2012 North Carolina A&T State University and North Carolina State University Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 07/29/2013

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 2012 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.

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.

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.

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. Through this work, NCA&T advanced the reduction of the use of chemical insecticides through effective substitution of biorational insecticide products. Work on replacement of synthetic antibiotics progressed with advances in understanding how (a) nutrients can counter the destructive modulation of cells by infectious pathogens and (b) mushrooms can be used as a feed supplement to reduce the need for health regulation by antibiotics in chickens. Other nutritional interventional work resulted in demonstrating how shifting pigs to an oat and yeast supplemented and higher fiber diets can yield greater average litter sizes. Progress in cell technology growth enabled researchers to successfully culture porcine airway cells to be used as a study tool for swine respiratory illnesses.

Results from NCA&T research teams demonstrated the ability to accelerate the propagation of commercially desirable plants and to show how constructed wetlands can help clean swine lagoon wastewater resulting in reducing nitrogen and phosphorus concentrations and greater sequestration of carbon. Work on hydrothermal processing of swine manure and other waste materials resulted in the development of a quality source of biofuel for transportation uses. This and other applications of this processing approach led to filing for a patent application. Another development relating to biofuels involved the design of a photobioreactor to grow microalgae on swine wastewater in a controlled environment year round.

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.

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

GLOBAL FOOD SECURITY - PLANT PRODUCTION SYSTEMS AND HEALTH

Plant Genome, Genetics, and Genetic Mechanisms

At NCSU, some of the genes involved in ethylene biosynthesis, signaling, and response are being identified and characterized in the plant model system Arabidopsis thaliana. Once the function and regulation of these ethylene-related genes are understood, the Arabidopsis genes or their orthologues from other organisms can be introduced into agriculturally significant species to alter ethylene production or sensitivity.

Plant Genetic Resources

A novel breeding method for producing adapted soybean breeding lines from wild soybean was developed and tested at NCSU. This breakthrough work has the potential to move large amounts of genetic diversity present in the wild soybean into applied breeding programs, thus expanding the narrow genetic base now available to soybean breeders.

Plant Product Quality and Utility (Preharvest)

NCSU Faculty are playing a key role in advising on the planning and construction of sweet potato postharvest storage facilities in North Carolina and other producing states. Several facilities with capacities of over 250,000 bushels were built in 2012, with others on the drawing board and scheduled to be built in the spring of 2013. Although similar in concept, the design of each facility is unique depending on whether it includes packing facilities, packed product storage and refrigeration.

Plant Management Systems

NCSU scientists used better knowledge of weather patterns and climate data to determine potential drought periods and when corn growers should plant to avoid drought stress at silking and what weather indicators could be used to predict when drought periods would occur so growers could adjust their planting dates accordingly. In 2012 this planting date prediction model was used statewide for the first time. As a result much of the corn crop in the state had already silked by the time a late June, early July drought hit. Corn yield statewide was the second highest on record (126 bushels/acre) even though 2012 was classified as below normal in summer rainfall.

Basic Plant Biology

NCSU scientists have identified several regulatory proteins and a potential iron sensor that interacts with these transcription factors to control how plants respond to iron deprivation. Understanding the molecular mechanisms of how plants absorb iron can direct food fortification efforts. Long-term goals of this research are to translate this information to important crop species such as soybean to generate plants with increased tolerance to low iron and increased nutritional content.

Insects, Mites, and Other Arthropods Affecting Plants

Food crop production is highly dependent on a number of factors that promote and allow growth including the regulation of pests that can reduce yield and product quality. NCA&T scientists are working to validate the efficacy of biorational insecticide products for the suppression of pests on vegetables for small farm application. Combinations of these insecticides were identified that represented low environmental contamination but effectiveness against pests on small collard and eggplant production.

Pathogens and Nematodes Affecting Plants

Understanding the biochemical and developmental pathways employed by plant parasitic nematodes will reveal targets for designing new, environmentally-safe nematicides. NCSU scientists and colleagues at the University of California-Davis are developing the root-knot nematode Meloidogyne hapla as a model system. We used progeny lines of a cross between inbred lines segregating for molecular markers and pathogenicity traits to produce an integrated genetic and physical map that will serve as a resource for investigating genome structure and for cloning genes of interest. The genes we identify as lying in the

regulatory networks required for the host-parasite interaction will be directly useful in developing root-knot nematode control strategies. The biochemical processes regulated by these networks represent potential targets for the development of novel nematicides. Controlling nematodes will lead to higher yields and plants that are less susceptible to other stresses (in particular, drought) and will help reduce our reliance on environmentally-damaging controls.

Weeds Affecting Plants

Approximately 99% of the cotton grown in North Carolina is planted to herbicide-resistant cultivars. Research and educational programs have focused on how best to manage weeds in these herbicide-resistant crops. This has included determining the need for residual herbicides, best timing of herbicide applications, value of herbicide mixtures, solutions for problem weeds not adequately controlled in the new systems, and control programs for herbicide-resistant volunteers. Extensive efforts have focused on comparing net returns of the new systems with conventional systems. Crop yields have increased, input costs have remained the same or been reduced, and quality problems such as foreign matter contamination have been reduced. The overall value to North Carolina cotton producers is estimated at $25 million.

Integrated Pest Management Systems

NCSU faculty worked with regulators responsible for certifying blueberries for export and representatives of the North Carolina Blueberry Council, Inc. to develop a strategy to incorporate IPM tactics into blueberry maggot fly management programs. Nearly all North Carolina blueberry growers export a portion of their harvest to Canada, and Western Canada currently imposes a quarantine on blueberries and huckleberries imported from regions where the blueberry maggot fly is established. Five large North Carolina blueberry farms have expressed an interest in implementing the IPM program.

Instrumentation and Control Systems

Several projects are addressing irrigation water management. An applied research project on a grower's farm is monitoring and controlling a subsurface drip irrigation system so that additional guidance may be developed. In addition, support has been provided for the Agricultural Water Resources Assistance Program. AgWRAP, administered by the North Carolina Department of Agriculture and Consumer Services Division of Soil and Water Conservation, is designed to identify opportunities to increase water use efficiency, availability and storage; implement best management practices (BMPs) to conserve and protect water resources; increase water use efficiency; and increase water storage and availability for agricultural purposes. Program support involved development of a water needs assessment and agricultural pond sizing tool and training for its use.

New and Improved Non-Food Products and Processes

Concerns about food safety and contamination have led pet food manufacturers to seek domestic sources of processed sweet potatoes, a gluten-free source of carbohydrates. After 25,000 pounds of off-grade and misshapen sweet potatoes were sliced and dried in tobacco barns on a cooperator's farm, the resulting material was supplied to several potential users. Responses were so positive that the cooperator and another company are planning commercial drying facilities to produce sliced, dried sweet potatoes for animal feed manufacturing.

Quality Maintenance in Storing and Marketing Non-Food Products

Research focused on using wood-based substrates in place of peat moss in the nursery and greenhouse industry. One company reported saving $100,000 in 2012 by substituting wood materials for peat moss. Wood materials weigh less than peat moss, which allowed the company to lower its shipping costs as well. The company realized a total savings of more than $1 million in freight costs and savings in peat moss purchases.

Economics of Agricultural Production and Farm Management

Research related to financial constraints and their impact on the U.S. agricultural sector shows that improved access to credit as a result of interstate bank branching deregulations adopted by U.S. states leads to higher farm sales and profits. In particular, research results suggest that the increase in bank competition and the accompanying reduction in credit constraints have, indeed, benefitted the U.S. agricultural sector. Estimates indicate that county-level farm sales increase by 3.9 percent after the state deregulates its banking sector and allows interstate bank expansion. Estimates also show that following interstate banking deregulation, county-level agricultural production expenditures in the state rise by 1.9 percent, which is less than the increase in sales, thus leading to higher farm profits.

Business Management, Finance, and Taxation

A faculty member was involved in developing tax education material for beginning farmers, limited-resource farmers and others. This effort resulted in the creation of Rural Tax Education and the website www.RuralTax.org as a delivery point of various tax fact sheets and sample income tax returns for agriculture and the rural sector of the U.S. economy. Unique individual visits to this website nearly doubled for 2012 as compared to 2011.

Marketing and Distribution Practices

Faculty members are working with small-scale, diversified, low-input produce farms to help these farms become Good Agricultural Practices (GAP) certified. Faculty members meet with farmers to identify best management practices these farmers currently use to reduce the risk of pathogen contamination and evaluate the cost of becoming GAP certified. In addition, we developed and published a guidance manual on proven, cost-effective, scale-appropriate whole farm GAPs for small farms. We also developed training on scale-appropriate on-farm produce production safety practices.

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

Reproductive Performance of Animals

Preliminary results from an NCA&T project looking at timing of a nutritional intervention to improve the reproductive capacity of sows has found evidence of a 0.28 pig/sow/year increase and a marginal increase in average litter weight in sows fed a high-fiber diet compared to sows fed a standard/control diet. This means that in a 100-sow herd with access to modest amounts of dietary fiber, a producer could raise 28 more pigs per year for the same dollar amount spent on non-fiber enriched diets.

Nutrient Utilization in Animals

Research with broilers has confirmed that while feed made up of smaller ingredient particles does promote feed digestibility, there is still a need to slow the feed passage rate through the gastrointestinal tract by stimulating reverse peristalsis, which is controlled by contractions of the feed-grinding gizzard, which provides sufficient time for digestive processes to take place. The strategic addition of a limited amount of larger particles of corn to pelleted broiler feed was found to improve overall digestive efficiency and reduce litter nitrogen, phosphorus, and moisture. The reduced litter nitrogen and moisture may lead to reduced ammonia emissions from litter. Improved feed efficiency will contribute over $600 million to the U.S. broiler industry while improving environmental sustainability.

Genetic Improvement of Animals

Infectious diseases cause $2 to $8 billion worth of losses to the animal industry. Livestock producers (cows, sheep and goats) are faced with ineffective therapeutics for infectious disease. Conventional approaches often fail to control infection and worse, promote the resistance of infectious pathogens against existing drugs. To address this, a comparative study of ruminants (sheep goats and cattle) was conducted at NCA&T to investigate how cell proteins are modulated by infectious pathogens and how nutrients can counter or reduce damage done by the pathogens. Results show that the genetics of animals and their pathogens offer avenues for controlling infectious diseases through selection and development of novel biotechnologies to augment existing approaches for control.

Animal Management Systems

The swine industry often weans pigs at an early age to promote increases in swine production, but the stress of early weaning, coupled with an immature immune system makes piglets more susceptible to developing post-weaning diarrhea (PWD), which is associated with an imbalance of gut microflora and impaired growth rate. Antibiotic growth promoters (AGP) are commonly used in piglet diets to avoid post-weaning diarrhea. However, because of mounting public concern over AGP and its link to the emergence of antibiotic resistant bacteria, alternatives to AGP that maintain the health status of weaned pigs are being sought. Sows were fed diets supplemented with a probiotic (yeast), a prebiotic (oat) or a symbiotic (yeast and oat). Sows fed oat showed significantly higher levels of the probiotic bifidobacteria in milk and had higher levels of certain immunoglobulins (IgM, IgG) in their milk. Moreover, the immunoglobulins (IgG) were more reactive to E. coli (a common cause of PWD), suggesting that the oat diet provided increases the health benefit of the milk. Consistent with these findings, piglets born of these sows weighed more at birth, lost less weight during weaning and had decreased incidences of diarrhea than pigs born of sows not fed an oat supplemented diet. These data suggest that oat may contribute to improved intestinal health and growth of piglets.

Animal Diseases

Respiratory illnesses in hogs are challenging to study because there are limited respiratory cell culture procedures available for the study of swine airways. To address this need, NCA&T researchers developed a way to grow porcine airway cells in the laboratory for use as a study tool without having to sacrifice living animals. The researchers isolated cells from pig windpipes and were able to successfully grow them in the laboratory. While this technology is not expected to prevent/treat animal diseases directly, it provides a tool that may be used to study disease process and develop methods to treating them. This technology needs to be further optimized and has potential commercial value.

