2010 North Carolina A&T State University Extension and North Carolina State University Research and Extension Combined Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 05/19/2011

I. Report Overview

1. Executive Summary

North Carolinians are the beneficiaries of an array of research and extension efforts designed to better their lives and to make their state a better place in which to live. These efforts are administered by two entities: the North Carolina Agricultural Research Service and North Carolina Cooperative Extension. This report documents 2010 research and extension programs in North Carolina.

NORTH CAROLINA AGRICULTURAL RESEARCH SERVICE (NCARS)

North Carolina State University is North Carolina's 1862 land grant university and the only Research land grant institution in the state. The North Carolina Agricultural Research Service, located within the College of Agriculture and Life Sciences at N.C. State University, serves not only as the college's agricultural, environmental and biological sciences research arm but also provides the research foundation in these areas for educational activities within academics and extension. The Agricultural Research Service is the principal state agency for research in agriculture, life sciences and forestry. The following North Carolina State University colleges collaborate on NCARS research projects.

- Agriculture and Life Sciences
- Natural Resources
- Physical and Mathematical Sciences
- Engineering
- Veterinary Medicine

In addition, the Research Service administers projects in the School of Human Environmental Sciences at the University of North Carolina Greensboro. Within the College of Agriculture and Life Sciences, the Agricultural Research Service coordinates research in 18 departments and works in partnership with the North Carolina Cooperative Extension Service and the college's Academic Programs office.

The mission of the Agricultural Research Service is to develop the knowledge and technology needed to:

- Improve the productivity, profitability and sustainability of industries in agriculture, forestry and life sciences;
- Conserve and improve the state's natural resources and environment;
- Improve the health, well being and quality of life of North Carolina citizens; and
- Provide the science base for research and extension programs.

In FY 2010 Research Service personnel included tenured and tenure-track research faculty accounting for approximately 400 research faculty, most on shared appointments with Academic Programs or Cooperative Extension. Working with these faculty members are more than 490 research professors, researchers, research assistants, professional support staff and graduate students; 230 laboratory or field technicians and other technical support; and 80 clerical/other staff. These faculty members and support personnel conduct basic and applied research involving 500 projects, of which 23 are multistate. These

projects support more than 70 commodities as well as many related agribusinesses and life science industries. Altogether, this includes 90 official commodity groups and agricultural industry associations.

NORTH CAROLINA COOPERATIVE EXTENSION

The College of Agriculture and Life Sciences at N.C. State University and the School of Agriculture and Environmental Sciences at North Carolina A&T State University work collaboratively to provide educational opportunities that are relevant and responsive to the needs of individuals, communities, counties and the state, thus achieving their shared land grant missions. At the heart of this partnership is North Carolina Cooperative Extension.

North Carolina Cooperative Extension partners with communities to deliver education and technology that enrich the lives, land and economy of North Carolinians. To address ever-changing needs, the organization operates under a dynamic long-range plan of work, a plan that changes as circumstances dictate. The plan encompasses nine major goals that focus on concerns statewide. Each goal has several objectives that are designed to operate interdependently among the nine goals, allowing Extension to provide multi-faceted responses to meet complex needs. To achieve the plan's objectives, specialists at the state's two land grant universities work hand-in-hand with field faculty serving all 100 North Carolina counties and the Eastern Band of the Cherokee Indians. Programs at N.C. A&T State University are targeted largely at limited-resource audiences. Parameters are included for every objective that may be used to measure the success of Extension programs with both limited- and nonlimited-resource audiences.

The work of Cooperative Extension professionals is coordinated with the efforts of the North Carolina Agricultural Research Service. Indeed, about 75 of the 400 Extension faculty within the College of Agriculture and Life Sciences have joint appointments with the Agricultural Research Service. In addition to this alliance with research faculty, Extension benefits from the input of a well-established statewide system of lay advisers, who represent the state's diverse population. To ensure that underserved and underrepresented audiences are among those included in program development and implementation, Cooperative Extension established a civil rights plan that features computer monitoring of program participation by gender and race, including goals and plans for assuring that all persons have equal access to any Extension organized group. A permanent Diversity Task Force monitors programs, suggests policy and develops and conducts training for the organization. Funding for Extension programs is provided by Smith-Lever appropriations, state and county funds, plus public and private grants.

As a proportion of overall spending, grants and contracts have become increasingly important. These funds have helped Cooperative Extension address emerging challenges in innovative ways; however, declining or flat levels of appropriated support from federal, state and county governments pose significant challenges for meeting program objectives. Stakeholder input undergirds all of Extension's efforts, as it did and continues to do in planning and implementing the five-year AREERA Plan of Work. This report reflects impacts of the joint educational programming efforts of the North Carolina Cooperative Extension Service of N.C. State University and the Cooperative Extension Program of N.C. A&T State University. This report also updates and highlights accomplishments and impacts of research conducted through the North Carolina Agricultural Research Service, 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 more than nine million citizens address critical challenges facing them today and in the future. Additional North Carolina Cooperative Extension program accomplishments and success stories can be found at http://www.ces.ncsu.edu/AboutCES/ and http://www.ag.ncat.edu/extension/.

PLANNED PROGRAM OVERVIEW SUMMARIES

The Research and Extension AREERA plans encompass nine broad planned program areas and five NIFA priority areas. These include:

- Plant Production Systems and Health
- Economic Systems
- Natural Resources and Environment
- Animals and Their Systems, Production and Health
- Agricultural, Natural Resource and Biological Engineering
- Food Production Systems: Development, Processing, Quality and Safety
- Human Nutrition and Health
- Families and Communities
- Youth Development
- Sustainable Energy
- Climate Change
- Food Safety
- Global Food Security and Hunger
- Childhood Obesity

Summaries of each of the fourteen program area accomplishments follow.

Plant Production Systems and Health

North Carolina has a strong and diverse agricultural economy. If anything, the state's agriculture has become more diverse in recent years as consumer preferences change and new market opportunities arise. To remain competitive in the national and global agricultural economy and take advantage of local marketing opportunities, growers must adopt more efficient production practices and continue to be open to new opportunities. In addition to traditional crops, North Carolina growers produce specialty crops, including medicinal herbs, specialty melons, heirloom fruits and vegetables, hops, caneberries, oriental pears, various crops for the state's growing ethnic populations and grapes for wine and nutraceutical properties. In addition, the green industry continues to be an important part of the state's agricultural sector, and consumer demand for organically produced fruits and vegetables continues to rise. North Carolina growers have diversified to meet demand, and consumers are benefiting from more fresh, locally grown produce in the marketplace. While this diversification has been good for North Carolina growers, it has placed demands on the NCARS to develop and deliver information on sustainable programs for the production, protection (from pests and pathogens), harvest, storage and marketing of these commodities. Although the target audience for this research is North Carolina growers, much of the research and many of the Extension programs have regional, national and international impact.

NCARS scientists are investigating ways to more efficiently use water, fertilizer and other inputs and to improve yield and quality. We are also using molecular tools and conventional plant breeding techniques to develop new varieties with improved yield, quality and ability to withstand stresses such as drought, freeze injury and pests. To assist growers in taking advantage of new opportunities and challenges, Extension programs, workshops and field tests/demonstrations are conducted at the county, regional and state levels to inform growers about alternative income sources, including commercialization of native species and the production of various ornamentals, fruit crops and vegetables, organic production methods, and agri-tourism. These activities draw audiences of all types and levels of experience, including new producers and existing producers, and large-scale, limited-resource and part-time producers. Topics addressed include production practices, pest management, alternative marketing channels, creating grower associations, promoting the use of local farmers markets, starting pick- or cut-your-own operations and combining agri-tourism and direct marketing.

In addition to challenges in producing and marketing both new and traditional crops, growers must deal with new pests or pests that have become resistant to commonly used agricultural chemicals. For

example, glyphosate-resistant weeds are widespread in North Carolina. NCARS scientists are working closely with county agents and producers to develop strategies to manage this and other problems.

Research and Extension activities are creating new opportunities to increase profitability of existing crops and to take advantage of local, national and international markets. Following are examples of these activities within each knowledge area.

Plant Genome, Genetics and Genetics Mechanisms

Several soybean cyst nematode genes that are responsible for parasitism were identified, and research indicated how these genes can be used to protect soybean plants from the nematode using RNAi technology.

Quantitative resistance to Southern leaf blight disease in maize was resolved in about 50 sequence variants. This was the first demonstration of large-scale, high-resolution whole-genome association analysis for plant disease resistance. Genome association connected with Southern leaf blight disease will allow advances in breeding for resistance to the disease. Success will allow the production of high-yielding resistant cultivars for U.S. production.

NCARS scientists developed a technology that uses matrix attachment regions (MARs) to improve genetic transformation technology for crops. Current gene transfer technology is an uncertain art because there is little control over factors such as position effects and gene silencing interactions that can modify or abrogate transgene expression. The transformation technology developed at N.C. State minimizes some aspects of this variation. If chromosome dynamics and epigenetics are better understood, transgene behavior may be more predictable, and we may be able to make better use of gene transfer techniques in plant improvement programs as well as in fundamental research. This technology should considerably broaden the range of beneficial improvements that can be achieved by genetic engineering techniques.

Plant Genetic Resources

An NCARS team sequenced the genome of the turf pathogen Sclerotinia homoeocarpa. This fungus is by far the most important turf pathogen worldwide, and the availability of genome data will dramatically accelerate research on host specificity, population dynamics and fungicide resistance.

Plant Product Quality and Utility

NCARS, with support of the North Carolina Peanut Growers Association, Cooperative Extension field faculty and peanut farmers, developed information and visual tools to assist peanut growers in determining when to dig peanut. North Carolina peanut growers used this information to increase annual income by $5.2 million through timelier digging.

NCARS engineers and biologists are collaborating with industry partners to seek solutions to difficult technical problems in producing algal oils and converting them into liquid transportation fuels. The ability exploit the promise of algae as a biofuels feedstock offers tremendous economic and environmental impact by reducing the transportation sector's reliance on fossil fuels without impacting food and fiber production.

Identification of new fresh market apple varieties or sports that are uniquely suited to production in the Southeast, together with development of technologies for consistently regulating crop load, promoting return bloom, delaying fruit drop, enhancing fruit appearance at harvest and fruit quality after storage are among strategies being pursued to ensure continuing viability and success of the North Carolina apple industry.

Plant Management Systems

The N.C. State University Micropropagation and Repository Unit was awarded a National Clean

Plant Network grant to serve as a major repository of berry varieties for the Eastern United States. This unit is a the primary source of planting material for North Carolina sweet potatoes, including ornamental sweet potatoes, strawberries and other crops.

North Carolina turf clients were the beneficiaries of more than 115 on-site diagnostic visits in 2010. These visits allow clients to make more cost effective and environmentally responsible decisions regarding turf cultural practices, fertilizer and pesticide applications.

The Cotton Insect Corner website http://ipm.ncsu.edu/cotton/insectcorner/, which is provided by NCARS faculty, contains information on all aspects of cotton insect management. Based on the number of Goggle searches for various cotton-related terms, this is most visible such cotton information program in the United States.

Basic Plant Biology

The plant vacuole is a storage compartment for proteins, hormones, metabolites and ions. Membrane proteins of the vacuole transport all of the metabolites and ions that regulate cellular homeostasis. NCARS scientists identified small molecules that inhibit the delivery of specific membrane proteins to the vacuole. These inhibitors are been used to characterize two distinct trafficking pathways. In addition, newly identified mutants with defects in trafficking of membrane proteins to the vacuole are being characterized. Anunderstanding of the mechanisms of delivery of membrane proteins to the vacuole is important to the development of improved plants with high nutritional value and improved tolerance to environmental stress.

NCARS scientists generated transgenic Arabidopsis plants with alterations in one of the key signaling pathways. These plants have altered sensitivity to environmental stresses including gravity, drought and defense responses to pathogens. Results suggest that dampening basal signaling alters stress responses. Transgenic tomato plants have been generated and are being analyzed for drought stress and response to phosphate limitation.

Insects, Mites and Other Arthropods Affecting Plants

NCARS researchers developed new insect management practices that are saving North Carolina sweet potato growers nearly a quarter of a million dollars annually while also reducing the amount and impact of pesticides released into the environment.

