervention by the scientist and may require up to five days of involvement, including:

1. Positive pest identification through the NCSU Plant Disease and Insect Clinic to ascertain if the pest is indigenous to North Carolina or may have arrived at the facility in shipments from its suppliers.
2. Site visits, including facility and product inspections and evaluation of product handling and

manufacturing procedures, Quality Assessment guidelines, etc. in order to determine possible "weak links" that may contribute to the likelihood of the problem.
3. Preparation of written documentation concerning the origin of such problems and then outlining a course of remedial and preventive action for this and similar problems.

Results
Industries experience fewer shipment rejections, maintain working relationships with their customers and not creating situations that might result in contract losses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
721	Insects and Other Pests Affecting Humans
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #4

1. Outcome Measures

Research projects generate findings that impact the knowledge of prevention or curing of diseases influenced by interactions of genetics and the environment

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the North Carolina State Center for Health Statistics, the prevalence of diabetes in the state is 8.5% (higher than the 7.3% national average). The progression of Type 2 diabetes from pre-diabetes to diabetes is typically accompanied by damage to the insulin-producing pancreatic beta cells.

What has been done
NCSU researchers are working to understand how the insulin gene is regulated so they can learn

to increase beta cell production of insulin, and even stimulate non-beta cells to make insulin. In addition, scientists have started investigating how proliferation of pancreatic cells is regulated. This is important for regenerating beta cells to treat diabetes, and also for reducing uncontrolled growth of pancreatic cancers.

Results

This work will contribute to the effort to stimulate insulin gene expression to prevent the progression of pre-diabetes to diabetes. This work also will contribute to treatment of pancreatic cancer. There are currently no good treatments of pancreatic cancers, which tend to be discovered late and grow and metastasize rapidly. If interactions between transcription factors promote cell proliferation, then disrupting these interactions would provide new targets for drug discovery.

4. Associated Knowledge Areas

KA Code	Knowledge Area
722	Zoonotic Diseases and Parasites Affecting Humans
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Rapidly changing political, policy and economic conditions influence citizens' and businesses' abilities to adapt to change while ensuring healthful living and high quality life. Continued economic conditions affect federal, state and local support for research and extension programs, in some cases creating challenges to maintain productive and impactful programs. The regulatory environment often creates challenges for farmers, processors, handlers and food providers; often compliance is expensive and complicated, especially the required documentation. Nevertheless, successful operators develop strategies to comply to ensure that the food supply is safe and plentiful and the environment is protected. Emphasis will continue to be placed on those programs in research and extension that have the greatest effect on sustainability of citizens, families and businesses.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Data from our Extension Reporting System, faculty activity reports and impact

statements, and Office of Technology Transfer were used to assess outcomes in this program area. Despite the challenges and influencers noted above, the data available indicate that this program is reaching suitable segments of the audience and that faculty are productive, when considering development of new technologies and publication records. We will continue to strive for a program that is relevant and productive for stakeholders and supports a creative and productive faculty.

Key Items of Evaluation

Efforts will continue to discover and develop natural products and other technologies to enhance healthy living, reduce disease and enhance nutrition, including developing new plants from which compounds to enhance health might be derived.

Our faculty and extension reporting efforts can be improved to capture more concrete impacts of this planned program area.