External Parasites and Pests of Animals

A novel management tool was developed to manage biting flies in dairy herds. The natural plant-derived insect repellent geraniol and a fatty acid (C8,9,10) were used to repel flies. These highly effective insect repellents cause flies to abandon the host. Where these abandoning flies go and if they return is not known. NCSU scientists are currently in the last year of a population study to determine the age and development of replacement flies. Such information will open the way for expanded use of naturally occurring insect repellents in organic and conventional dairy production. This research is currently a focus of a new multistate research project focused on pasture fly management.

Internal Parasites in Animals

Avian coccidiosis is a major parasitic disease of poultry that cost the industry millions of dollars annually due to poor feed utilization, reduced growth performance, and deaths. An NCA&T project using fungus myceliated grains singly or in combination on broiler chickens after an Eimeria challenge found that the Shiitake mushroom was superior in production performance and that Cordycep mushrooms reduced oocyst shedding in chicks

Animal Welfare/Well-Being and Protection

Poultry producers are faced with concerns that reducing and/or eliminating drugs/antibiotics for disease control may compromise food security/safety. This is due to concerns over the emergence of multi drug resistant of microbial strains linked to the use of antibiotic growth promoters in poultry. Consequently, there has been increased interest in finding alternative non-synthetic means of controlling pathogens that cause disease. An NCA&T study targeting the application of medicinal mushrooms (in extracts or myceliated grains) as an alternative to antibiotics found that inclusion of mushrooms in poultry feed produced immune stimulating effects and overall health in poultry.

Instrumentation and Control Systems

Dairy Records Management Systems developed an Android-based farm management system to deliver the benefits of mobile technology to participating dairy producers, veterinarians, and other farm consultants. The system includes the following major components:

· A user interface designed for highly intuitive and effective use, including field input.
· Database, editing, and communication technologies that serve as an extension of the on-farm desktop database.
· Alternatively, the communication technology is provided in a direct-to-DRMS mode, eliminating the need for an on-farm database.
· A distribution mechanism to support continual upgrading of the application.

New and Improved Non-Food Products and Processes

The search for genes and network systems contributing to diseases with complex genetic and environmental etiologies like cancer has been hampered by appropriate model systems. Similarly, advances in complex trait genetics have been limited by computational tools that are untested on complex data sets. If advances are to lead to personalized understanding of health and disease processes, new experimental systems that accurately model heterogeneous human populations are needed. NCSU scientists designed and built a new experimental mouse population called the Collaborative Cross. This resource is a novel population developed by the mating of eight genetically diverse founder lines to randomize the existing genetic variation. The resulting lines were then inbred to fix the genetic makeup, allowing experimental integration over space and time. Over 300 such lines have been built and are now being used in proof-of-concept experiments.

Quality Maintenance in Storing and Marketing Non-Food Products

The ammonia in manure and waste treatment systems is dilute and therefore limited in use to relatively short distances, usually on the same property on which the animals are raised. In North Carolina and much of the country, this prevents use of the valuable nutrients in the feed production system. ARS scientists have developed a membrane technology that is selective for gaseous ammonia. In the laboratory, this technology can remove 50% of the total ammoniacal nitrogen in a lagoon sample over a period of several days. NCSU engineers have obtained a grant with the ARS scientists to build a pilot scale ammonia recovery system based on this technology and to develop procedures that will facilitate on-farm operation. Development of this technology will help convert the pollution potential of liquid manure application into a valuable fertilizer product that can be transported out of the local watershed.

Economics of Agricultural Production and Farm Management

A steering committee was formed under the leadership of the U.S. Pork Center of Excellence, which included swine extension nutrition experts from several universities with leading swine nutrition programs. This committee developed an applied swine nutrition guide and a nutrient requirement estimator and feed formulation program that allows for the design of farm-specific diets. A second version of this software includes a module that allows producers to estimate nutrient excretion and assign values to manure nutrients for land application. The committee is now developing proposals to expand the software to include estimation of greenhouse gasses and other facets of pork production. The National Swine Nutrition Guide is an important resource that is being used by educators, students and agri-business personnel throughout the U.S. and world. Through the use of the guide and its formulation software, pork producers will be able to employ a comprehensive feeding program based on sound principles and tailored to the operation, ultimately increasing profitability and reducing environmental impacts. The program will further enable producers to include the value of nutrients excreted in manure for land application in their economic decision matrix.

Business Management, Finance, and Taxation

An agricultural economist at NCSU published a weekly agriculture commodity report, developed and maintained a viable contingent of North Carolina dairy and livestock enterprise budgets and conducted economic and financial analysis as needed. In addition, the faculty member contributed to the North

Carolina Stabilization and Growth, Inc. (Dairy Advantage) project by serving on the board and program resource team. The faculty member also advised Dairy Advantage regarding national dairy marketing and policy issues. The faculty member developed and delivered information in group and individual settings regarding value-added livestock products, partial enterprise analysis, forage economics, drought recovery, farm transition, whole-farm business plan development, farm business management, and risk management related to corn, soybeans, wheat, dairy, beef, hogs and forage crops.

Marketing and Distribution Practices

Expanded economic perspective is required as food and environmental and energy policy are being developed. Toward this end, systematic evaluation of the expected costs and benefits of additional technologies is continuing. This information is important in determining the direction of legislation, regulation, and design of biofuel and pig production systems in North Carolina. Expectations are that the quantity of food demanded, including meat, feed grains and oilseed meal, and the quantity of energy demanded will nearly double over the next few decades concurrently with demands for sharp reductions in environmental emissions. High levels of risk and volatility in markets for agricultural inputs and products are expected to continue. New economic insight is required to shape policy and focus research, development, and education to meet these challenges. We are working to broaden the scope of economic analysis of agriculture and silviculture to include production of energy, fertilizer, other non-food and non-fiber products, aesthetic and environmental services, as well as a safe use for otherwise wasted water, energy, nutrients, and other by-products of human activities.

CLIMATE CHANGE

Soil, Plant, Water, Nutrient Relationships

NCSU scientists conducted a series of experiments examining the effects of disurbance (including tillage, nitrogen inputs, elevated atmospheric CO_2 and O_3) on soil microbes and microbially-mediated processes and the relationship between soil microbial diversity and invasion of soilborne pathogens. This investigation demonstrated that CO_2-enhancement of mycorrhizae stimulates organic matter decompostion in soil. Research has also shown that elevated CO_2 facilitates organic carbon decomposition in N aggrading agroecosystems. This research hsthe potential to lead to better management of soil microbial communities for nutrient retention and soil carbon sequestration to reduce the CO_2 concentration in the atmosphere. More importantly, the findingthat CO_2-enhancement of mycorrhizae stimuates organic carbon decompostion challenges the current paradigm that CO_2-enhancement of mycorrhizae would promote soil carbon sequestration under future CO_2 scenarios. This knowlwdge advances our general understanding of microbial controls over soil carbon dynamics and may significantly help us design nutrient management regimes for soil carbon sequestration and mitigation of climat change.

Conservation and Efficient Use of Water

Tidal marshes are valuable wetland resources that contribute to the estuarine food web. Marshes also capture and store atmospheric carbon, and they are effective filters that that improve water quality by removing sediments, nutrients, and other pollutants. The loss and degradation of tidal marshes due to development led to an interest in restoring or creating new marshes to replace lost functions and values. Farmland that was wetland before being drained, cleared, and used for growing crops is being converted back to wetland to mitigate wetland losses and reduce nutrient inputs to adjacent estuaries. North Carolina State University, with support from the North Carolina Ecological Enhancement Program, and the North Carolina Department of Transportation has evaluated techniques for restoring and creating wetlands. Research indicates that restored wetlands provide many of the functions and values of natural wetlands.

Watershed Protection and Management

In freshwater systems, the larval life stage, glochidia, of Unionida mussels develops as an obligate parasite on host fish gills or fins before transforming into the juvenile stage and dropping to the sediment to

complete the life cycle. Because of the relationship between freshwater mussels and their often specific host fish species, mussels are not only limited by their own variable thermal tolerances, but also by those of their host fish. NCSU scientists compiled data from laboratory experimental exposures of freshwater mussels and similar findings from available literature regarding thermal sensitivities of eight species of freshwater mussels and their host fish to determine if the community structure of these systems is at risk from rising environmental temperatures. This research revealed that freshwater mussels were both more and less thermally sensitive than specific host fish species (2.9 degrees C mean absolute difference between mussel and host). In 62% of mussel-host fish comparisons, freshwater mussels were more thermally tolerant than their hosts (3.4 degrees C mean difference), suggesting that some mussels are effectively more stenothermic than tolerance criteria indicate, which may pose additional environmental risk. Further analysis revealed that variation in mussel thermal tolerance could not be significantly attributed to mean fish host thermal tolerance, acclimation temperature, species, or life stage, signifying that mussel thermal tolerance is controlled by complex factors not identified in this study. These findings suggest that thermal effects of anthropogenic landscape alteration and climate change may be compounded for freshwater mussels via their obligate life cycle interaction with fish.

Pollution Prevention and Mitigation

NCSU researchers have developed spatially-explicit landscape simulation models that incorporate local and regional empirical data to inform conservation decisions in the Southeast. Our models simulate future changes in the landscape due to (1) growth of urban and residential areas; (2) forest management trends resulting from potential demand for biofuels; (3) forest disturbances, including wildfires and southern pine beetle outbreaks, and the effects of climate change on these disturbances. The baseline scenarios of urban growth and forest disturbance are complete, and we are now focused on refining the forest management portions of our models. Our modeling is being used in conservation planning efforts by The Nature Conservancy and the South Atlantic Landscape Conservation Cooperative (LCC). Our data will be part of an online regional conservation data tool published by the South Atlantic LCC.

Important to the betterment of our environment is an increase in the diversity of plants, natural ecosystems, and agricultural systems. Part of an increase in diversity is the retention and extension of desirable plant species that are slow to germinate or have difficulty adapting to changing climatic conditions. NCA&T researchers are using micro-propagation techniques to increase germination and growth rates of commercial plants. Working with Alexandrian laurel -- which is known for its low seed germination rate, slow seed germination, and slow growth of seedlings -- researchers used tissue culture techniques to expedite seed germination and promote seedling growth. Increased seed germination up to 500%, shortened seed germination time to one quarter of the time needed by conventional method, and more vigorous and faster seedling growth were achieved.

Air Resource Protection and Management

The impact of ozone on growth and yield continues to be assessed for a number of crop species. Ozone-sensitive and tolerant varieties of crop species are being identified and compared in studies to determine the biochemical, physiological, and genetic basis for ozone tolerance. Antioxidant compounds have been identified as critical factors in ozone tolerance. A group of 30 soybean ancestors representing 92% of the pedigree of modern U.S. cultivars have been screened for ozone tolerance based on foliar injury, and Fiskeby ancestral genotypes identified as a potential source of resistance genes to ozone and other abiotic stress factors. A mapping population has been developed based on a cross between Fiskeby III and Mandarin Ottawa, ozone-tolerant and sensitive plant introductions, respectively. The population consists of 240 random inbred lines, and work is underway to map tolerance genes for ozone as well as drought, salt, aluminum, and iron deficiency chlorosis. This research has the potential to provide the knowledge and technology required for the development of stress-tolerant crops.

Structures, Facilities, and General Purpose Farm Supplies

Carbon dioxide and methane are potent greenhouse gases that contribute to global warming. A

major issue affecting swine waste management is how to capture or re-use the abundant nitrogen and phosphorus that can affect local water and air quality. NCA&T researchers are using constructed wetlands to treat anaerobic lagoon swine wastewater and have found that they were able to reduce the nitrogen and phosphorus concentrations by 75 and 40 percent respectively. Another benefit was the wetlands sequestered significant amounts of carbon.

Engineering Systems and Equipment

Continuous microwave pretreatment of alkaline switchgrass was accomplished using both a small and commercial scale microwave setup. Surface areas were increased at higher operating temperatures, which typically correlated with improved sugar yields. Fermentation of resultant sugars to ethanol was directly related to starting glucose levels. All processing outcomes boosted ethanol production compared to control, non-microwaved, switchgrass samples. Continuous flow microwave technology looks promising as a novel pretreatment step for improving the production of bioethanol.