The loss of broad spectrum organophosphate chemicals, once used to control key apple pests, left the industry with only a few narrow spectrum insecticides to control the codling moth, the most important insect pest of apples. Control of codling moth became more challenging when populations developed resistance to several commonly used insecticides.N.C. State University conducted a research and extension program from 2007 to 2010 to develop and implement reduced-risk pest management programs for apple insects, with specific attention paid to the codling moth.

Pathogens and Nematodes Affecting Plants

Depending on the location, peanut leaf spot and Sclerotinia advisories provided by N.C. State University resulted in a savings of one to three fungicide sprays compared to calendar programs in 2010. Programs such as this encourage growers to reduce fungicide use in calendar spray programs, guard against the development of fungicide resistance, and integrate host resistance with chemical disease control. Advisories saved $74,250 in one North Carolina county alone in 2010.

N.C. State University provides soybean growers with weekly reports of the presence or absence of Asiatic Soybean Rust. These reports are based on sentinel plots in 22 North Carolina counties. The reports allow growers to make informed management decisions concerning the likelihood of an infestation and plan for control measures if needed.

Weeds Affecting Plants

NCARS, with support from commodity groups and industry, has been a leader in the mid-Atlantic region in helping growers manage herbicide resistance in weeds by developing and recommending appropriate management strategies to manage resistant weeds.

Integrated Pest Management Systems

The Southern Region IPM Center at N.C. State University established a cucurbit downy mildew IPM PIPE (Pest Information Platform for Extension and Education) to provide information on this disease. Information on pathogen biology and the spatio-temporal progress of the disease has been incorporated with atmospheric transport models to forecast disease outbreak risk and the need for fungicide application. This system provides near real-time flexibility in decision-making for the in-season management of the disease.

NCARS faculty developed the Peanut IPM decision aid and a peanut website and taught users how to navigate the program. This decision aid helps users calculate the estimated cost of managing and risks of developing pests (seven diseases, two arthropods and three nematode species).

The first peer reviewed and published studies of yield and profit impact of routinely applying fungicides to wheat showed that routine fungicide applications in the Southeast result in an increase in profit for the grower only about 34 percent of the time. In other words, 66 percent of the time growers would lose money compared to never spraying fungicides. These studies indicate there is no economic benefit to this practice and no reason to take the risk to human health and the environment.

Economic Systems

Research and Extension programs promote sustainable economic development, responsible management of financial assets, and help families become more financially secure. Programs that target agriculture and agribusiness are particularly important as agriculture and agribusiness generate more than $74 billion in value-added income in North Carolina annually and account for 688,000 of the state's 4 million jobs. Following are representative initiatives and results.

A program has been developed that outlines a process to successfully transfer a family-owned business, such as a farm, to the next generation. This will be increasingly important to the agricultural community as the present generation of farmers retires. It is estimated that over the next 20 years, nearly $20 trillion of wealth will be transferred to succeeding generations.

In recent years legislation substantially expanded the scope and coverage of federally-subsidized crop insurance and provided incentives for the development of new insurance plans. This has resulted in a wide range of new crop insurance programs with unique risk issues. Research addressed issues relating to the modeling of crop yield and revenue risks used in federally-subsidized crop insurance programs. Accurate actuarial models are essential because errors will result in inaccurate insurance premium rates and substantial distortions in the program. The role of accurate premium rates in U.S. crop insurance programs is critical. Errors could result in taxpayer losses and could substantially diminish the usefulness of these programs as risk management tools for farmers.

In September 2009 the U.S. Department of Labor issued a proposed amendment to H-2A rules that would increase the wage rate by about $1.44 per hour. North Carolina farms employ almost 19 percent of all H-2A labor, so this rule change would have had a dramatic impact the state's agriculture. A North Carolina State University analysis of the wage rate increase effectively delayed the increase by showing

that the impact would be an annual transfer from farm employers to H-2A workers of about $150 million nationwide. The Department of Labor is required to complete a more in-depth analysis than was completed in 2009 if the transfer from the U.S. economy is more than $100 million. While the Department of Labor ultimately approved the H-2A wage rate increase, the process was delayed such that wage rate increases will occur in 2011 rather than 2010. Potential savings to North Carolina farmers were more than $28 million as a result of this delay.

By statute many states including North Carolina must calculate the dollar value of benefits associated with policies aimed at improving water quality. A method was needed that allows state-level analysts to perform these calculations in a rigorous but accessible way. We designed and transferred via a workshop a protocol that packages methods for valuing water quality improvements into a user-friendly spread sheet tool. Our workshop was attended by water quality managers from North Carolina, Georgia, Massachusetts, Vermont and Virginia. Feedback from participants and EPA staff suggests this protocol will be used as part of the policy process in several southeastern states, including North Carolina.

Increasing the availability of broadband in rural communities has been an important U.S. rural development policy goal over the past decade. Since 2000, federal broadband loan programs authorized under consecutive farm bills have directed more than $1.8 billion to private telecommunications providers in 40 states with the explicit goal of making high-speed data transmission capacity available to rural residents and businesses. Most recently, the American Recovery and Reinvestment Act of 2009 authorized $2.5 billion in new federal funding for these same purposes. Arguments in favor of these programs are supported by research projecting large economic benefits from widespread broadband deployment. However, these projections obscure the fact that the distribution of these benefits is not likely to be uniform, either spatially or across industries. NCARS research provided the strongest evidence to date that the USDA's Broadband Loan Program has positively affected the performance of the agricultural sector throughout the country. The research revealed increases in total commodity sales, crop sales and farm expenditures and profits. The research also indicated that while the current broadband loan program does not seem to affect total farm acreage, an earlier pilot loan program appears to have increased acreage by about 3.6 percent. These findings provide evidence that federal programs promoting the deployment of broadband into rural communities have improved farm profitability and the well-being of farmers.

An economic model of pork packer behavior was developed to test for the economic effects of banning packer-owned livestock. The model accounts for the effects of market power and cost efficiencies in procuring hogs from the spot market through contracts and through company-owned sources. The results indicate that independent hog producers, pork packers and consumers would all lose significantly if company-owned hogs were banned. The total annual amount saved by independent producers from not banning packer-owned hogs ranges between $46.7 to $184.1 million; pork packers would save between $430.8 and $711.4 million; and consumers would be better off by between $123.8 and $779.3 million. The U.S. Department of Justice and USDA have considered antitrust action against meatpackers to improve the welfare of independent producers. This study indicates that the group the antitrust action would attempt to help -- independent producers -- would be worse off.

Natural Resources and Environment

North Carolina's outstanding natural resources include a wide variety of streams, lakes, rivers, wetlands, estuaries, forests and aquifers, with unique habitats in the mountains, foothills and coastal regions of the state. These resources are critical elements supporting agriculture, economic development, recreation and quality of life for the state's citizens and visitors. Ongoing development and population increases create conflicts over water, land, air and wildlife management. Research and Extension efforts promote environmental protection and sustainable resource management. Water quality and availability, air quality, species diversity, wetland and stream preservation and restoration, and habitat enhancement

are all topics of interest and activity.

Extension efforts were focused on teaching adults and youth to manage natural resources effectively while maintaining local environmental quality. Educational outcome highlights include the following.

19,027 program participants increased their knowledge natural resource and environmental conservation.

7,975 youth and adults gained increased knowledge of natural resources environmental issues.

2,602 pesticide applicators were certified or recertified.

2,429 program participants were certified to implement and maintain best management practices.

642 program participants implemented community-based action projects for environmental protection.

489 landowners implemented agriculture and forestry best management practices, with 104,283 acres under best management practices.

318 farmers and landowners implemented nutrient management plans on 85,060 acres.

1,171 volunteers worked 7,691 hours on natural resource protection projects with a value of $155,742.

Faculty members completed design and construction of a 350-acre wetland restoration site at North River Farms, which drains to the North River in Carteret County, NC. This project included 7 years of monitoring of site hydrology, vegetation, stability and water quality.

Faculty members developed a comprehensive education program to improve stream restoration. This program includes a series of River Course workshops in which more than 4,000 professionals have learned about stream assessment, design, construction and monitoring. North Carolina State University has provided leadership since 1998 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.

Research efforts were focused on developing and evaluating innovative technological and management approaches for protecting and restoring quality natural resources. Research outcome highlights include:

The specificity of nutrient exports in watersheds is that it is not linear with time but rather occurs in spurts following rainfall events. As a result, most of the nitrate load (>50-60%) occurs in a small percentage of the time (<10%). The question arising is that if most of the load occurs in a relatively short period of time, what happens? Are the natural nitrate dissipation processes triggered? Do these processes remain the same? Or are these processes dampened during these periods? If they are triggered, then we need to find out why. The near stream zone, including the riparian and the hyporheic zones (sediment below streams), has long been recognized for its very important and natural role in removing nitrate as groundwater enters streams. Until now, there was no easy way of studying nitrate dissipation at the near stream zone during hydrological events because this requires the ability to measure the rapidly changing quality of water at several places at the same time. NCARS researchers developed an instrument that allows them to study nitrate dissipation at the near stream zone during hydrological events by measuring

the rapidly changing quality of water at several places at a time. This tool allows nitrate dissipation studies at the most important times. It allows for the first time the investigation of fast-occurring processes for an array of water sources. It may be applied for the investigation of nitrate dissipation dynamics not only at the near stream zone but for any study or experiments for which high time resolution data are needed.

Researchers conducted research and obtained a patent on a continuous-flow struvite crystallizer for removing phosphorus from waste water and concentrating it in a product (struvite) that has value as a feed ingredient for animals or as a slow-release fertilizer, especially for horticultural or golf course turf applications. Struvite contains ammonia, phosphate and magnesium. The initial application was with anaerobic lagoon liquid and showed a 50% to 80% removal of total phosphorus. A recent project has demonstrated similar removal efficiencies with covered digester effluent. It is probable that covered anaerobic digesters will become more prevalent on farms to collect the biogas and utilize it for energy. The other benefits from covered digesters are reduction of emissions of ammonia and greenhouse gases. The doctoral graduate who helped develop the technology has formed a company that licensed the technology from N.C. State University and is developing applications of the technology on dairies, swine farms, food processing wastewater treatment units and municipal wastewater treatment plants.

Three new sensor-based irrigation technologies were developed to maintain turfgrass quality for both warm-season and cool-season turfgrasses. In addition, TIMS Turfgrass Irrigation Management Software was developed. These efforts are helping reduce demand for water from urban water supply systems.

Methods have been developed for large-scale deployment of field border habitat using both organic and conventional approaches. Ongoing studies are examining the value of these habitats for insect pest and weed suppression, pollinator enhancement and farmland wildlife. An existing CRP program (CP33) has been modified to allow either organic or conventional growers the option of incorporating field border habitats on their farms to enhance beneficial insects as well as farmland wildlife.

Research is focusing on creating stressor-specific indices to diagnose the causes of ecological impairment in streams. Scientists developed a life cycle bioassay using a mayfly. This will allow researchers to better utilize resident macroinvertebrate communities to diagnose the causes of ecological impairment in streams.

Animals and their Systems, Production and Health

North Carolina has long had a strong agricultural economy with an emphasis on and diversity in plant production. In recent years, animal production has increased, with North Carolina currently ranked second nationally in swine production and boasting impressive numbers of poultry, chickens as well as turkeys, beef and dairy cattle, meat goats and aquaculture. North Carolina Agricultural Research Service scientists continue to focus their research in the areas of reproduction, nutrition, genetic improvement, growth and development and disease and parasite prevention and control. Disciplines further include bacteriology, virology, mycology, entomology and microbiology. In addition, many animal management systems are being developed and explored in the areas of waste management, forage management, hatchery management, feed and water systems, litter and bedding and breeding stock selection.

Following are examples of representative research and extension efforts in this area.

Research has demonstrated how maturation of organ systems that impact poultry performance can be altered by manipulation of incubation parameters. Intermittent heating of incubating chicken eggs from days 7 to 16 produced birds that had lower metabolic rates, improved heat loss and decreased stress at market age. Intermittent heating from days 16 to 18 produced birds that had 1% more breast muscle and less abdominal fat at market age. In both approaches, changes in incubation conditions did not adversely

affect hatchability and quality of the hatched chicks. Together, these developments could represent a $45 million annual benefit to the poultry industry.The information developed from these trials is used to develop educational materials used in the NCSU Hatchery Management Workshop as well as other educational efforts in the state and nation. The direction of research now is beginning to focus on initial incubation temperatures as well as how the eggs attain incubation temperature.