Waste Disposal, Recycling, and Reuse

Anaerobic co-digestion of animal manure and agricultural residues has been studied for biogas production. The optimum ratios of swine manure with different agricultural residues (corn stover, wheat straw, rice straw, coco husks, switchgrass, and Bermuda grass) have been investigated to maximize biogas production from the organic wastes. Additional enzymes have also been studied for their effect on biogas production. A research collaboration on anaerobic co-digestion of animal manure and agricultural residues for biogas production has been initiated with Research Triangle Institute, Research Triangle Park, NC. A joint effort will be on investigating kinetics of the anaerobic co-digestion and developing a user-friendly kit for the design of anaerobic co-digestion systems for biogas production, which would have great impact on the agricultural and bioenergy industries.

Instrumentation and Control Systems

The threats posed by climate change, urbanization, and invasive species underscore the need for proactive management, while conservation planning at regional and national levels has been limited by the lack of consistent, detailed and current data. The National Gap Analysis Program (GAP) has been working to address this problem by creating national datasets to support analysis and resource management. A database has been created that compiles and organizes information regarding habitat associations, modeling techniques, outside expert model reviewer input, and literature references for terrestrial vertebrates throughout the continental United States. Digital geographic range maps for over 2,000 terrestrial vertebrates are in development as are numerous data layers in support of spatial modeling of vertebrate habitat. Wildlife habitat relationships are being documented and compiled in the aforementioned database and will serve as the source of parameterization for spatial models of habitat.

Gap Analysis uses geographic information systems (GIS) technology to model vertebrate biodiversity throughout the United States and then assesses various forms of biodiversity in relation to protection status. The spatial data layers created for the GAP also provide scientists and policy makers with resources for habitat modeling and conservation assessments.

Drainage and Irrigation Systems and Facilities

NCSU scientists have designed a new generation of drainage water control structures to minimize the time and cost of drainage water management. These structures can be adjusted to open and close automatically according to a preset schedule. They will evolve to smart systems that manage the outlets of the drainage systems depending on the soil water conditions in the field. This research addresses local, national and global needs and responds to emerging changes in land uses and management practices. It is focused on adapting crop production systems on drained lands to a changing environment.

Natural Resource and Environmental Economics

Climate change challenges many of the basic assumptions used by conservation planners and managers because they rest on the assumption that conditions remain stationary or in equilibrium. Non-stationarity will increasingly characterize systems as they respond to changing ecosystem drivers (e.g.,

temperature, precipitation). Thus, a new generation of conservation and decision models is needed to reflect and account for the dynamics of land cover/use, climate, and ensuing responses by wildlife. An appropriate analytical framework to construct these models is patch occupancy. An analytical framework was built to integrate the dynamics of avian (or wildlife) populations in response to changes in temperatures and precipitation and ensuing changes in habitat. Models also account for neighbor effects (occupancy of nearby locations) and location of patch within overall species range.

SUSTAINABLE ENERGY INCLUDING BIOTECHNOLOGY

Plant Genetic Resources

NCSU research is focused on establishing functional uses of renewable materials suited to North Carolina for industrial bioproducts that promote sustainability and enhance rural development. Toward this end, The genome for Clostridium autoethanogenum has been sequenced, is in the process of being announced and is being annotated for use in proteomic studies to improve cellular functions in fuel production. Similar annotation work is being completed for the C. ljungdahlii OTA1 strain.

Plant Management Systems

NCSU research is addressing diverse aspects of physiology, production, selection, genetics, reproductive biology, and improvement of bioenergy crops. Accomplishments include identification of superior germplasm with greater adaptability and pest resistance, development of more efficient production techniques and improved understanding of physiological and biochemical mechanisms involved in greater tolerance to environmental stresses and resistance to problematic diseases and pests. Research is focused on evaluating the performance of energy canes in North Carolina, developing production practices and recommendations, breeding and developing improved varieties and improving efficiency of bioprocessing and cellulosic ethanol conversion. Continuation and expansion of these activities will support new economic development and a sustainable bioenergy industry in North Carolina.

The cost of feedstock for biofuel development is dependent on a number of factors. Often overlooked is the effect of changes in the interest rate on the production of perennial bioenergy plants such as switchgrass and miscanthus. In a study by NCA&T researchers, fixed costs and gross margins were used to determine that the price of switchgrass will have to increase by at least 11 percent to be as profitable as corn. A programming model was used to determine the price at which switchgrass could be included in an optimal farm plan. Supply prices for switchgrass and miscanthus were estimated as functions of the interest rate. Based on 2008 crop prices, the price of switchgrass would have to increase by 13 percent in order for it to be part of the optimal farm plan for a representative farm in North Carolina. This is due in part from the fact that the inclusion of switchgrass in the optimal farm plan would likely displace some corn and tobacco acreage. The relations between the interest rate and supply prices of switchgrass and miscanthus are approximately linear.

Structures, Facilities, and General Purpose Farm Supplies

A microalga cultivation system should have the ability to (1) control growth environment such as temperature, (2) mix multiple-phases of algal cells, nutrients, CO_2, O_2 and water, (3) prevent contamination and (4) minimize water loss due to evaporation. NCA&T researchers designed a 100-liter photobioreactor to grow microalgae on swine waste water under a controlled environment year around. It is currently being tested on the university farm to grow microalgae. A Ph.D. student in computational science and engineering is developing a computational fluid dynamic (CFD) model to improve the design and operation of the photoreactor for better efficiency and economics of the growth of microalgae on swine wastewater using the photobioreactor.

Engineering Systems and Equipment

Modified celluloytic enzymes (cellulases, beta glucosidase) were designed, characterized and compared to control enzyme preps. These enzymes are designed to be used to convert alkaline pretreated

switchgrass to reducing sugars for ethanol production. Conventional and transgenic switchgrass substrates were hydrolyzed using control and modified enzyme forms to generate reducing sugars for subsequent fermentation. The effect of sodium azide on these systems was also evaluated. The catalytic efficiency of the bioprocessing reaction was increased approximately 15% using modified cellulases/beta-glucosidases compared to control enzyme samples. Furthermore, exclusion of sodium azide during catalysis of switchgrass resulted in increased sugar production (mg reducing sugar/gram biomass) by nearly 12%.

Waste Disposal, Recycling, and Reuse

Animal wastes can cause water and air pollution without proper treatment. However, these wastes have the potential for being used as a new feedstock for biofuel production. Researchers at NCA&T investigated the feasibility of using hydrothermal processing of swine manure and other waste materials (e.g., duckweed, crude glycerol and waste vegetable oil) into bio-oils in a Parr reactor. They found that co-hydrothermal processing of swine manure and crude glycerol resulted in a significantly high bio-oil yield (~68%) which can be upgraded to produce a suitable composition and quality of biofuel for transportation.

Instrumentation and Control Systems

Research is focused on establishing functional uses of renewable materials suited to North Carolina for industrial bioproducts that promote sustainability and enhance rural development. Toward this end, six industrial-scale fermentation runs using sweet sorghum juice were successfully completed and techno-economic models developed for several sorghum processing scenarios incorporating combinations of on-farm and biorefinery operations.

New and Improved Non-Food Products and Processes

Hydrothermal processing of biomass is a depolymerization process that uses water at an elevated temperature and pressure to cleavage solid organic compounds in biomass into smaller fragments (liquid & gaseous). NCA&T researchers developed a hydrothermal process that involves reactions such as decarboxylation, dehydration, dehydrogenation and deoxygenation. The optimized process condition involves 20% solid concentration and processing time of 15 minutes at 340 degreesC. A result of this work has been the filing of an invention disclosure with NCA&T's Division of Research and Economic Development for a patent application.

A bioproduct from hydrothermal processing of swine waste is bio-oil, which can serve as a raw material for the production of adhesives and phenol formaldehyde-type resins. In collaboration with the Department of Civil Engineering, NCA&T researchers developed a biobinder from bio-oil for use in pavement material. The biobinder will improve petroleum-asphalt binder's low temperature properties resulting in the reduction of asphalt pavement construction costs. The cost of this biobinder production is estimated to be $0.13/L ($0.54/gal.) which is more favorable than that of fossil-based binder at $0.53/L ($2/ga).

CHILDHOOD OBESITY

Requirements and Function of Nutrients and Other Food Components

NC Cooperative Extension uses multiple strategies to increase the knowledge of program participants in healthy eating. Agents have conducted workshops and demonstrations in a variety of settings, including after school, faith communities, work sites and others. Media were used to effectively disseminate a clear message about healthy eating to even more citizens. More than 46,600 North Carolinian who participated in programs conducted by NC Cooperative Extension made at least one positive dietary change. Changes included increased consumption of fruits and vegetables, increased breakfast consumption, decreased fat consumption, increased dairy consumption and changes in portion sizes to better match dietary recommendations of myplate.gov. All of these behaviors reduce the risk of chronic diseases, including heart disease, stroke and some forms of cancer. These dietary behaviors are

also related to an increased likelihood of achieving and maintaining a healthy weight.

Nutrition Education and Behavior

4-H after-school sites serving middle school youth were assigned to test social media and non-social media conditions as means of reinforcing a nutrition lesson curriculum (topics included: Reading Food Labels, The Low-down on Sugar, The Low-down on Fat, Eating on the Run, Culture Foods Count, My Snack Options, Activity Circuits, Nutrition and Activity Matters, and Body Image). Pre- and post-tests were given with each lesson to participants to gauge knowledge gained. The results showed significant differences between social media and nonsocial media sites in information learned, suggesting that for rural youth social media may be more effective in improving knowledge and reinforcing nutrition information of certain topics when compared to the standard face-to-face curriculum delivery.

Healthy Lifestyle

NC Cooperative Extension in partnership with the NC Division of Public Health offers the Eat Smart, Move More, Weigh Less program. This is a 15-week weight management program that offers dietary, physical activity, and lifestyle strategies that are consistent with maintaining a healthy weight. Participants plan, track and live mindfully in addition to eating healthy and being physically active. More than 3,100 North Carolina citizens reduced their BMI. The Eat Smart, Move More Weigh Less program was in its fourth full year of implementation in 2012. Most participants set a healthy weight loss goal at the beginning of the program (some participants enroll to learn about healthy eating and physical activity and do not need to lose weight).

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

New and Improved Food Processing Technologies

Several unique and novel technologies have been developed and tested in NCSU labs and pilot plants. Aseptia/Wright Foods has licensed a portfolio of our patented and patent-pending technologies and opened a fruit and vegetable processing plant in Troy, NC in August 2012. The plant currently employs 90 people and announced plans for expansion, which will increase the work force to as many as 500 full time employees. The economic impact has been significant for the city of Troy, Montgomery County and North Carolina.

New and Improved Food Products

The potential of grape pomace (GP) as a source of DF and dietary polyphenol for healthy food development was investigated. NCA&T researchers found that incorporating 5-10% of GP in bread formulation significantly increased dietary fiber and polyphenol contents and antioxidant activity of bread. Sensory qualities such as color, taste, flavor, and texture of GP-fortified bread were acceptable, although consumer ratings were slightly lower than for white bread. Results indicate that GP is suitable to be used in baking as a source of natural antioxidants and dietary fiber.

Quality Maintenance in Storing and Marketing Food Products

Using a novel approach to curriculum development, NCCE created a program to reduce the risks of pathogen contamination and increase good food safety culture. The created package, Good Farmers' Market Practices, has been delivered in workshop form to 483 Market Vendors representing 67 markets across North Carolina. These workshops resulted in measurable infrastructure and behavior changes, including increased access to hand washing facilities and increased temperature control of potentially hazardous foods. This curriculum has been shared with Tennessee (University of Tennessee) Georgia (University of Georgia), Virginia (Virginia Tech), New Jersey (New Jersey Department of Agriculture) England, UK (University of Central Lancashire) as a regional resource for trainings. Working knowledge of these practices has given vendors the understanding and tools to reduce the potential for microbial contamination and has protected the economic future of farms by allowing market entry or market

retention.

Home and Commercial Food Service

Despite food safety communication efforts by many sectors, foodborne illness remains a significant health issue in the U.S. There are as many as 48 million cases of foodborne illness annually, costing society an estimated $1.4 trillion. It is estimated that up to 70% of illnesses come from food handlers making behavioral mistakes. In 2012, North Carolina cooperative extension field faculty delivered food manager trainings to 1,509 individuals in North Carolina.

The resurgence of local foods and home canning is good news for both the health of North Carolinians and the economic health of the state. However, after further examination of the self-reported practices of home food preservers, science-based methods are often not followed. The most troublesome issue is that over half of individuals report that they believe foodborne illness can be seen, tasted or smelled, an incorrect and potentially fatal belief. As cooperative extension agents are seen as the go-to home food preservation resource, curriculum updates were delivered to 26 agents in 2012. Agents have conducted home food preservation workshops, using the updated materials, across the state, resulting in an estimated 1,457 preservers being trained.

Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Acidified GMP and BPCS workshops are required for and directed at the level of operating supervisors of aseptic and conventionally canned processing and packaging systems in food processing establishments. These workshops qualify 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. An NCSU faculty member has co-instructed or coordinated five of these workshops and certified 100 individuals. In addition, the FDA has recognized the faculty member as an acidified foods process authority.

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

NCSU researchers have investigated sources and risk factors for pre-harvest contamination of turkeys with a major foodborne bacterial pathogen, Campylobacter. We have also investigated mechanisms utilized by a major foodborne pathogen, Listeria monocytogens, to colonize fresh produce. And we have analyzed the molecular basis for resistance of bacterial foodborne pathogens to antibiotics, heavy metals and disinfectants. This work provides baseline data that can be utilized for science-based strategies and tools to enhance the safety of the food supply, including fresh produce.

HUMAN AND COMMUNITY DEVELOPMENT - YOUTH DEVELOPMENT AND FAMILIES

Consumer Economics

The continued high incidence of obesity and related diseases such as heart disease, high blood pressure and Type 2 diabetes is related to the low intake of fresh fruits and vegetables and lack of access to fresh fruits and vegetables. Since the way consumers feel about fresh fruits and vegetables and various production systems influences their behavior toward fresh fruits and vegetables and production systems, knowing how consumers feel about production systems and fresh fruits and vegetables can be used to help increase their consumption of fresh fruits and vegetables and to increase their participation in developing community-based production systems that will provide affordable access to fresh fruits and vegetables. Survey results from over 664 respondents revealed that consumers who had a favorable attitude toward organic and sustainable production systems reported concern with food safety and wellness. In the case of fresh fruits and vegetables, freshness and taste were the favored attributes.

Individual and Family Resource Management

Family and Consumer Science agents collaborated with county and state partners to conduct workshops, conferences 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 lives. As a result of these efforts, 3,536 individuals and families implemented basic financial management strategies, and 7,721 people accessed programs and implemented strategies to support their family economic well-being

Human Development and Family Well-Being

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. As a result of educational programs, 5,797 youth and adults used effective life skills; 6,769 adults increased their use of identified community resources; 4,424 professionals used best practices with children, youth and older adults; and 4,789 professionals earned CEU's or other work-volunteer related credentials.

Sociological and Technological Change Affecting Individuals, Families, and Communities

Stakeholders and community leaders in Greensboro, NC worked with researchers win support for a community-based fruit and vegetable production unit and a lifestyle intervention program. Stakeholders recognized the consequences of unhealthy eating habits and committed to participate in and support the project to establish community-based farm and participate in lifestyle intervention workshops in their community. The Greensboro City Council provided a land grant and free access to city water for irrigation. The Fund for Democratic Communities is working to establish a cooperative grocery store, which supports the community farm and plans to serve as a distribution channel for farm products.

Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

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. As a result of efforts, 722 participants increased their knowledge of best management practices related to energy use and energy efficiency. Over 1,800 individuals used best management practices to reduce energy use and increase energy efficiency in their homes, business, agricultural industries or government.

Community Institutions, Health, and Social Services

A proven way to assist the economic fortunes of small farmers is through participating in producer cooperatives, which provide support, and with training in business and economic development. Researchers at NCA&T conducted an oilseed biofuel production and domestic marketing feasibility study and found that cooperatives strengthen the capacity of North Carolina's small and minority farmers to participate in and benefit from the region's emerging biofuels industry. The study found cooperative members receive peer-based education in growing and marketing biofuels crops in North Carolina. As one example, farmers in the northeastern part of the state have access to ongoing education through the establishment of a highly visible canola-growing and harvesting demonstration site near Elizabeth City. At least 30 farmers now have access to these demonstration plots. This project strengthened the capacity of North Carolina's small and minority farmers to participate in and benefit from the region's emerging biofuels industry. It also helps move North Carolina closer to its strategic goal of growing and producing within the state 10 percent of North Carolina's liquid fuels needs by 2017.

Youth Development

North Carolina offers youth and families a number of 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 2012 over 289,000 youth participated in 4-H day and residential camping, 4-H club activities, and school enrichment programs. In 2012, 21,565 youth were involved in 4-H Clubs, 15,1371 youth participated in school enrichment programs, 92,573 were active in special interest activities, 11,779 attended resident camps and 11,847 attended day camp. 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.

HUMAN HEALTH, NUTRITION AND WELL-BEING

Plant Genetic Resources

Working with General Mills, NCSU researchers genotyped a broccoli population developed at NCSU with more than 5,000 Single Nucleotide Polymorphic (SNP) markers that were developed from genomic scaffolds of rapeseed (canola). This mapping has been used to identify a single gene in broccoli that could double the amount of lutein found in broccoli. This finding led to a funded collaboration with the Monsanto Company to evaluate the transferability of this characteristic to elite broccoli material. If this is successful, it will lead to a product that will impact consumers that suffer from age-related macular degeneration and cataracts.

Basic Plant Biology

The antimicrobial activity of select plant essential oils was tested using the antibacterial assay for inhibitory activity against several bacterial species. Results showed that the antimicrobial activity of A. Alba was stronger than the other three essential oils at concentrations tested. S. feacalis was the most sensitive species to L. nobilis, P. capitatum, and R. canina at 500 µg/ml. E. coli strains were the least sensitive to three essential oils tested. Results indicate that select plant essential oils from A. alba, P. capitatum, R. canina, and L. nobilis could be used as a natural means to control pathogens in the food industry as well as in the treatment on the onset of certain types of health problems, such as cancer.

New and Improved Food Products

Volatiles associated with off flavors in peanuts have been identified. Peanut chemical composition, descriptive sensory analysis and consumer preferences have been determined in the US and in the UK, the Netherlands, and Germany. Understanding of off flavor components is leading to cheaper chemical methods to identify peanuts with off flavors. Information on descriptive sensory and US and European consumer acceptance of US peanuts constitutes the current most valuable marketing tool for export of US peanuts.

Nutrient Composition of Food

As a part of the NIH Botanical Center for Metabolic Syndrome, NCSU researchers are investigating the effect of botanicals on food intake and energy balance in animal models of diet induced obesity. The results of these studies are crucial in benefiting value-added agriculture of North Carolina and guiding future pre-clinical and clinical studies evaluating the effect of botanicals on modulating metabolism and disease. A novel botanical therapy based on pregnane glycosides may provide a useful and inexpensive adjunct to lifestyle modification.

Requirements and Function of Nutrients and Other Food Components

Research at NCSU is focused on the effect of botanicals on protein synthesis and muscle strength in cell culture and animal models. This research identifies an important drug target for a wide range of conditions that cause muscle wasting. We hope that one day brassinosteroids may provide an effective, natural, and safe alternative for age- and disease-associated muscle loss or be used to improve endurance and physical performance. Because some plants contain these compounds, like mustards, in the future we may be able to breed or engineer these plants for higher brassinosteroid content, thus producing functional foods that can treat or prevent diseases and increase physical performance.

Nutrition Education and Behavior

In its second year, NC Cooperative Extension's More In My Basket (MIMB) programexpanded county participation to meet an important need to address food insecurity. MIMB targets hunger reduction through an outreach program for North Carolina's Food and Nutrition Services Program; which is part of the federal Supplemental Nutrition Assistance Program (SNAP; formerlyfood stamps). More In My Basket nearly quadrupled in counties joining the program in its second year and became inclusive of Family and Consumer Sciences and 4-H agents in 55 counties.

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

C.jejuni is believed to account for approximately 90% of all cases of human Campylobacter infections. Treatment for Campylobacteriosis becomes difficult because of the antimicrobial resistance of these microbes. NCA&T researchers tested bitter melon extract (BME) on C. jejuni strains from poultry fecal samples and found that adherence ranged from 0.17% to 8%. Results of this study showed that BME significantly reduced the cytotoxic effects of C. jejuni on CHO cells, suggesting that it can be utilized as a natural therapeutic agent.

Insects and Other Pests Affecting Humans

A study is underway to determine if clothing treated with the insecticide permethrin provides protection from tick bites and tick-borne illness.

Zoonotic Diseases and Parasites Affecting Humans

NCSU researchers are testing the hypothesis that rapid, sustained production of the anti-inflammatory cytokine IL-10 prevents the development of inflammation in Leptospira interrogansininfected mice. L. interrogans, a zoonotic pathogen,is the causative agent of leptospirosis, which is a significant public health threat in impoverished countries with poor sanitation systems and abundant urban rodent populations.

Healthy Lifestyle

When elderly people take prescription drugs, the natural flora (good bacteria) in their guts are subject to change resulting in potential negative impact on long-term health. A study of the interaction between different prescription drugs and natural flora (Bifidobacterium spp.) isolated from human gastrointestinal tract analyses revealed a decrease in bifidobacterial population by 3.0 log CFU/mL in the presence of tested drugs. This indicates that common medicines given to the elderly could have negative impact on the good natural flora of the gut.

Human Development and Family Well-Being

NC Cooperative Extension provides an acclaimed curriculum called Powerful Tools for Caregivers for family caregivers. This program is a 6-session intensive (15-hour) course addressing self-care for the caregiver. A 9-hour version is also available for people unable to attend a 15-hour class, including employed persons with work-family challenges. Educational sessions teach (or remind) people about self-care behaviors such as exercise, relaxation and seeking medical care; present strategies for managing emotions to reduce guilt, anger and depression; help build confidence in coping with caregiving; and suggest ways to tap into social networks and community resources.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	400.0	39.0	425.0	46.0
Actual	542.0	72.5	474.0	46.0

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 within the College of Agriculture and Life Sciences at North Carolina State University have joint appointments with NCARS. Extension on-campus faculty collaborate with nearly 500 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 qualtiy 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 used 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, uncluding 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 inteact 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 propoals 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
11553493	3576796	7911842	4127678

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	5356296	3573188	6897008	4382081
Actual Matching	5356296	3326213	6897008	1875978
Actual All Other	41233704	237621	53528525	4203392
Total Actual Expended	51946296	7137022	67322541	10461451

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	978444

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%	10%	20%
202	Plant Genetic Resources	10%	10%	10%	10%
204	Plant Product Quality and Utility (Preharvest)	5%	5%	5%	10%
205	Plant Management Systems	10%	20%	15%	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%	5%	10%
404	Instrumentation and Control Systems	1%	0%	0%	0%
511	New and Improved Non-Food Products and Processes	1%	0%	0%	0%
512	Quality Maintenance in Storing and Marketing Non-Food Products	1%	0%	0%	0%
601	Economics of Agricultural Production and Farm Management	6%	0%	5%	0%
602	Business Management, Finance, and Taxation	3%	0%	5%	0%
604	Marketing and Distribution Practices	6%	0%	5%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	102.0	9.0	160.0	7.0

Actual Paid Professional	136.0	18.0	190.0	6.0
Actual Volunteer	61.0	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**
1339074	894192	2758803	554223
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1339074	832386	2758803	55020
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
10308426	135518	21411410	48358

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, horticulatual and ornamental crops and related areas that provdie a resource for producers, handlers, procesors and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	418211	1227962	0	0

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

Patent Applications Submitted

Year:	2012
Actual:	20

Patents listed

Crop Resistance to Nematodes by Disrupting Host Plant Receptors of Cyst Nematodes Secreted CLE Peptides

Alteration of tobacco alkaloid content through modification to specific cytochrome p450 genes(Hong Kong)

Inhibition of Biofilms in Living Plants by Use of Triazole Derivatives

Methods of Inhibiting Ethylene Responses in Plants Using Cyclopropene Amine Compounds

Tobacco Inbred Plants NCBEX1F, NCBEX1MS and NC EX90(US)

Calycanthus 'Aphrodite'(US)

Buddleja NC2006-6 'Lilac Chip'

Buddelja NC2006-10 'Ice Chip'

Alteration of tobacco alkaloid content through modification of specific cytochrome p450 genes(US)

PVP for 'NC-Cape Fear'

Tobacco Inbred Plants NCBEX1F, NCBEX1MS and NC EX90(International)

Peptide Aptamers that Bind to the Rep Proteins of ssDNA Viruses

Method of Inhibiting Ethylene Response in Plants Using Dicyclopropene Compounds(Europe)

Nanotechnology System for Agricultural Applications

Method of Inhibiting Ethylene Response in Plants Using Dicyclopropene Compounds(New Zealand)

Calycanthus x 'Aphrodite'

Use of bio-pesticide for control of dollar spot and anthracnose in turfgrasses

PVP application for 'Gerard 229' (NC03-8331) winter oat

PVP for 'Gerard 224' (NC03-2421)

PVP for 'SS 76-50' (NC01-3497)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	105	412	517

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
2012	31

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
2012	1227962

Output #3

Output Measure

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

Year	Actual
2012	85563

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	20000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
High feed prices for pigs and poultry created a need to produce more feed grains locally to save freight costs and ensure a reliable local supply.