Research on in ovo feeding has the potential to greatly increase the efficiency and economical competitiveness of the poultry industry. Moreover, knowledge gained from in ovo feeding research has resulted in changes in hatchery management and breeder nutrition to enhance the survival of broilers and chicks.

As poultry feed costs rise due to market constraints on energy resources, the need to improve energy and protein utilization efficiency is more critical to the sustainability and competitiveness of the poultry industry than ever before. Research indicates that dietary inclusion of enzymes can potentially reduce feed costs by at least $15 per ton while moderately improving growth performance.

An interdisciplinary team has conducted a series of feed utilization studies to help beef cattle producers reduce input costs. Young bulls and heifers have been tested with regard to feed utilization. Highly efficient animals have been use as seedstock in research herds to create new generations of animals that will improve feed utilization.

The efficacy of various mycotoxin binders to attenuate the toxicity of mycotoxins was determined in a series of trials conducted in collaboration with large North Carolina hog producers as well as companies in allied industry. More precise information on the impact of low level mycotoxins on health and performance was determined. This research prompted changes in feed manufacturing practices that improved productivity and pig health.

Data from a series of trials conducted in commercial pork production facilities to document the impact of piglet size at birth on subsequent survival, growth and feed efficiency were used to model a software tool to be used in management decisions. North Carolina pork producers, who produce over 13 million pigs annually, have adopted this decision tool in their production system and are currently evaluating a change in their production goals and contracts to focus on size and quality of piglet as opposed to large litter size.

Three large studies were completed on a commercial 2,600 sow unit to evaluate the impact of fat supplementation (different levels and sources) on sow reproductive performance and energy digestibility of fats of different chemical composition. These studies demonstrated that the most benefit from supplemental fat (animal-vegetable blend) in modern, commercial lactating sows was achieved when diets contained 2 percent supplemental fat.

Studies were conducted that showed that chromium supplementation of beef cows improved reproduction, especially in young cows. The percentage of cows that became pregnant during the breeding period was increased from 78 to 93 percent for cows five years of age or younger. Safety and efficacy studies also were conducted that resulted in the Food and Drug Administration allowing chromium propionate to be used in cattle diets as a source of supplemental chromium.

The identification of chromosomal regions associated with growth, bone density, breast yield, fatness and many other carcass and metabolic traits in two novel broiler cross reference populations was completed. The development of this resource population and the identification of DNA markers associated with several traits, including growth and bone mineralization, will provide molecular tests that can be used by producers to improve the growth rate or bone integrity of future poultry stocks.

Research showed that the inclusion of large particles of corn in broiler feed to stimulate gizzard function reduced the negative effects of various anti-nutritional factors and improved broiler digestive efficiency, reduced fecal nitrogen waste and improved feed efficiency while improving environmental sustainability.

Acute enteric disease of turkey poults is a major cause of morbidity and mortality. Research indicates that enteric viruses are able to disrupt host defenses, especially in very young animals. This research is beginning to elucidate the specific cellular changes that occur in the intestine and lead to the development of clinical diarrhea.

Researchers documented and demonstrated reduced-risk integrated pest management approaches in confined swine production systems. This work included a field survey to profile and summarize production practices and pesticide use and to identify available pest management alternatives. Cockroach pheromones and visual inspections were compared as tools for implementation of IPM strategies in managing cockroaches, and visual counts were deemed acceptable. Alternative strategies, including cultural, physical and chemical (boric acid) controls are being evaluated as well as biological agents. A new pathogenic Densovirus has been discovered, and scientists tested and validated a new method for reducing cockroach populations with liquid baits of boric acid.

Researchers investigated the levels of bioaerosols released from a large poultry layer facility in North Carolina that is typical of similar facilities throughout the U.S. At the investigated farm, bacterial concentrations were measured at the housing units as well as at four locations at the north, south, east, and west farm boundaries. Data will be used to develop mathematical models for airborne microbial contaminant dispersion in the environment. Initial results demonstrate that airborne microbial contaminants are released from animal farms.

The first of several swine euthanasia field trials were performed in 2009 and 2010. Performance and test results are being evaluated, and protocols will be optimized as additional trials are performed in 2011. Data compilation and analysis are ongoing. In the event of an adverse animal health event, the USDA and other environmental agencies will be better prepared to initiate and address emergency management procedures to protect and promote the safety of our nation's food supply. This research will enhance the health status of the U.S. meat supply by anticipating and responding to new or emerging biosecurity hazards .....

The animal research programs at N.C. State and NC A&T State universities are enhanced by an extensive outreach component that disseminates the most recent research-based information to producers throughout North Carolina. Field and campus-based faculty conduct trainings, workshops, demonstrations, field days, conferences and one-on-one consultation for producers and consumers. Information is further distributed through distance education, hard-copy and electronic newsletters, radio and television programs, press releases, trade journals, scientific journals and popular press articles. NC A&T State University is further dedicated to the continuation of pasture-based production systems, aquaculture and the use of alternative breeds of livestock.

Agricultural, Natural Resource and Biological Engineering

Research and extension programs in this planned program area focus on agricultural air quality, agricultural energy conservation, alternative energy sources and engineered waste management systems. Extension activities include workshops, conferences, trainings and field days. Many research projects have direct outreach components, increasing the overall effectiveness of these projects.

Following are summaries of representative projects in this area.

A novel technology of alkaline pretreatment of switchgrass at ambient temperature has been developed. This new pretreatment technology provides almost the same efficiency of sugar and ethanol yields from switchgrass as current high-temperature chemical pretreatment technologies. However, energy consumption of the pretreatment technology is much lower than the current chemical pretreatments, thus lowering the overall cost of fuel ethanol production from lignocellulosic biomass. This new technology has been proven successful on switchgrass and can be applied to other lignocellulosic materials such as agricultural residues.

Various studies of efficient and environmentally friendly bioconversion processes that use regional feedstocks such as agricultural residues, switchgrass, miscanthus, cottonseed, soybean, sweetpotatoes and sugarbeets are underway. A study of the effectiveness of ozonolysis on subsequent sugar generation through enzymatic hydrolysis of miscanthus continued.

A study of the use of ultrasonication to pretreat switchgrass to produce cellulosic ethanol was initiated. An environmentally friendly sustainable approach that uses immobilized lipase-producing fungal cells for conversion of oil to biodiesel is still being studied as an alternative to conventional biodiesel production processes that require hazardous chemical mixtures of acids/bases and organic solvents. Sugarbeets are being studied for their potential as substrates for production of biodegradable plastics via fermentation. The techniques being investigated for both fuels and chemicals aim at reducing process costs and toxic waste generation and allow utilization of low-cost feedstocks like grasses that require minimal input for growth.

Research has shown it is possible to produce oilseeds on highway rights-of-way at costs similar to current mowing operations. Additionally, based on the observed crop yields, it is estimated that more than 1.5 million gallons of biodiesel could be produced from state-owned highway rights-of-way.

RTK-GPS with automatic steering has been employed to guide digger-shaker-inverters while plowing peanuts from the ground at harvest time, thus improving digger performance and reducing harvest losses.

Swine waste management practices and technology developed through N.C. State research are helping reduce the loss of nutrients from land application fields to nearby streams, reducing the risk of eutrophication and the impact of nutrient enrichment of rivers, lakes and estuaries. The best of the technologies that were developed and tested are now being implemented on the first new swine farms to be constructed in the state in over 10 years. This expansion will bring new employment and economic opportunity to rural regions of the state.

Food Production Systems: Development, Processing, Quality and Safety

Food production systems link farmers and other agricultural producers with consumers. Following are representative efforts in this area.

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N.C. State University in cooperation with other state agencies has developed various support tools to assist existing and aspiring farmstead cheese producers to speed the learning curve and access expertise in areas of quality, regulations, sanitation, processing, packaging and business start-up. Short courses have been developed to assist would-be producers considering farmstead operations in avoiding pitfalls, practical fact gathering and determining financial requirements.

A new wheat variety and two new oat varieties have been developed. The new wheat variety, NC-Yadkin, will provide growers with an alternative in the full-season maturity market. It exhibits excellent grain yield, good test weight, powdery mildew, leaf rust and Hessian fly resistance. The new oat varieties,

NC02-8331 and NC03-2421, have excellent overall performance and grain quality. NC03-2421 performs excellently from North Carolina to Georgia. These new small grain cultivars will keep North Carolina growers competitive and increase profits. Disease and insect pressure is quite intense, and these lines will provide protection from some of the worst pests.

The sensory service center provides specialized sensory services to companies while teaching student cutting-edge industrially relevant skills. Specialized sensory tests are conducted for university projects and companies (>20 annually) on a variety of food products and project objectives. Students (>10 annually) are trained to conduct industrially relevant tests and have the opportunity to interface with future employers. The value of these tools and findings to the food industry has been estimated at more than $5 million per year.

Based on the highly successful AgriSafe and Certified Safe Farm Programs developed in Iowa, the AgriSafe Network of North Carolina and Certified Safe Farm of North Carolina programs were initiated. These programs combine health and safety components that are proven to result in lower health claims costs and safer, healthier farmers.

Human Nutrition and Health

The importance of promoting nutrition and wellness throughout life has been clearly established. Dietary factors are associated with five of the 10 leading causes of death in North Carolina and the United States. Programs that provide consumers with research-based information and strategies for behavioral change on healthy eating and physical activity are imperative. Participants must be informed and empowered to make positive lifestyle changes to optimize health. No time is more important than childhood to promote healthy eating and health practices. Children in North Carolina do not consume enough fruits or vegetables and have diets that are low in fiber and higher in fat than recommended. North Carolina 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 in North Carolina continues to rise. Treatment of overweight and obesity is difficult. Preventing overweight and obesity in children is essential to address this issue. Demographic changes in North Carolina's population continue to impact nutrition and health issues. The fastest growing age group in the state is the 65 years-and-over segment. The elderly run disproportionate risks of malnutrition and poverty as well as poor overall health status. In fact, over 85% of older adults suffer from chronic diseases and could benefit from dietary intervention. The general nutrition needs of the well elderly must be addressed; however, the needs of the elderly for prevention of malnutrition and chronic disease actually begin much earlier in life.

The nutrition and health program promoted optimum nutrition and health through diet and lifestyle in all North Carolinians regardless of gender, income, age or race/ethnicity. Education programs addressed diet, health and chronic disease prevention and were offered to North Carolinians of diverse income levels, age groups, genders, and cultural backgrounds across the state. Programs offered included Give Your Heart a Healthy Beat; Project Eat Right: Add to Life Program; Color Me Healthy; Eat Smart, Move More, Weigh Less; Dining with Diabetes; SyberShop; Women Living Healthy - Women Living Well; Workable Wellness and Families Eating Smart and Moving More; Cook Smart. Eat Smart; and Steps to Health. Programs were held in many different settings, including congregate nutrition sites, senior centers, schools, churches, government buildings, businesses, daycare centers, work sites and outdoors. Various methods were employed, including the Internet, computers, mailed materials, media, one-on-one contact and public meetings. Research projects continue to seek scientific discoveries that will enhance the quality of living for the state's and nation's human population. Audiences reached included children, adults and the elderly, day care workers, hospital employees, housing authorities, Head Start, Red Cross, food banks,

daycare home providers, food stamp and WIC recipients and community coalitions.

More than 125,000 North Carolinians 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 recommendations per mypyramid.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.

Child care providers who attended training increased their knowledge of nutrition and physical activity in children. These providers serve preschool children across the state. By changing practices at the child care center level, we create an environment that is supportive of healthy eating and physical activity behaviors. Child care providers participating in training increased the level of nutrition education taught in the preschool classroom as well as the amount of physical activity for the children. One way this was achieved was by using the Color Me Healthy curriculum, a program on healthy eating and physical activity designed for the preschool classroom. This curriculum has been shown to be an effective tool at increasing nutrition knowledge, fruit and vegetable recognition and willingness to try new foods.