What has been done
A collaborative effort involving private industry, the land grant university, commodity organizations, NC Department of Agriculture and other stakeholders initiated an effort to increase feed grain production in the state, but increasing yields of corn and wheat, and by significantly increased grain sorghum acreage. The private company committed to making the market for increased sorghum produced.

Results
A pilot sorghum project in 2011 growing season saw about 10,000 acres grown. With significant funding from the partners, active research and extension/technical assistance programs, the 2012 growing season saw an estimated 70,000 acres grown, with plans for increasing acreage again in 2013. Conservative estimates of the value of the added production amount to over $20 million for this crop alone.

4. Associated Knowledge Areas

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

211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
512	Quality Maintenance in Storing and Marketing Non-Food Products
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	20000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Identification of the factor(s) affecting Fraser fir growth and development is essential to maintaining and improving the North Carolina Christmas tree industry. Establishment of preferential ground covers in Fraser fir plantations has gained significant interest in recent years. Previous demonstrative research has indicated a significant positive effect of clover establishment in relation to soil N availability. However, the N contribution of selective cover crops in Fraser plantations is not well understood. Positive effects of preferential ground covers in regards to soil nutrient status can have a significant effect on Fraser fir production profitability, particularly with recent increases in fertilizer prices. No scientific studies to date have documented the effects of clover cover crops on soil properties in Fraser fir plantations.

What has been done

Researchers and extension personnel conducted preliminary on-farm studies documenting reduced nitrogen fertilizer needs with implementation of preferential ground cover management

strategies. Additional studies funded by the North Carolina Christmas Tree Growers Association were initiated in 2009 to quantify the effects of preferential ground cover establishment on soil nutrient status and other select soil properties. These studies have been monitored since inception.

Results

Quantifying the benefits of selected ground covers will provide production information that will likely reduce input costs through reductions in both nitrogen fertilizer applications and herbicides. Proven successful, adoption of this type of management system will improve the sustainability of Christmas tree production systems in NC compared with traditional herbicide practices and tree fertility maintenance.

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
2012	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

New peanut varieties,including those with high oleic acid content, are being released for commercial use. Peanuts with this trait potentially have longer shelf life and thus more desirable in the market.

What has been done

Two new high yielding varieties have been released (Bailey and Sugg), and over a two year period essentially will represent almost the entire crops produced in North and South Carolina and Virginia. The 2013 season will be the first season where sufficient seed is available to meet the demand for these varieties.

Results

The increased yields and value of these new varieties has generated an estimated $16 million benefit to growers in these three states,compared to existing varieties.

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
2012	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Arthropod borne viruses (arboviruses) are major sources of disease for humans and domestic animals. They are collectively second only to malaria as the world?s number one health problem. About 700 of these agents are presently known, with emerging strains appearing annually. For one of these agents, Dengue Fever, approximately 100 million cases are reported annually with many more cases unreported. About 2.5 billion people are at risk of contracting this disease annually.

What has been done

Despite the enormous economic and medical impact of these agents very few effective vaccines exist for their control. Live virus vaccines, which are the most effective forms of vaccines, have been particularly difficult to produce. We have developed a technique for the production of live virus vaccines for arthropod vectored viruses. This technology is based on the discovery that evolution has provided these viruses with genetic information essential for replication in one of the two hosts (mammals and insects) but not the other. We have identified genetic elements required for efficient replication in the mammalian host and removed them. These deletion mutations restrict the growth of the virus to the insect host resulting in a host range mutation that is a deletion with little prospect of reversion to wild type.

Results

Injection of the insect-produced virus into mammals results in the production of high titers of neutralizing antibody and protection against challenge with wild type virus in the absence of disease. We have demonstrated that this strategy works in monkeys. The vaccine is ready for human trials. In principle this technology will produce a live virus vaccine against any of these arthropod vectored diseases for which a cDNA clone can be produced. This technology is now being being applied to West Nile virus and Chikungunya virus.

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
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2012 20000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The billbug is a unique insect pest that is native to North Carolina and not found in the Midwest. Over the years, it has caused average yield losses of 25% to 40% in corn with little growers could do about it. The most common method of attempted control was with the use of a highly toxic insecticide which caused some environmental contamination.

What has been done
Research at NCSU identified a new approach to billbug control. Applying a very low rate of a tobacco extract (neonicitinoid) to corn seed proved to be extremely effective at complete control of billbug in corn.

Results
This research improved corn yields in the eastern counties of the state by 30%, resulting in growers returning to corn production and increasing farm income by $25 million dollars 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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year **Actual**

2012 85563

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With the adoption by North Carolina soybean producers of Roundup-Ready soybeans (now on more than 95% of the state?s soybean acreage) has come a dramatically higher seed cost. Producers were paying $12 to $16 per 50-lb. bag of seed in 1995 (prior to the introduction of Roundup-Ready technology) and now pay $42 to $56 per 50-lb. bag.

What has been done
Replicated, statistically sound on-farm tests convincingly demonstrated that yields could be maintained at populations as low as 50,000 plants per acre with May planting dates and as low as 100,000 plants per acre with June and July planting dates. These results have been emphasized extensively at producer meetings, agent and dealer training, field days, farm tours and in the farm press output. A handout titled "Suggested Soybean Plant Populations for North Carolina (CS-SB-21)" has been prepared and distributed.

Results
In 2006, 50 field faculty representing 75.5% of the state?s soybean acreage estimated that soybean planting rates were reduced by 16.5 lbs. of seed per acre from 2001 to 2006, with a resulting yield increase of 1.6 Bu/A. If no further changes in planting rate or yield took place from 2006 to 2012, we estimate that N.C. soybean growers realized increased income of more than $60 million by planting less soybean seed in 2012.

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
2012	500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Interest in growing hops in North Carolina on a commercial scale has increased with an international shortage of hops in 2007 and an increase in the number of small breweries in the state in recent years.

What has been done
Extension agents and specialists and researchers from NCSU, an NC Department of Agriculture and Consumer Services agronomist and others came together to develop research-based information for hops producers and would?be producers. Soils and fertility information was developed and variety tests begun.

Results
Hops workshops, field days and festivals attract hundreds of people, and there are now an estimated 80 commercial hop yards in North Carolina, ranging in size from a tenth to three acres.

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
2012	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Most crop plants currently used for biofuel production compete with food and feed production for resources like land and water, which has led to increases in food prices. We are working on two different plant systems to generate economical and environmentally sustainable biofuel: a) marine microalgae (Dunaliella salina) with rapid growth and no requirement for land or fresh water, and b) Camelina sativa, an exceptional biofuel crop because it grows rapidly on poor soils with little water and fertilizer input. However, the productivity of Camelina and other biofuel crops is too low to make it economically viable.

What has been done
A team of plant biologists, microbiologists, agricultural engineers and chemical/mechanical and aerospace engineers as well as economists is working to generate biofuel feed stock. This project will generate a heat-tolerant Camelina plant. To increase the productivity of Camelina, we will engineer the entire carbon flux ? from increasing photosynthetic CO2 uptake in the leaf to the synthesis of energy rich molecules in the seeds. These energy-rich molecules will mostly consist of modified oils and terpenes. The modified oils are better suited for jet fuels and will reduce the need for hydrogen and energy in the conversion process. The terpenes can be cost-effectively converted into aromatics. Aromatics are essential components of jet fuels, but their chemical synthesis is more costly and energy intensive than their extraction from biological materials.

Results
The increased productivity of this enhanced ?Jet-Camelina? crop and the development of energy and cost efficient harvesting, extraction and conversion technology will provide an energy-dense liquid transportation fuel as a drop-in replacement for petroleum-based fuels.

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
2012	45000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Implementing an integrated pest management program requires timely information about pest populations and available management options. This information is generally not readily available in the field, which hampers nursery crop production managers? ability to make timely decisions.

What has been done
Nursery crop production and pest management specialists have organized the Southern Nursery IPM (SNIPM) working group to develop IPM solutions for growers in the region. SNIPM created two applications for mobile devices, IPMPro and IPMLite, that assist growers, landscapers and homeowners in preventing pest damage by sending text alerts to clients that remind them to scout for a particular pest. The IPMPro application provides chemical recommendations.

Results
The apps were launched in March 2012. To date, more than 200 copies have been sold.

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
2012	35

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The demand for locally grown food in the North Carolina Piedmont is growing, yet people who wish to farm don?t always have the information they need to begin farming.

What has been done
The Piedmont Farm School was a seven-month program that taught new, aspiring and transition farmers how to write business plans and develop as farm entrepreneurs. NC Cooperative Extension in six Piedmont counties worked together to develop curriculum, plan and implement the program.

Results
Thirty-two participants completed the program. Twenty-five participants wrote an outline of a business plan and accessed new marketing arenas. Nine participants reported increased farm profit in 2012 as a direct result of practices learned at the school.

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
2012	25557

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Cooperative Extension clients are in need of educational programs and information that will help them make farm business management decisions that result in positive impacts for their own operations and rural communities.

What has been done
A Cooperative Extension associate developed and delivered information in group and individual settings regarding value-added livestock products, whole-farm business plan development, farm business management and risk management regarding corn, soybeans, wheat, dairy, beef, hogs and forage crops.

Results
As a result of this information, clients realized more than $7 million in net profits. These were the result of both decreased input costs and/or increased profits by implementing recommended marketing and risk management advice.

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 continure 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 and reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Research and extension programs have presented North Carolina agriculture with new plant varieties and enterprises, more efficient production systems, and expanded opportunities for more efficient, profitable and competitive operations.

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: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	60.0	3.0	105.0	8.0
Actual Paid Professional	81.0	9.0	104.0	9.0
Actual Volunteer	41.0	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**
803444	447096	1517342	954409
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
803444	416193	1517342	625325
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
6185056	20400	11776275	207989

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. Stake-holders 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 NC A&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 wide array of animal systems Communities of Practice are in eXtension, providng a valuable resource for production practices, animal health and management, and marketing.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	278807	818642	42000	45000

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

Patent Applications Submitted

Year:	2012
Actual:	3

Patents listed

Methods and Compositions for improving growth of meat-type poultry

Livestock Insect-Removal Systems and Related Methods

Attenuated FNR Deficient Enterobacteria

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	7	207	214

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2012	1503

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2012	146

Output #3

Output Measure

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

Year	Actual
2012	20

Output #4

Output Measure

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

Year	Actual
2012	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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	8000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Byproduct feeds remain an important part of beef cattle feeding programs both in North Carolina and in surrounding states. Development of the ethanol industry and the resulting increase in the price of corn has increased the importance of byproducts to beef producers even more.