EFNEP (Expanded Food and Nutrition Education Program) enrolled 5,086 families, while 15,889 participants took part in 4-H EFNEP. The following data were compiled from pre and post evaluation surveys administered to participants by EFNEP program assistants across the state. Completing the series of lessons improved nutrition, food behavior and food safety practices. As a result of EFNEP participation 76% improved in one or more food safety practices, 90% improved in one or more food resource management practices, 41% of participants increased their amount of physical activity, 57% increased fruit consumption, 53% increased vegetable consumption and 55% increased consumption of calcium rich foods.

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

Families and Communities

Families and communities continue to face challenges. Economic concerns, military deployments, substance abuse, family violence and job losses all place enormous stress on the family unit and in turn on community resources. As a basic unit of society, it is essential that families have access to information and education that assist them in addressing the real-life challenges that they face every day.

In response to the needs of families and communities, N.C. State- and N.C. A&T State-based faculty and county based field faculty working with NC Cooperative Extension are teaching the skills and helping to provide the tools that families need to endure the current economic and social climate. Educational outreach efforts addressing family resource management, budgeting and record keeping, debt reduction, retirement planning, foreclosure prevention and credit management address the economic challenges facing families. Program efforts yielded the following results.

- 2,080 individuals and families developed a household budget.

- 1,278 developed a household record-keeping system.

• A significant number of individuals and families developed other financial management skills, including 3,153 who use cost comparison skills.

• 520 individuals acquired the skills and discipline to pay their bills on time.

• Four Individual Development Account (IDA) participants purchased homes.

• 11,575 individuals budgeted their basic monthly expenses.

• 13 individuals and families used strategies to prevent home foreclosure.

Outreach programs addressing quality time, parenting practices, child development, importance of fathers and discipline have been designed to help parents develop effective and positive parenting skills. Program efforts yielded the following results.

• 1,150 parents adopted appropriate guidance/supervision practices.

• 335 fathers increased involvement with their children at home, in school and in the community.

• 1,296 parents adopted appropriate disciplinary practices.

• 1,747 parents used positive parenting practices

• 182 incarcerated parents implemented strategies for staying involved in their children's lives.

• 657 court-mandated and agency referred parents consistently used positive parenting strategies.

• In conducting parenting programs, there were 14,083 known client contacts by volunteers, with a dollar value of $153,981.

Youth Development

Faculty and staff at N.C. State University are engaged in a wide array of Extension and research-related projects that promote 4-H positive youth development. These efforts are broad in scope, impact and clientele served. Major initiatives include health and well-being, K-12 (School to Work success), volunteerism and leadership development (Citizen Leaders). 4-H youth development programs provide youth a pathway to view learning as relevant to the world around them, to connect with their communities and to become concerned and contributing members of the global economy. In 2010, the planned program of 4-H Youth Development was active in Extension and research activities.

We live in a new economy powered by technology, fueled by information and driven by knowledge. In 2010, more than 54,000 youth increased their knowledge of career pathways, while 18,483 youth participated in service learning, internship and mentorship programs, where they learned first-hand the critical elements involved in particular career pathways.

The health and well being of North Carolina youth has changed significantly in the past decade. As a result of 4-H Youth Development programs, 9,862 youth increased their daily consumption of fruit and vegetables by at least one serving in 2010, while 10,325 youth increasing their daily physical activity. In addition, 5,026 youth reduced their amount of screen time.

In 2010, 54,550 youth used appropriate communication techniques, and 47,323 used appropriate

goal setting strategies. As a result of 4-H Youth Development programs, 26,445 youth adopted positive study skills, and 25,547 youth completed of their homework.

Sustainable Energy

Rising energy prices, heavy dependence on foreign oil and growing concern for the environment have resulted in increasingly aggressive nationwide research into alternative and sustainable energy sources. North Carolina is uniquely positioned to be a major player in biofuel production because of its abundant biomass resources and workforce capacity. The Environmental Review Commission of the North Carolina General Assembly has produced a strategic plan that calls for 10 percent of liquid fuels sold in the state to come from biofuels grown and produced in North Carolina by 2017. Increased production of biofuels from the state's agricultural crops and byproducts could result in significant economic gain for North Carolina.

Using everything from switchgrass and sweet potatoes to agricultural byproducts such as animal waste, research and extension programs are focused on developing ways to convert biomass into sustainable energy. Following are short descriptions of representative efforts.

Various studies of efficient and environmentally friendly bioconversion processes that use regional feedstocks such as agricultural residues, switchgrass, miscanthus, cottonseed, soybean, sweet potatoes and sugarbeets are underway. A study of the effectiveness of ozonolysis on subsequent sugar generation through enzymatic hydrolysis of miscanthus continued.

A study of the use of ultrasonication to pretreat switchgrass to produce cellulosic ethanol was initiated. An environmentally friendly sustainable approach that uses immobilized lipase-producing fungal cells for conversion of oil to biodiesel is still being studied as an alternative to conventional biodiesel production processes that require hazardous chemical mixtures of acids/bases and organic solvents. Sugarbeets are being studied for their potential as substrates for production of biodegradable plastics via fermentation. The techniques being investigated for both fuels and chemicals aim to reduce process costs and toxic waste generation and allow utilization of low-cost feedstocks like grasses that require minimal input for growth.

The North Carolina Department of Transportation needs biodiesel fuel to operate its fleet of vehicles. The department also has significant right-of-way holdings that could support the production of oilseeds, the primary feedstock of interest for biodiesel production. Beginning in the fall of 2009, canola was planted along North Carolina highway rights-of-way in four counties across the state. These canola crops were established to determine yield potential and management strategies that are required to produce oilseeds in soils that are highly compacted and have little top soil. Canola was harvested in May 2010 and followed by sunflower and safflower plots. Canola was again planted in October 2010. The canola harvested in May 2010 was crushed and the oil converted to 150 gallons of biodiesel that was use in an NC DOT fleet truck. A GIS model has been developed that helps identify and select highway right-of-way areas in the state that could be used to support oilseed production. Thus far this study has shown it is possible to produce oilseeds in rights-of-way at costs similar to current mowing operations. Additionally, based on the observed crop yields, it is estimated that over 1.5 million gallons of biodiesel could be produced from state-owned highway rights-of-way.

A 2-year study began in November 2010 to quantify the cost benefits of using a transpired solar wall in combination with positive pressure ventilation to heat pig nursery and turkey brooder barns. Energy use, environmental parameters and animal performance data are being collected in test barns for comparison with adjacent, identical control barns without the transpired solar wall. An analysis of the data will help quantify the cost-benefits of using a transpired solar wall with a positive pressure ventilation system in pig

nurseries and turkey brooder barns in North Carolina. This study will not only quantify the benefits in terms of energy savings but also air quality and pig performance. With this information, North Carolina pig and turkey producers could apply to the USDA Rural Energy for America Grants (REAP) program for partial grants and loans to install these heating systems, which appear to have the potential to reduce the use of propane fuel for heating, enhance profitability and cushion producers against the uncertainty posed by the highly volatile energy market.

Conventional bioethanol production involves the use of acids and bases for pretreatment and hydrolysis of lignocellulosic biomass. Although effective, these processes result in large amounts of toxic waste water, which require significant downstream treatment, which, in turn, increases the overall cost of bioethanol production. Research is focusing on the use of solid catalysts for pretreatment and hydrolysis. Using solid acid catalysts will not only minimize water use but also reduce the downstream processing costs associated with bioethanol production.

Agricultural crop residues (corn stover, sorghum bagasse) and dedicated biomass crops (perennial grasses, trees) contain complex carbohydrates including cellulose and hemicellulose that can be converted to high value products (e.g., food products, pharmaceuticals, biochemicals, biopolymers and biofuels). The development of biologically-based methods for converting raw materials into higher value products that are cost effective will increase the feasibility of using plant/crop based resources as additional feedstocks for consumer goods. Biological processes and products that improve system efficiency and economic impact are being designed and developed to investigate the biotechnological potential of North Carolina commodities (e.g., sorghums, industrial sweet potatoes, grasses, cotton, wood, duckweed). Efforts are also being made to integrate the use of energy-related biomass into farming operations to enhance sustainability and reduce costs. Harvest and handling methods, gasification, enzymatic conversion of biomass materials to functional sugars, and anaerobic fermentation technology are being explored for potential impact in this area. Cost-effective and quality production of products such as enzymes, biochemicals and biofuels from agro-industrial residues and dedicated biomass crops will enhance the value of and provide alternative uses for underutilized renewable resources in North Carolina, while supporting sustainable agriculture. For example, industrial scale production, harvest and fermentation of sweet sorghum for ethanol has been successfully demonstrated with greater than 80% conversion of available sugars to ethanol. And enzymatic conversion and fermentation parameters to effectively convert white-flesh and purple-flesh industrial sweet potatoes to fermentable sugars and ethanol have been defined on a laboratory scale. Initial estimates indicate that 700 gallons of ethanol/acre of sweet potatoes can be achieved.

Achievement of North Carolina's goal to grow and produce 10% of the state's liquid fuels by 2017 will likely require the use of both traditional and new cropping systems throughout the state. Limited research has been conducted in the U.S., particularly in the southeastern states, regarding the sustainability of many of the proposed new-use bioenergy crops, such as switchgrass and giant miscanthus. Specifically, very limited data have been reported on the effects of these biofuel cropping systems on soil biochemical and physical properties. Since these crops will likely be targeted on marginal lands of limited use for traditional row cropping systems, or as an alternative to row crops in some locations, understanding the impacts of these alternative systems on our soil resources is of utmost importance. Expansion of research activities to investigate the effects of the new bioenergy crops on our soils in this region is critical to ensure adoption of appropriate, sustainable, and non-invasive biofuel systems. Initial research is underway to evaluate the performance of many of these crops in North Carolina, develop production practices and recommendations, breed and develop improved varieties, and improve efficiency of bioprocessing and cellulosic ethanol conversion. Researchers and extension personnel have conducted preliminary studies investigating the agronomic characteristics and nutrient demand for potential bioenergy crop species. Studies were initiated in 2008, 2009 and 2010 to compare soil nutrient status, nutrient uptake and cycling, and yield of multiple bioenergy crop species. We have shown that particular species, including giant miscanthus and switchgrass, are viable options for biomass crops in multiple locations throughout North

Carolina. We have also collected data that will ultimately lead to development of nutrient recommendations for these crops. These data and subsequent recommendations will be critical for establishment of renewable energy sources throughout the state.

The E-Conservation Energy Education Program teaches citizens tosave 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. Cooperative Extension agents across the state provide direct services to 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. The E-Conservation program provides professional home energy audits for consumers. Between June 2009 and December 2010, 202 energy audits were completed. Follow up reports from 43 homeowners receiving audits who also had complete six month follow up interview data revealed that 62% (24) reported an increase in home comfort due to changes made following the home audit; 80% (32) indicated a decrease in energy use due to changes made following the home audit, and 58% (23) indicated a decrease in energy cost due to changes made following the home audit. Of those who completed the six-month follow-up interview, 96% (41) made at least one low/no cost change to save energy. Among these homeowners, 7% (3) made one low/no cost change, 26% (11) made two to four low/no cost changes, and 63% (27) made five or more no/low cost changes. The average amount spent on low cost changes was $12. Of those homeowners with completed six month follow-up interviews, 11 made one high-cost change and 15 made two to four high-cost changes. One homeowner made five high-cost changes. The average amount spent on high-cost improvements was $475. In 2010, a total of 938 participants received the consumer energy kit following an energy education workshop. The kit includes two compact fluorescent light bulbs, one low-flow showerhead and two educational printed publications. Of those who returned their follow-up survey, 94% had installed their fluorescent light bulbs and 59% had installed their low-flow showerhead. As a result of installing the CFL, participants saved approximately 86,930 kWh in energy use, $8,006 in energy costs, and 112,140 pounds of carbon dioxide. As a result of installing the low-flow showerhead, total projected annual savings for the 59% of 938 homeowners who installed the low-flow showerhead are 3,027,675 gallons of water saved each year, $118,079 energy dollars saved, 1,306,745 kWh, and 1,684,598 pounds of carbon dioxide.