What has been done
Applied research showed that both dry and wet corn gluten feed are economically viable feed ingredients for use in beef finishing diets. This information has led to increased adoption of those ingredients in cattle diets. Other research exploring feeding frequency and feed sources have also impacted the profitability of byproduct utilization in the state. The extension ruminant nutrition program works both directly with producers and through extension agents to enhance and expand the use of byproducts in feeding programs.

Results
In 2012, 10,000 tons of soybean hulls, 6000 tons of dry corn gluten feed and 8,000 tons of wet corn gluten feed, and 10,000 tons of other miscellaneous byproducts were utilized by clients for a realized savings of over $1 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
2012	8000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Swine and poultry growers in the Southeast must import much of the grain used in animal feed. Growers must look for every efficiency available if they are to remain competitive with Midwest growers.

What has been done
Preliminary results from a project looking at timing of an nutritional intervention to improve the reproductive capacity of sows has found evidence of a 0.28 pig/sow/year increase and a marginal increase in average litter weight in sows fed high-fiber diet compared to sows fed a standard/control diet.

Results
A 100-sow herd with access to modest amounts of dietary fiber, a producer could raise 28 more pigs per year for the same dollar amount spent on non-fiber enriched diets.

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
2012	6435

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fescue toxicosis remains the single most important production problem in the southeastern U.S., leading to an estimated $1 billion reduction in revenue. Despite our knowledge of the problems associated with endophyte infected fescue, producers continue to use it as their primary forage due to its superior agronomic characteristics and a lack of viable options for their forage systems.

What has been done
Our recently completed long-term study comparing a new non-toxic infected fescue known as MaxQ to toxic infected fescue and endophyte-free fescue showed that non-toxic infected fescue would provide performance similar to endophyte-free fescue while resulting in stand survival and yield similar to toxic-infected fescue. The results of this study also demonstrated that while toxic

infected fescue resulted in dramatically reduced performance in the spring and summer it resulted in similar performance and higher carrying capacity than non-toxic infected or endophyte-free fescue during the winter grazing season.

Results
These results will lead to improved forage systems including non-toxic fescue for spring and early summer grazing and toxic-infected fescue for winter grazing.

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
2012	5000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers need information regarding the issue of genetics and management practices to reduce disease-associated losses.

What has been done
Field days have been conducted to provide insight into genetic differences between species and management practices that aid in reducing disease and species-associated losses.

Results
This activity has increased awareness of opportunities for economic benefit through diversification of enterprises and from adoption of improved management practices.

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

Not Reporting on this Outcome Measure

Outcome #6

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

2012 1092

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Selling value-added products at farmer?s markets or other stores can increase income for entrepreneurs but the regulations surrounding these products can be confusing. Entrepreneurs often need assistance navigating the regulatory framework and the food safety expertise to ensure safe products are manufactured.

What has been done

The Entrepreneurial Assistance Program seeks to help entrepreneurs or businesses in North Carolina and beyond ensure their food products are safe and meet regulatory guidelines. Food product testing for safety parameters and nutritional labeling are the two main services provided in conjunction with general advising and answering questions on the multitude of topics of importance to a food entrepreneur.

Results

In 2012, the Entrepreneurial Assistance program provided product testing and/or nutritional labeling services to approximately 420 customers, resulting in about 710 products tested and 530 products labeled.

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 #7

1. Outcome Measures

Growers Adopting Improved Business Management Practices

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
- Populations changes (immigration, new cultural groupings, etc.)

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 continure 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 competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Research and extension programs have presented North Carolina agriculture with new production strategies and enterprises, more efficient production systems, and expanded opportunities for more efficient, profitable and competitive operations.

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	10%	10%	10%	10%
133	Pollution Prevention and Mitigation	10%	10%	10%	10%
141	Air Resource Protection and Management	5%	5%	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%	10%	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	20%	20%	20%	20%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	55.0	4.0	25.0	6.0
Actual Paid Professional	43.0	2.0	28.0	6.0
Actual Volunteer	4.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
428504	100149	413821	911078
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
428504	93227	413821	356857
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
3298696	8756	3211712	423077

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

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	51419	60312	0	0

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	9	82	91

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Waste Management Certification Programs

Year	Actual
2012	75

Output #2

Output Measure

- Number research project completed on environmental/natural resource issues

Year	Actual
2012	96

Output #3

Output Measure

- Number of non-degree credit environmental activities conducted

Year	Actual
2012	384

Output #4

Output Measure

- Enrollees for Natural Resources Leadership Institutes training

Year	Actual
2012	0

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

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
2012	587

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Extensive soil tillage depletes soil organic matter, decreases soil stability and decreases soil water infiltration and soil water retention.

What has been done
A field workshop was conducted on a field experiment that demonstrated to growers how reducing tillage and incorporating cover crops in farming rotations will increase soil stability, water infiltration and soil water retention significantly.

Results
Ten growers minimized tillage and planted cover crops in their farms. Eight of the ten growers noticed beneficial changes in their soil on the first crop year and two of the 10 growers noticed some change on the second crop year.

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 #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
2012	1426

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The ammonia in manure and waste treatment systems is dilute and therefore limited in use to relatively short distances, usually on the same property on which the animals are raised. In North Carolina and much of the country, this prevents use of the valuable nutrients in the feed production system.

What has been done
Scientists at the USDA Agricultural Research Service have developed a membrane technology that is selective for gaseous ammonia. The ARS scientists demonstrated in the laboratory that this technology can remove 50% of the total ammoniacal nitrogen in a lagoon sample over a period of several days. Engineers at NCSU have obtained a grant with the ARS scientists to build a pilot scale ammonia recovery system based on this technology and to develop procedures that will facilitate on-farm operation.

Results
Development of this technology will help convert the pollution potential of liquid manure application into a valuable fertilizer product that can be transported out of the local watershed. Once developed, this technology will provide business and employment opportunities in many rural communities associated with animal production. Application to other industries and waste streams is also possible.

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
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	19431

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Educating farmers about optimum fertilizer management and production practices such as high population corn management, fertilizer spreader calibration and legume and manure alternatives to inorganic fertilizers improves farm profitability and reduces the likelihood of runoff of nitrogen, phosphorus, and sediments the state waterways.

What has been done
NCSU scientists have collaborated with producers to develop fertilizer rate and timing recommendations for conventionally produced agronomic crops as well as certified organic production systems. These include studies to evaluate the nutrient availability coefficients used to estimate N and P supplied to cotton, corn and wheat by poultry litter and manure sources.

Results
Based on NC Agricultural Statistics and estimates of current fertilizer usage and costs, the following are estimated impacts. Fertilizer N in the Tidewater region is predominantly applied to

corn (213,800 acres), wheat (184,200 acres), cotton (120,100 acres), and Irish potato (16,150 acres); 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 water control structures, nutrient management planning, or optimum N timing resulting in a 50% reduction in N runoff on the treated fields; then total N runoff would be reduced by approximately 25%. If fertilizer N use was reduced by 10% on these farms, this would directly save farmers approximately 6.6 million pounds of N or $3.3 million per year.

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
2012	2910

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Due to legislation, increased public awareness, and an increasingly sophisticated population of professionals in environmental fields, there is a growing need for training programs in North Carolina on waste management, nutrient management, and watershed protection.

What has been done
NCSU offered 94 short courses and conferences in 2012 for municipal and industrial wastewater

operators, environmental health specialists, septic system installers and operators, professional engineers, soil scientists, well contractors, water quality specialists, government agency employees, and elected officials.

Results

Three thousand five hundred ninety five (3,595) participants received technical training for license renewal and/or professional development.

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
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	872622

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

New fertilizer materials are available and need to be evaluated for efficacy in commercial farms. These include increasing amounts of poultry litter and layer manure.

What has been done

Studies evaluated the nutrient availability coefficients used to estimate N and P supplied to cotton, corn and wheat by poultry litter and manure sources. A doctoral dissertation and planned research publications describe aspects of poultry manure used as soil fertility amendments.

Results
Providing basic soil fertility and crop problem diagnosis recommendations supports newly emerging crops and farming systems, and permits evaluation of new fertility management practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
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
2012	2684

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Stream restoration is an important watershed management practice improving water quality and aquatic habitat in many North Carolina watersheds. Causes of stream impairment include land use changes affecting stormwater runoff, removal of riparian vegetation, and channel straightening or other modifications. Many state and federal agencies provide funding for restoration projects, requiring that effective restoration planning, design, and construction practices be implemented. An applied research and education program is needed to evaluate and

demonstrate technologies and teach professionals how to accomplish stream restoration objectives effectively.

What has been done

NCSU faculty developed a comprehensive education program to improve the practice of stream restoration. This program includes a series of River Course workshops in which over 5,000 professionals have learned about stream assessment, design, construction, and monitoring. NCSU also provides leadership for the biennial Southeast Stream Restoration Conference, attended by over 500 practitioners, government officials, and academics. More than 60 grant-funded projects across the state are used to demonstrate and evaluate stream restoration practices in a variety of watershed conditions.

Results

The quality of stream restoration projects has improved in the past decade, as professionals have gained increased understanding of stream restoration principles and applications. Funding for projects has increased as resource agencies determine that previous projects are successful in meeting water quality and habitat goals. Ecosystem mitigation policies have been adjusted based on outcomes of this program to meet restoration goals.

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

2012 421

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Irrigation water was needed for conservation agriculture technology experiments for vegetable production at local high schools. Rainwater was the most economical source but was not readily available.

What has been done
Rain harvester tanks (2,500 gallons) were installed to collect rainwater. In addition, water meters were installed to monitor how much municipal water was being saved by using these tanks.

Results
In most cases, harvested rainwater is now used for experiments instead of using municipal water.

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

2012 21

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increased use of biofuels on North Carolina farms may save farmers money.

What has been done
Several training workshops on biofuel use at the farm level were conducted.

Results
One small-scale dairy farmer has begun to produce biodiesel from used vegetable oil and use the fuel to power his tractors.

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 environmental and economic conditions (weather extremes, economic climate) influence producers abilities 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 continure 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 and reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Results of research and extension programs and activities are focused on strategies to conserve and efficiently use natural resources, new technologies, engineered systems and economic and policy approaches to minimize negative impacts of agricultural, manufacturing and homeowner activities on the environment and our climate.

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	7.0	2.0	10.0	5.0
Actual Paid Professional	22.0	2.0	19.0	8.0
Actual Volunteer	1.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
214252	100149	275880	665593
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
214252	93227	275880	363799
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1649348	0	2141141	2307017

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

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2108	5634	0	0

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

Patent Applications Submitted

Year:	2012
Actual:	3

Patents listed
Process For Conversion Of Biomass To Fuel(Mexico)

Process For Conversion Of Biomass To Fuel(US)

Expression of Extremophile Enzymes as Co-products From Biofuel-producing Algae and Cyanobacteria

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	46	46

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Studies on producing agricultural and forestry substrates for biofuel production

Year	Actual
2012	25

Output #2

Output Measure

- Studies on engineering conversion processes for biofuels and other components

Year	Actual
2012	25

Output #3

Output Measure

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

Year	Actual
2012	1500

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
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Animal wastes can cause water and air pollution without proper treatment. These wastes can also be used as a feedstock for biofuel production.

What has been done
NCA&T researchers conducted studies on the hydrothermal processing of swine manure and other waste materials (e.g., duckweed, crude glycerol and waste vegetable oil) into bio-oils in a Parr reactor.

Results
Co-hydrothermal processing of swine manure and crude glycerol resulted in a significantly high bio-oil yield (~68%), which was upgraded to produce a suitable composition and quality of biofuel for transportation use.

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
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Microalgae may represent a promising biofuel feedstock. However, a microalgae cultivation system should (1) control environmental factors that affect growth, such as temperature, (2) mix multiple-phases of algal cells, nutrients, CO2, O2 and water, (3) prevent contamination and (4) minimize water loss due to evaporation.

What has been done
A 100-liter photobioreactor to grow microalgae on swine wastewater was designed and built on the NCA&T farm. The photobioreactors provides a controlled environment to test microalgae cultivation year around.

Results
A Ph.D. student in computational science and engineering is developing a computational fluid dynamic (CFD) model to improve the design and operation of the photobioreactor for better efficiency and economics of the growth of microalgae on swine wastewater.

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
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A bioproduct from hydrothermal processing of swine waste is bio-oil which can serve as a raw material for the production of adhesives and phenol formaldehyde-type resins.

What has been done
NCA&T researchers developed a biobinder from bio-oil for use in pavement material.

Results
The biobinder will improve petroleum-asphalt binder?s low temperature properties, resulting in the reduction of asphalt pavement construction costs. The cost of biobinder production is estimated to be $0.13/L ($0.54/gal), which is more favorable than that of fossil-based binder at $0.53/L ($2/gal).

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Residential energy conservation measures can lower family home heating and cooling costs, which can be particularly important for low-income households.

What has been done
The E-Conservation Energy Education Program teaches citizens to save energy, lower homeowner energy utility costs and protect North Carolina's environment by reducing pollution and greenhouse gas emissions. The program informs and educates North Carolina consumers about ways to both reduce energy use and increase energy efficiency in the home. E-Conservation reaches and teaches consumers to be proactive in reducing their home energy consumption and in saving money through no-and low-cost energy efficiency measures, behavioral changes and home retrofits.

Results
County Cooperative Extension agents across the state provide direct services to NC citizens by conducting outreach workshops; disseminating materials such as fact sheets, newsletters and consumer energy kits; partnering with local utilities and municipalities to maximize energy resources; offering energy audits, and assisting in the overall evaluation of the program. Previously, the E-Conservation program provided professional home energy audits for consumers, utilizing North Carolina green businesses. This ability to offer audits was suspended when funding stopped at the end of 2011; however, it will be offered again between 2012 and 2014.

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	85

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
During winter, thermal energy requirements increase production costs for greenhouses.

What has been done
A biomass hot water heating system was used for a Harnett County, North Carolina greenhouse operation producing tomatoes and tobacco transplants. Instrumentation was installed to quantify the energy requirements for the production of greenhouse tomatoes and tobacco transplants.

Results
During the fall, winter and early spring, supplemental heat is needed in the greenhouses to maintain the optimal production temperature for the plants. Replacing LP gas with biomass greatly reduces the production cost. The data collected will be used to assist in specifying system components for other installations.

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

Rapidly changing environmental and economic conditions (weather extremes, economic climate) influence producers abilities 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 continure 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 and reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Research and demonstration projects and activities are focused both on strategies to reduce fossil fuel use through conservation, use of biofuels, proper construction techniques and other factors to move to reliance on more sustainable energy sources, including solar and other alternative uses. Specific research in the college is aimed to create new energy crops for biofuel production, discover new technologies to enhance the conversion of biosubstrates to renewable fuel sources, and to exploit known and new processes leading to production of biofuels and related coproducts that may have high value.

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%	20%	50%	0%
703	Nutrition Education and Behavior	30%	30%	30%	50%
724	Healthy Lifestyle	50%	50%	20%	50%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	35.0	3.0	12.0	3.0
Actual Paid Professional	24.0	11.0	1.0	3.0
Actual Volunteer	82.0	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
535630	536515	68970	142650
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
535630	499431	68970	63192
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4123370	29883	535285	0

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 NC A & 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, artilces, online learning activities, and interactive tools on families, food and fitness topics.

The Families Food and Fitness CoP'ss vision is to become a source of research-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 evidence (science/research)-based information and learning opportunities through eXtension.

Families Food and Fitness is organized around three goals:
- Imroved diets;
- Increased physical activity; and
- Maintenance of body wieght in a healthy range and avoidance of excess weight gain.

The website content is focused on 6 key behaviors that have been identified in the literature to be associated with maintaining and achieving a healthy body weight:
1. Move more everyday
2. Tame the tube
3. Control portion size
4. Enjoy more fruits and vegetables
5. Prepare more meals at home
6. Re-think your drink

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	339363	353822	23952	0

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	2	13	15

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
2012	4412

Output #2

Output Measure

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

Year	Actual
2012	30666

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
2012	46618

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The importance of promoting nutrition and wellness throughout life has been clearly established. Dietary factors are associated with 5 of 10 leading causes of death in North Carolina and the United States. Programs that provide consumers with research-based information on healthy eating are imperative to increase their knowledge of the importance of making changes in their dietary patterns to optimize health. Further, consumers need knowledge as to how to go about

making these changes based on their lifestyle and environments.

What has been done

NC Cooperative Extension has used multiple strategies to increase the knowledge of participants in healthy eating. Agents have conducted workshops and demonstrations in a variety of settings including after school, faith community, work site and others. Media were used to effectively disseminate a clear message about healthy eating to even more citizens.

Results

More than 46,600 North Carolinian's who participated in programs conducted by NC Cooperative Extension made at least one positive dietary change. Changes include increased consumption of fruits and vegetables, increased breakfast consumption, decreased fat consumption, increased dairy consumption and change in portion sizes to better match dietary recommendations of myplate.gov. All of these behaviors reduce the risk of chronic diseases including heart disease, stroke and some forms of cancer. Also, these dietary behaviors are related to an increased likelihood of achieving and maintaining a healthy weight.

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
2012	3159

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overweight and obesity issues are of critical importance to the public's health. Overweight and obesity increases the risk of many chronic conditions, including sleep apnea, arthritis, type 2 diabetes, heart disease, and some forms of cancer. In addition, the economic toll of overweight and obesity in North Carolina reaches billions of dollars each year in health care costs and loss of productivity.

What has been done
NC Cooperative Extension, in partnership with the NC Division of Public Health, offers the Eat Smart, Move More, Weigh Less program. Eat Smart, Move More, Weigh Less is a 15-week weight management program that offers dietary, physical activity, and lifestyle strategies that are consistent with a healthy weight. Participants plan, track and live mindfully in addition to eating healthy and being physically active.

Results
Over 3100 North Carolina citizens reduced their BMI. The Eat Smart, Move More Weigh Less was in its fourth full year of implementation in 2012. Most participants set a healthy weight loss goal at the beginning of the program (some participants enroll to learn about healthy eating and physical activity and do not need to lose weight).

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
2012	1185

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
High blood pressure increases risk for heart disease and stroke.

What has been done
Several programs conducted by NC Cooperative Extension promote eating and physical activity patterns that have been shown to decrease blood pressure.

Results
Over 1100 participants decreased blood pressure as a result of participating in programs conducted by NC Cooperative Extension. Many other participants adopted physical activity or healthy eating behaviors that can positively affect blood pressure.

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
2012	35441

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many North Carolinians are not active on a regular basis. Few are active to the level recommended by the Dietary Guidelines for Americans. Physical activity is widely accepted as a

positive behavior for optimal health and can decrease the risk of heart disease, stroke, and high blood pressure. Physical activity also helps with weight control.

What has been done
NC Cooperative Extension encourages both moderate and vigorous physical activity in several lifestyle management programs. Participants are educated about recommended levels of physical activity and develop skills that can help them become physically active for life.

Results
More than 35,000 participants increased their physical activity. While this is the first step, the next step is to encourage participants to meet or exceed the minimum o f30 minutes of activity on most days.

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
2012	14681

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fruit and vegetable consumption is a critical component of a healthy diet. Increased fruit and vegetable consumption alone has been shown to be effective in decreasing fat and calories while increasing fiber and critical nutrients. Fruit and vegetable consumption is associated with an increased intake of phytonutrients that have been shown to decrease the risk of heart disease

and certain forms of cancer.

What has been done

Many programs and media campaigns across North Carolina focus on fruit and vegetable consumption. In addition to educational programs that include fruit and vegetable consumption as a healthy behavior that should be adopted, we also encourage community gardens, home gardening, and home food preservation.

Results

More than 14,500 participants across North Carolina their fruit and vegetable consumption by at least one serving.

EFNEP (Expanded Food and Nutrition Education Program) audiences increased their fruit and vegetable consumption. Results indicate that of 5130 families enrolled in EFNEP 56% of participants increased their fruit consumption and 51% increased their vegetable consumption. Of the 251 pregnant teens or parenting teens that were enrolled in 4-H EFNEP participant, 58% increased their fruit consumption and 58% increased their 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 environment. Without these changes, successful health behavior change is difficult to achieve and sustain. Confidence in adopting and maintaining a behavior may be

strengthened 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 level 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 2012, 14681 adults and 23952 youth increased their fruit and vegetable consumption, 35441 participants increased their physical activity, 3159 participants reduced their BMI, 1185 adults reduce their blood pressure, 578 adults improve dhtier blood clucose (A1c) level, 581 adults reduced their cholesterol, and 7985 participants consumed less sodium in their diet. Those individuals who make healthy food choice snad 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 (ESMMWL) is a weight-managememt program that uses research-bases strategies for weight loss/weight maintenance. This 15-week program informs, empower and motivates participants ot live mindfully as they make choices about eating and physical activity. the program provides opportunities 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%	15%	20%	25%
502	New and Improved Food Products	15%	15%	15%	30%
503	Quality Maintenance in Storing and Marketing Food Products	10%	10%	10%	20%
504	Home and Commercial Food Service	10%	10%	5%	0%
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%	10%	10%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	40%	40%	40%	25%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	54.0	2.0	55.0	6.0
Actual Paid Professional	76.0	3.5	95.0	6.0
Actual Volunteer	1.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
749881	171684	1379402	208415
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
749881	159818	1379402	76185
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5772719	12572	10705705	299940

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 includes a wide array of plant and animal systems Communities of Practice that provide relevant information and strategies for producers,procesors, and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	43040	81183	0	0

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	14	121	135

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2012	468

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2012	57

Output #3

Output Measure

- Local, area, regional and state conferences to be conducted
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of firms adopting quality and safety strategies

Year	Actual
2012	165

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
2012	1509

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Despite food safety communication efforts by many sectors, foodborne illness remains a significant heath issue in the US. It is estimated taht up to 70% of illness come from food handlers making behavioral mistakes.

What has been done
Food safety certification course offered through organizations such as the international HACCP Alliance and National Seafood HACCP Alliance were conducted for food manufacturing firms and state and federal regulatory personnel.

Results
Knowledge of biological, chemical and physical risks associated with agricultural products and processes employed in manufacturing and production systems has increased. Certification of course participants fulfills state and federal regulatory requirements in a number of food areas, such as acidified food products, seafood, meat and poultry products. In addition, compliance of firms increased and safety of food improved through participation in courses. In 2012, North Carolina cooperative extension field faculty delivered food manager trainings to 1509 individuals in North Carolina who received ServSafe program certification. In addition, Good Farmers? Market Practices, was delivered in a workshop form to 483 market vendors representing 67 markets across North Carolina. These workshops have resulted in measurable infrastructure changes and behavior changes including increased access to handwashing facilities and increased temperature control.

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
2012	3

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.

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
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The development of advanced thermal processing technologies for foods and biomaterials to maximize nutritional and sensory quality of processed products as well as provide safe, shelf-stable foods without need for refrigeration provides opportunities for economic development.

What has been done

Several unique and novel technologies have been developed and tested in NCSU labs and pilot plants. Aseptia/Wright Foods has licensed a portfolio of our patented and patent-pending technologies and opened a fruit and vegetable processing plant in Troy, NC in August 2012.

Results

The plant currently employs 90 people. The company announced plans for further expansion, which will include increasing the work force to as many as 500 full time employees. The economic impact has been significant for the city of Troy, Montgomery County and North Carolina.

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
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New food manufacturing products are desired by food manufacturers to enhance quality, shelf life and nutritive value.

What has been done
Food scientists and engineers have discovered ways to rapidly sterilize and package shelf stable intermediary fruit and vegetable products for use in food manufacturing, and they've created complementary approaches to ensure quality control and safety of the materials.

Results
Several unique and novel technologies have been developed and tested in NCSU labs and pilot plants. Aseptia/Wright Foods has licensed a portfolio of our patented and patent-pending technologies and opened a fruit and vegetable processing plant in Troy, NC in August 2012. The plant currently employs 90 people and announced plans for expansion, which will increase the work force to as many as 500 full time employees. The economic impact has been significant for the city of Troy, Montgomery County and North Carolina.