An integrated research project was conducted to convert swine waste into bioenergy at a swine operation. Swine manure is first converted through anaerobic digestion to biogas, which is used for electricity and heat production. The produced heat can be used in the swine houses and in vegetable-producing greenhouses. Carbon dioxide from the combustion of the biogas can also be utilized to enhance the productivity of the vegetables in the greenhouses. Effluent from the anaerobic digester is used to grow high-starch duckweed, which can be an efficient alternative to corn for fuel ethanol production. This integrated approach makes the conversion of swine waste to bioenergy much more efficient.

Climate change

While the long-term impact of climate change is still largely unknown, research has shown that atmospheric concentrations of greenhouse gases such as CO_2, CH_4, $O_3$and N_2O are increasing. Research is needed to determine what type of plant responses can be expected from these changes. Climate change may alter weather patterns, temperatures and rainfall, which, in turn, may have an impact on

weeds, pests and disease. The prevalence of weeds, pests and disease as well as changes in rainfall and temperature obviously will have an impact on agriculture.

Following are representative examples of research and extension programs that involve climate change.

Research on the combined effects of elevated $CO_2$and O_3on soybean, cotton, rice, wheat, clover and peanut shows that the promotion of growth and yield by CO_2-enrichment can be attributed in part to the alleviation of damage from tropospheric O_3. Yields from crops grown in clean air were much less stimulated by elevated CO_2compared with plants grown in ambient air or in air with added O_3. Our studies have shown that plant responses to $CO_2$and $O_3$are concentration-dependent and tend to counteract each other. Clearly, the effects of elevated CO_2on plant growth and yield are modified by O_3, but the interaction has yet to be fully evaluated. This has important implications for our understanding of plant productivity responses to elevated $CO_2$and our ability to predict changes in the future.

In addition to determining the effects of elevated $CO_2$and O_3on crop production, we are studying the effects of these gases on plant-soil interactions. We are conducting research on the effects of $O_3$and elevated CO_2on plant-mediated changed in soil quality, carbon and nitrogen dynamics. Elevated atmospheric CO_2increases biomass inputs to soils and may contribute to increased carbon sequestration, while O_3has the opposite effect. A long-term (5-plus-year) experiment is being conducted to determine if soil carbon sequestration and soil N dynamics are affected by elevated $CO_2$and O_3 in a soybean-wheat no-till cropping system. Results to date show that elevated CO_2increases soil respiration and decomposition rates, which results in no significant increase in soil C content. Increased soil N inputs from N_2-fixing soybean plants are likely stimulating microbial decomposition processes. Elevated O_3has no detectable effect on these relationships. We conclude that soil C sequestration may be little enhanced by elevated CO_2in agroecosystems utilizing N_2-fixing crops, although yields from these crops should be stimulated by about 15%.

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 has been screened for ozone tolerance based on foliar injury, and ancestral genotypes have been identified as a potential source of resistance genes to ozone and other abiotic stress factors. Tolerant ancestors identified on the basis of foliar injury are currently being tested for yield under elevated ozone conditions.

Soils regulate environmental moisture and temperature dynamics at scales ranging from the habitat of microbial organisms to continental weather patterns. Soil properties influencing moisture and temperature dynamics and the mechanisms by which combined moisture and energy transfer occur in soil are poorly understood and difficult to predict. We are characterizing water and temperature dynamics in the soil at scales ranging from sub-centimeter to regional. Monitoring and predictive techniques are currently being refined through laboratory, field and modeling experiments to allow improved agricultural and environmental management. This research may provide opportunities for improved water management in cropland, rangeland and forested and urban systems; improved prediction of weather and climate dynamics, and improved management surface fluxes of greenhouse gases from soil.

We are assessing the impact of climate change, land use and population change on water quantity, water quality (measured as turbidity), and potential flooding. We have developed two ecosystem models to assess stress impacts on water quantity and quality. 1. We are examining potential changes in stream water turbidity using multiple linear regression relationships between measured stream water turbidity, 24-hour precipitation events, land cover (amount of agricultural land), and the impacts of 10-, 25-, 50-, and

100-year 24-hour rainfall events, with specific concern for aquatic wildlife and habitat stability. These relationships can then be used as a conceptual framework to empirically examine how increases in precipitation intensity, as driven by climate change, may impact water quality at more frequent intervals. 2. We are combining climate change scenarios, population projections, anthropogenic water demand and use data, and land use/land cover data to examine potential changes in water quantity across the study area. This research indicates that changes in land use associated with population growth are more likely to have negative implications for aquatic biodiversity than the impacts of climate change on 24-hour stream turbidity across the study region. Across the study basins, 63% of streams may experience moderate habitat degradation and 36% may experience major physiological stress every 10 years. Climate change may temporarily increase stream turbidity, but the steep topography (where intensive agriculture is uncommon) and heavy forest cover within the study basins greatly assist in minimizing long-term stream turbidity and negative biodiversity impacts. Water stress for both humans and aquatic species may increase depending upon the rates of climate and population change. The Mississippi River basin (primarily its western regions) will see the least amount of water stress, while the Tennessee River basin is projected to experience the greatest and most frequent occurrences of water stress.

An agricultural air quality research team is investigating various aspects of air emissions associated with animal feeding operations (AFOs), specifically poultry operations. Specific activities include measurement and monitoring of emissions of air pollutants from commercial scale AFO facilities; modeling generation and volatilization of ammonia from broiler litter; farm-scale evaluation of ozonation technology for mitigating ammonia and pathogens in broiler houses; and characterizing the spatial and temporal variations in the physical, chemical and biological properties of aerosols emitted from AFO facilities. As a result of this work, we have characterized the spatial and temporal variations in $PM_{2.5}$/PM_{10}mass concentration, chemical composition and biological nature between source and downwind areas. We have also identified key factors influencing air emissions and quality in animal production facilities and surrounding environments. This work has also provided baseline emissions of particulate matter, ammonia, hydrogen sulfide, carbon dioxide, and volatile organic compounds (VOCs) from high-rise egg production systems. This information is being used by the Environmental Protection Agency to produce a non-biased assessment of AFO air emissions standards. In addition, we have developed a mechanistic emission model to estimate ammonia emission fluxes from broiler litter under different growing conditions. This effort led to development of innovative mitigation and management strategies for improvement of air quality, animal performance and animal well-being to enhance the sustainability of animal agriculture.

Increased vegetative growth of plants and premature depletion of soil resources under elevated CO_2may limit anticipated yield enhancements due to globally increasing CO_2concentrations. We are investigating the interactions between temperature, elevated $CO_2$and pollutant O_3on growth and yield in soybean. The possibility of increased growth and leaf temperatures associated with increasing global atmospheric CO_2concentrations make it imperative that we increase our understanding of the interactive effects of these variables on future crop productivity. We are also investigating the mechanism by which elevated CO_2prevents O_3damage in soybean. Elevated CO_2reduces leaf conductance and keeps O_3flux into the leaf below the damage threshold. In addition, we are characterizing stomatal responses to light, temperature and humidity in O_3sensitive and non-sensitive snapbean lines in an effort to determine if differences in stomatal responses might account for some of the differences in sensitivity to O_3.

Food Safety

Multiple research and educational outreach programs are being conducted that fit under the broad umbrella of improving the quality, safety, security and nutrition of food products produced in North

Carolina. An important aspect of this plan of work is the transfer of technology and knowledge to our stakeholders and clientele. Direct outreach efforts include engaging stakeholders in workshops, conferences, discussion groups, one-on-one teaching, demonstrations, field trials, short courses, continuing education classes and scientific meetings. Indirect methods include Internet sites and courses, newsletters, press releases, television and radio interviews and programming, trade journals, scientific journals and popular press articles. Following are short descriptions of representative activities.

Despite food safety communication efforts by many sectors, foodborne illness remains a significant health issue in the U.S. It is estimated that up to 70% of illnesses come from food handlers making behavioral mistakes. In 2010, 16 food safety infosheets containing stories of outbreaks and focusing on the factors most likely to lead to a foodborne illness were distributed to an estimated 10,000 subscribers and readers through various online methods, including a relaunched www.foodsafetyinfosheets.comwebsite. Additionally, three direct subscribers were known to send infosheets to all of their organization's outlets--a total of 1,350 sites and 300 support associates (an estimated 15,000 food handlers received these publications). Food safety infosheets have been shown to be effective in positively affecting the food-handling practices of the target audience.

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, it is apparent that science-based methods are often not followed. The most troublesome issue is that over half of individuals report 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, new curriculum updates were delivered to 42 agents in 2010. Agents have conducted home food preservation workshops using the updated materials across the state, resulting in an estimated 1,500 North Carolinians being trained. In addition, 135 preservation-related inquiries were answered in 2010.

Food acids can be used to kill bacteria that may be present on ready-to-eat (uncooked) foods, including the E. coli and Salmonella strains that have been involved in recent foodborne disease outbreaks. For acidic foods that are not heat processed, including some pickled vegetables and related products, manufacturers must file a process with FDA that shows sufficient acid is present to kill disease causing bacteria. Depending on conditions, up to six-day holding times are required to allow acid killing. Recently, we found that the lack of oxygen in sealed jars used for pickled vegetables and juice products aids the survival of bacteria in acid solutions. This finding prompted further study of acids under oxygen-free conditions. In conducting research to address this issue, we have shown that there is a large difference (over 100 fold) in the rates at which different food acids kill E. coli in sealed jars with no oxygen present. Some food acids, including commonly used food preservatives, were found to be much more efficient at killing E. coli than acetic acid, which is used in most pickled vegetables and other acidic foods. Further work will be needed to understand how these different acids work to kill bacteria. However, application of these results may allow manufactures to significantly reduce the required holding times for acid killing of bacteria during the production of acidified foods.

Peanut meal is the feed grade material remaining after the commercial extraction of oil from peanut seed. While an excellent source of protein (~50%), peanut meal is typically highly contaminated with aflatoxin, which limits current feed applications and prevents any future food applications. We have developed and demonstrated on the lab and "bucket" scale a novel process to sequester aflatoxin from peanut meal during protein extraction such that aflatoxin-free protein/peptide concentrates can be spray dried from this material. Such concentrates are highly nutritional and functional and could be used as a food ingredient in the future. A co-product of this process is a feed grade material containing the sequestered aflatoxin, which should have enhanced feed properties (toxins are biologically unavailable) as compared to the starting peanut meal. This process could allow peanut meal and other similar mycotoxin contaminated biomaterials to be processed into value-added components. A patent based on this

technology was filed in July 2010 to expedite commercialization of this process.

Training for workers in the food-service industry is an indispensible part of ensuring the safety of our food. An N.C. State University faculty member provided the food safety portion of a training session for 23 North Carolina health inspectors while also participating in training sessions certifying approximately 105 individuals in ServSafe, a managerial food handling certification required for supervisors in restaurants. In addition, a faculty member co-instructed or coordinated four three-day workshops on the development and implementation of HACCP food safety systems for meat and poultry processors, certifying approximately 80 individuals.

Human noroviruses are the leading cause of foodborne disease. For a number of reasons, detection of these viruses in foods is difficult; no methods are commercially available and few labs have the capability to screen for norovirus contamination of foods. There is a need to develop better virus detection methods to facilitate our understanding and control of these important food borne disease agents. The major stumbling block to the development of better virus diagnostics for food and environmental samples is the need to concentrate and purify viruses from sample matrices prior to the application of molecular-based detection methods. We have developed broadly reactive and highly sensitive, yet simple and inexpensive, concentration and purification methods. Using simple upstream sample manipulations (e.g., elution and enzymatic digestion) in combination with magnetic bead-bound human histoblood group antigens and their antibodies, we have designed a protocol for the capture and concentration of human noroviruses from select foods (oysters, deli meats and fresh produce) at increased risk of contamination. When used in recirculating magnetic capture devices, this newer method provides consistent detection of viruses at the low levels (1-100 infectious viruses) anticipated in naturally contaminated foods. These detection limits surpass virtually any currently used method. This research has the potential to significantly change our approach to concentrating and purifying viruses from complex samples like food, water and surface swabs. With additional refinement and validation, the methods developed in this work may be used routinely by state and federal food safety and public health laboratories and form the basis for commercial virus detection kits. The availability of a routine method to screen foods and environmental samples for viral contamination could be used for epidemiological investigation of food borne disease outbreaks; tracking virus transmission during food production, processing and handling; and evaluating the efficacy of candidate mitigation strategies for foods at risk of contamination. Taken together, this will increase our understanding of the transmission of food borne viruses, facilitating the design of effective control strategies. The result will be improvements to public health by reduction in the burden of disease associated with human noroviruses.