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
2012	1000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
It is important that food manufacturing processes and personnel understand and apply all know principles for effectively ensuring the safety of food products.

What has been done
Training and preparation for processing/manufacturer process audits is a role that food scientists have served for our industry. Preparation for GMP and other food safety audits equip personnel to protect the integrity of safe food manufacturing processes.

Results
Acidified GMP and BPCS workshops are required for and directed at the level of operating supervisors of aseptic and conventionally canned processing and packaging systems in food processing establishments. These workshops qualify 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. An NCSU faculty member has co-instructed or coordinated five of these workshops and certified 100 individuals. In addition, the FDA has recognized the faculty member as an acidified foods process authority.

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
2012	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New food products that promote health are needed to help ensure public health.

What has been done
The potential of grape pomace (GP) as a source of DF and dietary polyphenol for healthy food development was investigated.

Results
NCA&T researchers found that incorporating 5-10% of GP in bread formulation significantly increased dietary fiber and polyphenol contents, and antioxidant activity of bread. Sensory qualities such as color, taste, flavor and texture of GP-fortified bread were acceptable, although consumer ratings were slightly lower than for white bread. The results indicate that GP is suitable to be used in baking as a source of natural antioxidants and dietary fiber.

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 (weather extremes, economic climate) influence producers abilities 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 continure 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 and reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Research and extension programs and activities seek to excel in the following areas:

1. generate disseminate information that will enhance the safety of the food system--from production the table--and eliminate food borne illness
2. discover new technologies for handling and processing of food materials the will enhance their nutrition value and quality, find more uses in food manufacturing, and lead to new businesses
3. develop engineering solutions to take full advantage of the nutritive value and quantity of raw food materials generated in our agricultural systems
4. leadership is GAP, HACCP and other programs to enhance food safety

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	0%	5%	0%	0%
801	Individual and Family Resource Management	34%	20%	34%	0%
802	Human Development and Family Well-Being	33%	25%	33%	25%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%	10%	0%	25%
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	33%	15%	33%	25%
805	Community Institutions, Health, and Social Services	0%	5%	0%	25%
806	Youth Development	0%	20%	0%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	77.0	12.0	8.0	5.0
Actual Paid Professional	92.0	17.0	5.0	5.0
Actual Volunteer	156.0	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**
910570	822656	68970	737298
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
910570	765795	68970	259415
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
7009730	26545	535285	374818

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 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 Community of Practices include: Family Caregiving, Financial Security for All, Better Kid Care, Military Families, and Home Energy. These sources provide valuable information for educators, volunteers, childre 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

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	76910	173925	75625	0

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	18	13	31

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Develop and conduct Family Resource Management training and workshops.

Year	Actual
2012	341

Output #2

Output Measure

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

Year	Actual
2012	437

Output #3

Output Measure

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

Year	Actual
2012	425

Output #4

Output Measure

- Conduct Healthy Homes training for health and housing professionals.

Year	Actual
2012	77

Output #5

Output Measure

- Parents mandated by the court and agency referred parents consistently using positive parenting strategies.
  Not reporting on this Output for this Annual Report

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
2012	31

Output #8

Output Measure

- Healthy Eating, Physical Activity and Chronic Disease Risk Reduction

Year	Actual
2012	339363

Output #9

Output Measure

- Preparing Youth for an Employable Future and Economic Success

Year	Actual
2012	85279

Output #10

Output Measure

- Building Community through Volunteerism

Year	Actual
2012	8817

Output #11

Output Measure

- Building Citizen Leaders

Year	Actual
2012	21049

Output #12

Output Measure

- Developing Life Skills

  Not reporting on this Output for this Annual Report

Output #13

Output Measure

- K-12 Academic Achievement and Educational Success

Year	Actual
2012	144505

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
2012	5116

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 5797 youth and adults used effective life skills; 6769 adults increased their use of identified community resources; 4424 professionals used best practices with children, youth and older adults; and 4789 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
2012	3536

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, 3536 individuals and families implemented basic financial management strategies and 7721 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

   Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

   Individuals and families will reduce debt

   Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

   Individuals/families will participate in retirement planning

   Not Reporting on this Outcome Measure

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
2012	1812

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. According to Chancellor James Oblinger of NC State, North Carolina imports energy at a cost of about $16 billion a year, and over the next 50 years the issues of energy are going to become more complex and difficult to solve. There is a critical need for information, education and research as the government and investors rush to respond to the energy crisis. Although the state has abundant renewable resources that can be developed for energy, virtually all energy sources are now imported from outside the state. 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. However, while exploring and developing alternative sources, it is essential to consider the overall impact of alternative fuels on the state's environment and economy.

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, 722 participants increased their knowledge about best management practices related to energy use and energy efficiency. Over 1800 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

Not Reporting on this Outcome Measure

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

Not Reporting on this Outcome Measure

Outcome #10

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #11

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #12

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

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
2012	289135

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 2012 over 289,000 youth participated in 4-H day and residential camping, 4-H club activities, and school enrichment programs.

Results
In 2012, 21565 youth were involved in 4-H Clubs, 151371 youth participated in school enrichment programs, 92573 were active in special interest activities, 11779 attended resident camps and 11847 attended day camp. 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

   Not Reporting on this Outcome Measure

Outcome #15

1. **Outcome Measures**

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

   Not Reporting on this Outcome Measure

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

   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 Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (NC DPI Regulations)

Brief Explanation

North Carolina does not report youth activities under subject matter categories for camps, special interests, school enrichment and 4-H Clubs. Instead, all are aggregated to result in one number of total participants for the categories of day camps, residential camps, school enrichment, special interest and clubs.

The national budget crisis and its trickle down impact on the state of North Carolina have affect some of the program efforts, impacts and outcomes. As the economy has tightened, communites and famlies stay closer to home and are less inclined to participate in educational programs. Despite Extensions footing in communities, when parents struggle with family finances and employment, their youth are impacted.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations include retrospective (post program), pre and post program; formative (on-going), case study; and comparisons between program participants (individual, group, organization) and non-participants. Programs are evaluated for impact by object/goal in the contest of the Long Range Focus Area Team Plans.

Key Items of Evaluation

Youth programs focused on areas such as academic achievement, life skills and communication. These programs are designed to prepare today's young people to become contributing members of society. North Carolina does not report youth activities under subject matter categories for camps, special interests, school enrichment and 4-H Clubs. Instead, all are aggregated to result in one number of total participants for the categories of day camps, residential camps, school enrichment, special interest and clubs. Additionally, life skill development is captured under the reporting for K-12 academic achievement and educational success.

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%	10%	15%	25%
701	Nutrient Composition of Food	10%	10%	10%	25%
702	Requirements and Function of Nutrients and Other Food Components	10%	10%	10%	25%
703	Nutrition Education and Behavior	15%	20%	0%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%	15%	5%	0%
721	Insects and Other Pests Affecting Humans	10%	5%	10%	0%
722	Zoonotic Diseases and Parasites Affecting Humans	5%	5%	10%	0%
724	Healthy Lifestyle	10%	15%	10%	0%
802	Human Development and Family Well-Being	10%	10%	0%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	4.0	50.0	6.0
Actual Paid Professional	68.0	10.0	32.0	6.0
Actual Volunteer	15.0	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**
374941	500747	413820	208415
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
374941	466136	413820	76185
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2886359	3947	3211712	542193

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

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: 10

Patents listed

US patent No. 8,211,485- Process For Preparing Hypoallergenic and Non-allergenic Peanuts (Arachis Hypogaea) Utilizing An Endopeptidase

Lactobacillus Acidophilus Nucleic Acid Sequences Encoding Carbohydrate Utilization-Related Proteins and Uses Thereof(Europe)

Polymer Based Nanofibers Impregnated with Drug Infused Plant Virus Particles as a Responsive Fabric for Therapeutic Delivery

Lactobacillus Acidophilus Nucleic Acid Encoding Fructo-Oligosaccharide Utilization Compounds and uses Therof

A process for the modification of plant viral capsides for use as a therapeutics delivery vessel

Modulation of BfmR by Imidazole-based Anti-biofilm Agents

Methods of Reduce Polyposis and Colorectal Cancer

Lactobacillus Acidophilus Nucleic Acid Sequences Encoding Carbohydrate Utilization-Related Proteins and Uses Thereof(Australia)

Methods of Preparing Cyclic Peptides and Uses Thereof

Lactobacillus Acidophilus Nucleic Acid Sequences Encoding Carbohydrate Utilization-Related Proteins and Uses Thereof(US)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	19	122	141

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
2012	4101

Output #2

Output Measure

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

Year	Actual
2012	128781

Output #3

Output Measure

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

Year	Actual
2012	50

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
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Plant based food constituents are finding a place in diets or dietary supplements for humans to help maintain health prevent diseases.

What has been done
Working with General Mills, NCSU researchers genotyped a broccoli population developed at NCSU with more than 5,000 Single Nucleotide Polymorphic (SNP) markers that were developed from genomic scaffolds of rapeseed (canola).

Results
This mapping has been used to identify a single gene in broccoli that could double the amount of lutein found in broccoli. This finding led to a funded collaboration with the Monsanto Company to evaluate the transferability of this characteristic to elite broccoli material. If this is successful, it will lead to a product that will impact consumers that suffer from age-related macular degeneration and cataracts.

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
2012	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increased emphasis is being placed on the importance of fruits and vegetable in the human diet, both for providing traditional nutrients, but often to provide antioxidants and other materials shown to enhance health and help prevent diseases.

What has been done
Plant breeders are working with chemists, basic geneticists and scientists working with biobased products to develop new breeding materials and eventually plant varieties that will carry beneficial nutraceuticals to consumers of these fruits and vegetables.

Results
Efforts continue with broccoli, cabbage, blueberries, muscadine grapes and tomatoes to create breeding lines and varieties that produce and provide a variety of beneficial antioxidants and other materials known to impact human health.

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
2012	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Emerging foodborne pathogens have become a major public health concern. Many naturally occurring compounds found in medicinal plants, herbs, and spices have been shown to possess antimicrobial activities against many foodborne pathogens. The enterohemorrhagic Escherichia coli strain O157:H7 is a major bacterial foodborne pathogen. Cattle are considered to be the major reservoir for E. coli O157:H7, and approximately 80% of herds (beef and dairy) may be affected. Synthetic antibiotics provide the main basis for the therapy of bacterial infections. However, overuse of antibiotics has become the major factor for the emergence and dissemination of multi-drug-resistant strains of several groups of microorganisms. Use of herbal products such as antimicrobial agents may provide the best alternative to the wide and injudicious use of synthetic antibiotics.

What has been done
The potential antimicrobial activities of sorrel (H. sabdariffa) were tested against food, veterinary, and clinical sources of E. coli O157:H7.

Results
Results showed that a 10% concentration of sorrel extract had the greatest inhibitory effect, but that the source of the samples was related to differential inhibition levels; the lowest mean inhibition was 7.00 ? 0.04 mm from clinical samples and the highest was 15.37 ? 0.61mm from a food source. These findings indicated that sorrel was effective at all levels in inhibiting E. coli O157:H7, suggested it possesses antimicrobial activity and holds great promise as an antimicrobial agent.

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
2012	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

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' abilities to adapt to change while ensuring healthful living and high quality of life. Continued effects of the economy on federal, state and local support for research and extension programs continure 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 our capacities to generate and provide new knowledge to help individuals, families and populations exist and prosper in a healthy, productive and satisfying environment. And in an environment and reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability citizens, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Research and extension programs are focused on the following:

1. Understanding the impediments to healthy living (diseases, environmental factors, vectors, nutrition, etc.) that might be mitigated by research solutions
2. Exploiting natural products that might play roles in enhancing nutrition, reducing diseases incidence or severity, enhancement of existing antibiotic or other disease treatment approaches
3. Discovering biobased materials that play a role in human nutrition
4. Breeding new plant lines or varieties that have nutraceutical value for enhancing health