Acidified Good Manufacturing Practice (GMP) and Better Process Control School (BPCS) workshops are required for 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 canned foods to meet the requirements of the umbrella GMP, the specific GMP for acidified foods and the specific GMP for Low Acid Canned Foods. By definition, an operating supervisor is a person who is in the plant at the time product is processed and packaged. The operating supervisor is responsible for the use of adequate pH and time and temperature processes as well as closure integrity inspections for rendering the product safe and for proper record keeping and control programs, which will detect deviations from safe operating procedures. An N.C. State University faculty member co-instructed or coordinated nine of these workshops, including one international course. As a result, 202 individuals were certified as operating supervisors, with 42 of these being international supervisors.

N.C. MarketReady, multidisciplinary effort of N.C. Cooperative Extension that provides educational resources to help North Carolina agriculture be more profitable, has compiled valuable resources and materials on A Fresh Produce Safety web portal (http://www.ncsu.edu/enterprises/ncfreshproducesafety). This website contains information on produce traceability, postharvest quality, cost share opportunities and

Good Agricultural Practices (GAPs). N.C. MarketReady programs are designed to enhance and integrate farmers' skills and knowledge in five key focus areas: agricultural enterprise and business skills development; fresh produce safety; horticultural production skills education; and strengthening markets.

Global Food Security and Hunger

The N.C. State University Micropropagation and Repository Unit is the primary source of planting material for North Carolina sweet potato growers. This unit supports growers by providing virus-free, true-to-type seed stock. Among the sweet potato cultivars the Micropropagation and Repository Unit works with is Covington, which was developed through the N.C. State sweet potato breeding program and is now grown on more than 75% of the North Carolina acreage planted to sweet potatoes. This micropropagation unit is also a source for ornamental sweet potatoes, strawberries and other berry crops. The unit was recently awarded a grant from the National Clean Plant Network to serve as a major repository of berry varieties for the eastern U.S.

The Southern Region IPM Center at N.C. State University established a cucurbit downy mildew IPM PIPE (Pest Information Platform for Extension and Education) to provide information on this disease. Information on pathogen biology and the spatio-temporal progress of the disease has been incorporated with atmospheric transport models to forecast disease outbreak risk and the need for fungicide application. This system provides near real-time flexibility in decision-making for the in-season management of the disease. Based on a survey conducted in Georgia, North Carolina and Michigan, growers who use the system see a reduction of 2 to 3 fungicide applications during the growing season compared to a calendar-based fungicide spray schedule. With approximately 122,000 acres of cucurbits in these three states, this translates to more than $6 million in savings to producers. The CDM IPM PIPE working group has established common fungicide control recommendations for cucurbit production in all production areas in the eastern U.S. This has eliminated some of the state-to-state or region-to-region variations in control recommendations that can be confusing to producers and managers who grow cucurbits in multiple states.

An NCARS researcher identified several genes in the soybean cyst nematode responsible for parasitism. In addition, this research showed how these genes can be used to protect soybean plants from the nematode using RNAi technology. Agreements to commercialize the technology have been reached with Pioneer HiBred International that may result in incorporation of this resistance into future soybean cultivars. Research is currently underway to extend this concept to protect other crops from other nematodes. The soybean cyst nematode is the most damaging pathogen of soybeans grown in the U.S., with yield losses from the nematode approaching a billion dollars per year, including significant soybean losses in North Carolina.

Soils regulate environmental moisture and temperature dynamics at scales ranging from the habitat of microbial organisms to continental weather patterns. Soil properties influencing moisture and temperature dynamics and the mechanisms by which combined moisture and energy transfer occur in soil are poorly understood and difficult to predict. NCARS scientists are characterizing water and temperature dynamics in the soil at scales ranging from sub-centimeter to regional. Monitoring and predictive techniques are currently being refined through laboratory, field and modeling experiments to allow improved agricultural and environmental management. The knowledge developed through this research may provide opportunities for improved water management in cropland, rangeland and forested and urban systems; improved prediction of weather and climate dynamics, and improved management surface fluxes of greenhouse gases from soil.

NCARS scientists generated genetically modified model plants (Arabidopsis) that are more tolerant

to heat and high light stress. This research was funded by NASA and is part of efforts to develop a bioregenerative life support system essential for long-term space missions. However, these transgenic plants provide a model for developing food crops for growth both in space and under stressful conditions on earth.

Research has shown that agricultural drainage systems can be controlled or managed to reduce N losses to surface waters by 25 to 50 percent, depending on soils and conditions. This controlled drainage practice also conserves water and increases yields. Controlled drainage has been accepted by the State of North Carolina as one of three Best Management Practices for reducing N and phosphorus (P) loads to surface waters. State and federal cost share programs were established to promote the use of the practice for reduction of nutrient losses in drainage waters. Recent field research has shown that controlled drainage, when managed according to established guidelines, increased corn and soybean yields by an average of 8 to 10 percent on two lower coastal plains sites. The models developed in this research are being used to analyze and develop guidelines for the application of controlled drainage and related water management systems in other states and countries and to develop more effective methods of land treatment of wastewaters on drained soils. The development and application of drainage water management practices that reduce off-site environmental impacts is vital to achieve sustainable crop production on drained lands.

Research has demonstrated how maturation of organ systems that impact poultry performance can be altered by manipulation of incubation parameters. Intermittent heating of incubating chicken eggs from days 7 to 16 produced birds that had lower metabolic rates, improved heat loss and decreased stress at market age. Intermittent heating from days 16 to 18 produced birds that had 1% more breast muscle and less abdominal fat at market age. In both approaches, changes in incubation conditions did not adversely affect hatchability and quality of the hatched chicks. Together, these developments could represent a $45 million annual benefit to the poultry industry.The information developed from these trials is used to develop educational materials used in the NCSU Hatchery Management Workshop as well as other educational efforts in the state and nation. The direction of research now is beginning to focus on initial incubation temperatures as well as how the eggs attain incubation temperature.

An interdisciplinary team conducted a series of feed utilization studies to help beef cattle producers reduce input costs. Young bulls and heifers have been tested with regard to feed utilization. Highly efficient animals have been use as seedstock in research herds to create new generations of animals that will improve feed utilization.

Data from a series of trials conducted in commercial pork production facilities to document the impact of piglet size at birth on subsequent survival, growth and feed efficiency were used to model a software tool to be used in management decisions. North Carolina pork producers, who produce over 13 million pigs annually, have adopted this decision tool in their production system and are currently evaluating a change in their production goals and contracts to focus on size and quality of piglet as opposed to large litter size.

Childhood Obesity

Educational programs addressing diet, health, and chronic disease prevention are offered to children of diverse income levels, age groups, genders and/or cultural backgrounds across the state. Programs offered include Give Your Heart A Healthy Beat; Project Eat Right: Add to Life Program; Color Me Healthy; Moving Towards a Healthier You; Dining with Diabetes; SyberShop; Women Living Healthy and Women

Living Well; and Families Eating Smart and Moving More. Programs are held in many different settings, including congregate nutrition sites, senior centers, schools, churches, government buildings, businesses, daycare centers, work sites and outdoors. Various methods are employed, including using the Internet, computers, mailed materials, media, one-on-one contact and public meetings.

Following are short descriptions of projects that are representative of the work being done in this area.

An informal working group in North Carolina Cooperative Extension was created to plan a vision for building the capacity of agents to facilitate school gardens throughout the state. Faculty at N.C. State University and N.C. A&T State University collaborated with field faculty from Guilford County, N.C., to deliver three regional training workshops to agents across disciplines (agriculture, 4-H and Family and Consumer Sciences), master gardeners, 4-H volunteer leaders and teachers. These workshops were designed to increase conceptual understanding of school gardens. As a result of the school garden training, participants developed a heightened awareness and skill set around the dynamics of youth gardens, from inception, programming within the garden context and sustainability. The trainings built interest, enthusiasm and understanding about plants, soils and nutrition and prepared participants to support youth and leaders in their community. Working group members collaborated on funding school garden opportunities and were awarded the FoodCorps program, which is a pilot national farm to school and school garden program. FoodCorps provides members who will be placed in communities to work in school garden programs. FoodCorps members will work with local organizations and schools to build and tend school gardens, teach nutrition education from the garden and develop farm-to-cafeteria pathways. FoodCorps provides the human resources to do the work on the ground level and will contribute towards creating statewide models for integrating nutrition and local foods into schools and school gardens.

The 4-H Air Force partnership youth development specialist provided leadership, support and coordination to the FitFactor and FitFamily initiatives. These web-based programs encourage families to increase physical activity and healthy eating choices. In 2010, Air Force Airman and Family Services FitFactor enrolled 15,700 youth, while FitFamily registered 12,100 families. These programs meet the varied interest of youth and introduce valuable life skills, educational and social opportunities that have a positive impact on youth, families and the community.

Low-income households have a higher prevalence of health conditions related to poor nutrition. While obesity rates have doubled in children over the last two decades, they have increased the most among those in the lowest income levels, especially African American and Mexican American children. During the 2009-2010 program year, N.C. State University's SNAP-Ed program Steps to Health provided education to older adults in congregate nutrition sites, third graders in low-income schools and to kindergarten children in one county (pilot program). Cooperative Extension agents use interactive teaching methods including lectures, discussions, video games, worksheets, sing-a-longs, cooking demonstrations and taste testing to increase the impact and knowledge retention of the nutrition lessons taught. Parents and guardians of the kindergarten and third graders were invited to attend the classroom sessions and were sent a weekly nutrition educational handout with recipes related to the classroom sessions. During the 2009- 2010 program year, 449 older adults, 2,121 third graders and 112 kindergarten students participated in the SNAP-Ed program, and 21,604 educational contacts were made. Pre and post-knowledge surveys showed overall improvement in the knowledge and behaviors related to nutrition, physical activity and food budgeting.

Food habits developed at an early age form the foundation for food preferences that continue into adulthood. If dietary habits are poor, the stage is set for the development of chronic, debilitating diseases such as heart disease, diabetes and certain cancers later in life. In North Carolina, five out of 10 of the leading causes of death and disability are related to dietary factors. In North Carolina, 20 Nutrition Program assistants work with the youth component of the Expanded Food and Nutrition Education

Program (4-H EFNEP). A series of classes are delivered over a six weeks period to program participants ages 5 to 19. Nutrition and food safety education using hands on food preparation and moving activities are provided via 4-H clubs, in after school settings, at school as an enrichment to the curriculum, at community and neighborhood centers, through day camps and workshops. During fiscal year 2009-2010,15,899youth graduated from 4-H EFNEP. Data from the Nutrition Education Evaluation Reporting System (NEERS) are used to measure food practices and dietary improvements for youth. Four impact indicators were used at entry and upon 4-H EFNEP graduation. Results based upon these data show that 78% of the youth reported eating a variety of foods; 87% increased their nutrition knowledge; 93% increased their ability to select low-cost, nutritious foods; and 43% reported improved practices in food preparation and safety.

Faith communities are prime locations to gather families for education about nutrition and physical activity. The Faithful Families Eating Smart and Moving More program is designed to assist faith community families attain the knowledge, skills and attitudes needed to reduce food insecurity in the home. It teaches families to use the food obtained from various assistance programs efficiently and to ensure the prudent use of all resources so that nutritionally sound diets can be consumed on a consistent basis. Faithful Families targets families with children up to age 18. A curriculum titledFaithful Families Eating Smart and Moving More was created with faith-based questions to use in faith communities. This curriculum impacts individuals in the faith setting by providing basic knowledge about nutrition and physical activity and tying it to the participant's faith. Faithful Families completed its pilot year in Harnett County, N.C., and began programming in Lee County, N.C. Data from graduates show behavior change among a high percentage of them. In addition, the creation of policies and environment in the areas of nutrition and/or physical activity will impact all that attend services and events.

Many limited-resource families struggle with food resource management, food security, meeting the nutritional needs of their family, and keeping food safe and nutritionally sound. Additionally, limited-resource families are at greater risk of chronic diseases associated with poor nutrition. Through a nine-lesson or more series of classes, EFNEP (Expanded Food and Nutrition Education Program) participants learn how to provide nutritious, safe meals for their families on limited budgets. In addition, EFNEP targets key behaviors to reduce the risk of overweight and obesity, such as increasing physical activity and reducing the amount of sugary beverages in the diet. EFNEP continues to build upon agency partnerships to extend the outreach of the program. EFNEP partnered with the North Carolina Division of Public Health, Physical Activity and Nutrition (PAN) branch to submit a successful proposal for a continuation of a pilot project, called Faithful Families (see above). EFNEP has also partnered with the UNC Center for Health Promotion and Disease Prevention along with several pediatric clinics serving limited resource families to offer EFNEP to families participating in the Kids Eating Smart and Moving More research study. Local partnerships have also been developed. Pitt Memorial Hospital Foundation provided funding to offer EFNEP to five counties in northeast North Carolina. Counties that have not provided matching support in the past have also partnered with EFNEP to bring the program to their citizens. As a result, the Nutrition Program assistants responsible for delivery of EFNEP to adult audiences delivered a series of lessons to 5,086 families. As a result of these efforts, the state EFNEP Nutrition Education Evaluation and Reporting System (NEERS) annual report (a composite of the pre/post behavior surveys and dietary recalls of adult graduated participants) documented that 89% of the participants were enrolled in at least one or more food assistance programs; 98% exhibited a positive change in any food group at exit (bread, fruit, vegetable, milk and meat); 90% of graduating participants showed improvements in one or more food resource management practices (i.e. plans meals, compares prices, does not run out of food or uses grocery lists); 76% of graduating participants showed improvement in one or more of the food safety practices (i.e. thawing and storing foods properly); 69% used food labels more often to make food choices; 55% increased consumption of calcium-rich foods; 53% increased vegetable consumption; 57% increased fruit consumption; 41% of participants increased the amount of physical activity; 55% increased number of meals consumed as a family. There were also substantial improvements in the intake of food to meet the recommendations of MyPyramid. Participants graduating from the program reported the following

improvements in their daily consumption: 57% in the fruit group, 53% in the vegetable group, and 55% in the calcium/dairy group.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	400.0	41.0	425.0	0.0
Actual	400.0	41.0	425.0	0.0

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

Brief explanation.
North Carolina Cooperative Extension System has an active advisory leadership council for the state and for each of the one hundred counties and the Cherokee Indian Reservation. The Advisory Leadership System is a major partner in the continuous and dynamic review of program development including program planning, implementation, and assessment of Extension programs. The Advisory Leadership System has major responsibility in obtaining stakeholder input through out the program development process. Members of the State Advisory Leadership System and county Advisory Leadership Council represent geographical, cultural, ethnic, and economic diversity of the state's population. In addition to Advisory Leadership Councils, each county has specialized committees with responsibilities for review of overall programming, collaborating in needs assessments and environmental scans, and marketing extension programs and impacts.These specialized committees provide specific program input for

individual commodities, issues and ongoing program needs.Membership on both the council and the specialized committees represents the diversity of the respective county population including underserved populations and retired professionals from business, extension and other relevant organizations and agencies. While the advisory council will meet quarterly, the specialized committees will meet at least annually to discuss accomplishments and needs still to be addressed and techniques to market extension.This system is monitored administratively to assure that stakeholders provide such program input and actions. At the state level, a statewide advisory council provides programmatic inputs, review and guidance for the overall program functions for the North Carolina Cooperative Extension Service at North Carolina State University.This group meets quarterly as will as for special meetings to meet organizational review and input needs.This council is made up of influential individuals who represent a broad scope of the diverse population in North Carolina and who have distinguished hemselves as respected and responsible knowledgeable leaders who can provide local perspectives into a statewide organization.In addition to being direction.The process ensures that programs are reviewed and overall needs assessed on a continuous basis, but no less than once every two years.However, with the respective advisory groups functioning on a much more frequent basis,stakeholder input produces continuous program review, allowing for adjustments as local needs change. To ensure appropriate, inclusive, and adequate stakeholder input, the organization implements an environmental scan in each county and for the Eastern Band of the Cherokee Indians every other year. These scans are conducted by a diverse group of extension employees, volunteers, clientele, commodity groups, and county residents.The scans provide a wide base of needs, issues, trends, and emerging issues that are representative of diverse groups throughout the county. Stakeholder input utilized in determining research directions is received through numerous associations. NCARS interacts with 90 official commodity and agricultural industry associations from within North Carolina. A College of Agriculture and Life Sciences administrator is appointed as the official liaison for each of these associations and attends at least one and sometimes more of their meetings or conferences each year. During these meetings, opinions and facts related to the needs and concerns of that industry sector are obtained through both formal presentations and informal conversations with attendees. The NCARS representative is always introduced early in the meeting so that any individual there can contact them and discuss whatever issues they desire. In addition, the college has employed a Director of Commodity Relations, who reports directly to the Dean and coordinates the activities of the liaisons. This individual also has responsibility for working with any association that has a need or concern relative to the college's programs, particularly if it might involve any state or federal legislation having a direct effect on research activities within NCARS. Groups and organizations assist in program reviews as well as advocate for the NCARS agenda by promoting the importance of agricultural and life science research. 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 the department's research programs. There are 21 such advisory groups among the 18 research departments that meet at least once per year, and their membership includes a total of over 200 stakeholders from a wide range of agricultural interests. In addition, there are currently nine formal centers within the college with industry advisory boards that meet at least twice per year, adding another 60 stakeholders providing NCARS administrators and scientists input and direction from research programs. An integral part of the overall State Advisory Council, the Extension Program at NC A&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, collaborating agency and organization representatives and individuals representing non-governmental organizations. The Strategic Planning Council meets three times a year. One joint meeting is held annually with the State Advisory Council. Networking and collaboration between the State Advisory Council and the Strategic Planning Council is facilitated by chairs of both advisory groups and as well as two

members who serve on both councils. Thus, Cooperative Extension has a planned, proactive process for ensuring significant stakeholder input into program. Stakeholder input utilized in determining research directions is received through numerous associations.
NCARS interacts with 90 official commodity and agricultural industry associations from within North Carolina. A College of Agriculture and Life Sciences administrator is appointed as the official liaison for each of these associations and attends at least one meeting or event of the association a year. Of the 90 state agricultural industry associations, 24 provide funding to various research projects annually, usually on a competitive basis. In these cases, the association board give NCARS information on high-priority research areas to be used in the request for proposals, and the board decides which proposals to fund. This is the most targeted type of stakeholder input.
NCARS leadership team interacts deliberately and frequently with leaders in the North Carolina Agricultural Foundation, N.C. Farm Bureau Federation, N. C.State Grange, North Carolina Department of Agriculture and Consumer Services, the N. C. Agribusiness Council and numerous other allied organizations that provide insight on research needs and priorities.

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.

Cooperative Extension used mailed surveys, electronic/web surveys, telephone surveys, one on one interviews, focus groups, and community forums to collect the stakeholder inputs for the needs assessment and program prioritization process. The North Carolina Agricultural Research Service (NCARS) is committed to seeking, receiving and utilizing input from all stakeholder groups, including under-represented groups and the general public. A significant portion of the input from individuals throughout the state comes from interactions of research scientists with county-based Extension personnel and directly with producers, industry and other agribusiness representatives. Approximately 100 research faculty also have Extension appointments. These faculty are the primary day-to-day communication link between agribusiness, county extension centers and NCARS. Because their research and extension activities are directed toward the development-implementation phase of new knowledge and technology, they are constantly relating industry needs and suggestions to other researchers whose emphasis is more in the discovery phase. In addition, these faculty interact with county Extension personnel in such a way that input from individual consumers is also effectively communicated to NCARS administration and faculty. Stakeholder input utilized in determining research directions is also received through

numerous associations. NCARS interacts with 90 official commodity and agricultural industry associations from within North Carolina. A College of Agriculture and Life Sciences administrator is appointed as the official liaison for each of these associations and attends at least one, and sometimes more, of their meetings or conferences each year. During these meetings, opinions and facts related to the needs and concerns of that industry sector are obtained through both formal presentations and informal conversations with attendees. The NCARS representative is always introduced early in the meeting so that any individual there can contact them and discuss whatever issues they desire. In addition, the college has employed a Director of Commodity Relations, who reports directly to the Dean and coordinates the activities of the liaisons. This individual also has responsibility for working with any association that has a need or concern relative to the college's programs, particularly if it might involve any state or federal egislation. Of the 90 state agricultural industry associations, 24 provide funding to various research projects annually, usually on a competitive basis. In these cases, the association board gives NCARS information on high priority research areas to be used in the request for proposals, and the board decides which proposals to fund. This is the most targeted type of stakeholder input, having a direct effect on research activities within NCARS. NCARS leadership team interacts deliberately and frequently with leaders in the North Carolina Agricultural Foundation, N.C. Farm Bureau Federation, N. C.State Grange, North Carolina Department of Agriculture and Consumer Services, the N. C. Agribusiness Council and numerous other allied organizations that provide insight on research needs and priorities.These groups and organizations assist in program reviews, as well as advocate for the NCARS agenda by promoting the importance of agricultural and life science research. 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 the department's research programs. There are 21 such advisory groups among the 18 research departments that meet at least once per year, and their membership includes a total of over 200 stakeholders from a wide range of agricultural interests. In addition, there are currently nine formal centers within the college with industry advisory boards that meet at least twice per year, adding another 60 stakeholders providing NCARS administrators and scientists input and direction from research programs. NCARS receives support annually from college-based foundations, including the Agricultural Foundation, CALS Research Foundation, Tobacco Foundation and the Dairy Foundation. These foundations fund research and extension 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 hear discussion of priority areas for research and extension activity in all aspects of agricultural production and agribusiness. Then in late winter, these committees meet again to select and approve research and extension projects for funding, which provides another opportunity for input on program priorities.

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.

1. Method to identify individuals and groups
Use Advisory Committees
Use Internal Focus Groups
Use External Focus Groups
Open Listening Sessions
Needs Assessments
Use Surveys

As indicated in the POW regarding stakeholder input, a very deliberate initiative is continuously underway by Research and Extension to meet, listen, involve, and interact with any and all stakeholders, whether traditional or non-traditional. Such efforts continue in a highly proactive manner as indicated by the 22,438 citizens of North Carolina being involved in a recent needs assessment process. Also, 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 influence and interactions regarding program direction, issues identification, budgets and their priorities, staffing and developing plans of actions. This is a huge on-going function that is ingrained in the program planning and implementation for both Research and Extension in North Carolina. It is our on-going intent to involve and serve the citizens of this state in the most effective ways possible to enhance the quality of their 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 the stakeholder inputs for the needs assessment and program prioritization process. The North Carolina Agricultural Research Service (NCARS) is committed to seeking, receiving and utilizing input from all stakeholder groups, including under-represented groups and the general public. A significant portion of the input from individuals throughout the state comes from interactions of research scientists with county-based Extension personnel and directly with producers, industry and other agribusiness representatives. Approximately 100 research faculty also have Extension appointments. These faculty are the primary day-to-day communication link between agribusiness, county extension centers and NCARS. Because their research and extension activities are directed toward the development-

implementation phase of new knowledge and technology, they are constantly relating industry needs and suggestions to other researchers whose emphasis is more in the discovery phase. In addition, these faculty interact with county Extension personnel in such a way that input from individual consumers is also effectively communicated to NCARS administration and faculty

3. A statement of how the input will be considered

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

Brief explanation.

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

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 was 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 was used to prioritize and target issues, needs and assets that serve to focus, guide and direct Extension programming. For the Agricultural Research Service, stakeholder input is especially utilized in determining research directions as well as for gaining program support and advocacy for NCARS research initiatives.For example, the commodity association boards give NCARS information on high priority research areas to be used in the request for proposals, and the board decides which proposals to fund. This is the most targeted type of stakeholder input, having a direct effect on research activities within NCARS. Also, leaders in the North Carolina Agricultural Foundation, N.C. Farm Bureau Federation, N.C. State Grange, North Carolina Department of Agriculture and Consumer Services, the N.C. Agribusiness Council and numerous other allied organizations not only provide insight on research needs and priorities, but these groups and organizations also assist in program reviews, as well as advocate for the NCARS agenda 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 citizens across the state were related to the strong programs of Cooperative Extension. Agricultural preservation, sustainability and development and nutrition and health were identified as key issues. Nutrition and health

were also labeled as key issues.Increasing economic opportunity, business development, and developing community leadership 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 as key issues facing North Carolinians. The North Carolina Agricultural Research Service maintains close ties to the 90 state agricultural industry associations, in 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 the request for proposals, and the board decides which proposals to fund. This is the most targeted type of stakeholder input, having a direct effect on research activities within NCARS. 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 the department's research programs. There are 21 such advisory groups among the 18 research departments that meet at least once per year and their membership includes a total of over 200 stakeholders from a wide range of agricultural interests. In addition, there are currently nine formal centers within the college with industry advisory boards that meet at least twice per year, adding another 60 stakeholders providing NCARS administrators and scientists input and direction for research programs. NCARS receives support annually from college-based foundations, including the Agricultural Foundation, Tobacco Foundation and the 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 hear discussion of priority areas for research activity in all aspects of agricultural production and agribusiness. Then in late winter, these committees meet again to select and approve research projects for funding, which provides another opportunity for input on research priorities. As greater emphasis is being placed on integrated Extension and Research efforts, top administrators and program personnel hold both Research and Extension appointments and duties. These personnel continuously interface on decisions for program prioritization, budgeting, staffing, and a greater exchange of information from the state's citizens to assure that all audiences are identified and served to the extent that the mission and resources of these Research and Extension programs make such coverage possible.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
11541338	3583281	7566349	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	11539401	3583000	7566285	0
Actual Matching	11539401	3583000	7566285	0
Actual All Other	25990000	215000	18610000	0
Total Actual Expended	49068802	7381000	33742570	0

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Plant Production Systems and Health

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%	
202	Plant Genetic Resources	10%	10%	10%	
204	Plant Product Quality and Utility (Preharvest)	5%	5%	5%	
205	Plant Management Systems	20%	20%	20%	
206	Basic Plant Biology	10%	10%	15%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%	10%	10%	
212	Pathogens and Nematodes Affecting Plants	15%	15%	15%	
213	Weeds Affecting Plants	15%	15%	10%	
216	Integrated Pest Management Systems	5%	5%	5%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	103.0	8.0	170.0	0.0
Actual	85.0	5.5	160.0	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**
1835000	750000	1650000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1835000	750000	1650000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
3200000	55000	1790000	0

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	352000	1200000	22800	23300

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

Patent Applications Submitted

Year: 2010

Actual: 5

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	110	340	450

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
2010	29

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
2010	375000

Output #3

Output Measure

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

Year	Actual
2010	1700

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*

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	Quantitative Target	Actual
2010	1050000	1050000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers are looking for alternative crops to supplement their income at the same time consumers are looking for locally grown, fresh produce.

What has been done
Identification of new fresh market apple varieties or sports that are uniquely suited to production in the Southeast, together with development of technologies for consistently regulating crop load, promoting return bloom, delaying fruit drop, enhancing fruit appearance at harvest and fruit quality after storage are among strategies being pursued to ensure continuing viability and success of the North Carolina apple industry.

Results
Reductions in cosmetic defects increased pack-outs of Golden Delicious apples by an average of 13 percent, resulted in additional revenue per acre of $1,680. A long-term evaluation of technology for delaying fruit drop demonstrated that the technology increased Red Delicious annual yields by an average of 100 bushels per acre, equivalent to a 10 percent yield increase. The incremental increases in fruit revenue as growers make the transition from production of low-value processed apple crops to high-value fresh market apple varieties and value-added products will ensure a vibrant and profitable apple industry in the Southeast.

4. Associated Knowledge Areas

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

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

Outcome #2

1. Outcome Measures

Increased profit through the adoption of improved nutrient management practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3100000	3300000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Organic food and beverage sales have increased approximately 21 percent annually in recent years. NCARS research seeks to understand how to develop resilient and productive agricultural systems that rely on biological and ecological soil processes for supply of key plant nutrients, with an emphasis on understanding soil fertility management in organic agriculture.

What has been done
Seven experimental fields were planted at three research stations and four working farms. On each site 15 species/varieties of common, novel and underutilized legume cover crops were planted, including Hairy Vetch, Common Vetch, Crimson Clover, Berseem Clover, White Lupin, and Austrian Winter Pea. Production data were collected on the legume types, including flowering time, total biomass, total N fixed through nitrogen fixation, and total N contributed to the field.

Results
These studies are allowing us to understand how winter annual legume cover crops perform in different regions and soil types across North Carolina and providing information on planting and termination strategy that might impact N release and organic matter accrual in organic systems.

This information is valuable to organic as well as conventional growers wishing to incorporate legume cover crops into their current rotations.

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

Not Reporting on this Outcome Measure

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	Quantitative Target	Actual
2010	10	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
American agriculture needs new crop production products and techniques if American farmers are to be competitive in both domestic and international markets.

What has been done

Several soybean cyst nematode genes that are responsible for parasitism were identified

Results

These genes can be used to protect soybean plants from the nematode using RNAi technology. Soybean cyst nematode is the most damaging pathogen of soybeans grown in the U.S., with yield losses approaching a billion dollars per year, including significant soybean losses in North Carolina.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Increased profit through the adoption of new production practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	33000000	35000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The loss of broad spectrum organophosphate chemicals, once used to control key apple pests, left the industry with only a few narrow spectrum insecticides to control the codling moth, the most important insect pest of apples. Control of codling moth became more challenging when populations developed resistance to several commonly used insecticides.

What has been done

N.C. State University conducted a research and extension program from 2007 to 2010 to develop and implement reduced-risk pest management programs for apple insects, with specific attention paid to the codling moth. Methods were developed to monitor populations for resistance to various insecticides, which helped growers avoid using products that were no longer effective. The use of pheromone-mediated mating disruption was tested for management of codling moth and oriental fruit moth. An educational program targeting apple growers and the pest control industry was used to implement these new pest management strategies on an area-wide basis. Pest and beneficial arthropod populations were monitored in approximately 30 orchards during the project to measure changes in pest populations and grower practices.

Results

Based on data collected from orchards participating in the project, the use of broad spectrum insecticides declined more than 70 percent between 2007 and 2010, and the number of applications per season declined from an average of 9.8 to 7.1 per season. Reductions in insecticide use were largely due to the widespread adoption of mating disruption for codling moth and oriental fruit moth; the percentage of N.C. apple acreage under mating disruption increased from 3 percent in 2006 to almost 60 percent in 2010. Prior to this project, overall damage due to codling moth and oriental fruit moth averaged 3.2 percent, and by 2010 overall damage by these insects declined to 0.15 percent.

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	Quantitative Target	Actual
2010	75000	77000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Timely digging of peanut pods is important in optimizing peanut yield and economic value. Digging peanut one week prior to or one week following optimum digging can decrease yield by 10 percent.

What has been done
With the support of the North Carolina Peanut Growers Association, Cooperative Extension field faculty and peanut farmers, N.C. State University developed information and visual tools to assist peanut growers in determining when to dig peanut.

Results
Approximately 65 percent of peanut farmers utilize Cooperative Extension educational materials and/or direct contact with county field faculty during this process. Peanuts were produced on approximately 85,000 acres in 2010. N.C. peanut growers used this information to increase annual income by $5.2 million through timelier digging.

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	Quantitative Target	Actual
2010	2000	2750

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Organic food sales have more than quintupled since 1997 and were predicted to reach $26 billion in 2010. But land under organic production has only doubled over this time period.

What has been done
Planning for an organic agriculture research program for western North Carolina was initiated in the summer of 2010. This included surveying and interviewing of almost 300 farmers, community members and extension personnel to understand regional research, extension and educational needs. A workshop with more than 115 attendees was held in August to launch the program and showcase the four studies undertaken in the summer of 2010.

Results
The short-term impact will be increased regionally appropriate research-based knowledge and education on organic agriculture in western North Carolina. In the long term, this will result in increased farm viability, profitability, labor and other efficiencies, sustainability and increased community support for local food.

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	26	19

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The plant vacuole is a storage compartment for proteins, hormones, metabolites and ions. Membrane proteins of the vacuole transport all of the metabolites and ions that regulate cellular homeostasis. Very little is known about how these proteins are delivered to the vacuolar membrane.

What has been done
NCARS scientists have identified small molecules that inhibit the delivery of specific membrane proteins to the vacuole. These inhibitors are been used to characterize two distinct trafficking pathways. In addition, newly identified mutants with defects in trafficking of membrane proteins to the vacuole are being characterized.

Results
An understanding of the mechanisms of delivery of membrane proteins to the vacuole is important to the development of improved plants with high nutritional value and improved tolerance to environmental stress.

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*

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

External factors which affected outcomes
• Natural disasters (drought, weather extremes, etc.)
• Economy
• Appropriation changes
• Public policy changes
• Government regulations
• Competing public priorities
• Competing programmatic challenges
Weather was not as important in affecting research and extension programs in 2010 as previous years. Temperatures were moderate, and rainfall was generally adequate across the state. Above average rainfall late in the season did impact the harvest of late-season crops such as peanuts, cotton, and soybeans. The greatest factor that affected the outcomes was the decline in support from the state, which resulted in a reduction in both research and extension faculty and county extension agents. Also, increased competition for federal funds continues to make it more difficult to maintain programs and initiate new ones.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Economic Systems

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management	30%	30%	30%	
602	Business Management, Finance, and Taxation	25%	25%	25%	
604	Marketing and Distribution Practices	5%	5%	5%	
605	Natural Resource and Environmental Economics	25%	25%	25%	
607	Consumer Economics	15%	15%	15%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	14.0	9.0	10.0	0.0
Actual	12.0	7.0	5.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
850000	500000	1700000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
850000	500000	1700000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
110000	130000	990000	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We plan to conduct a multiplicity of educational programs and utilize applied research projects to enhance the knowledge base of targeted citizens in North Carolina and other designated areas. This will involve conducting programs that organize farm management schools, conduct meetings on topics such as risk management, net profit calculations, tax preparer schools, and conduct feasibility studies that examine the economics of alternative and traditional enterprises. We will conduct Research projects and Extension programs that provide economic decision support for sustainable agricultural commodities and products that feature changing and new technologies, evaluation of alternative incentive-based systems, risk aversion, public policy, rural communities and labor markets.

2. Brief description of the target audience

Agribusiness personnel, tax preparers, financial advisers, limited resource farmers (active, new and potential), farm managers, rural appraisers, supply chain operators, county agents, colleagues, state department of agriculture specialists, and commodity association board members.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3900	9000	1300	3800

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	30	52	82

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Non-degree credit activities conducted focusing on markets, farm and business management

Year	Actual
2010	45

Output #2

Output Measure

- Number of county and area tax preparer schools

Year	Actual
2010	32

Output #3

Output Measure

- Registered attendees at estate planning, legal advice, and financial management schools

Year	Actual
2010	459

Output #4

Output Measure

- Enrollees for the Natural Resource Leadership Institute year-long training

Year	Actual
2010	18

Output #5

Output Measure

- Integrated Research Projects Conducted

Year	Actual
2010	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1200	1350

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina taxpayers and professional tax preparers need information on tax law changes.

What has been done
Workshops and programs that address various tax issues are held across the North Carolina. Among the audiences for these efforts are groups that represent the producers of various agricultural commodities such as the NC Pecan Growers Association, North Carolina Apple Growers, NC Wine Growers, specialty crop producers in Western North Carolina, forestry groups and the North Carolina Christmas Tree Growers. In addition, Income Tax Schools are held for professional tax preparers. The majority of commercial farmers use professional tax preparers, so these schools reach the agricultural community, although indirectly. Special schools address issues such as agricultural, estate and fiduciary taxation.

Results
Approximately 1,350 tax professionals attend 12 two-day Income Tax Schools. Nearly 400 also attend special schools on topics such as agricultural, estate and fiduciary tax issues. Attendees come away from these sessions with a better understanding of tax law and regulations.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

New organic, farmers, and agritourism markets established by individual entrepreneurs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	30	35

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Organic food sales have more than quintupled since 1997 and were predicted to reach $26 billion in 2010. But land under organic production has only doubled over this time period.

What has been done
Planning for an organic agriculture research program for western North Carolina was initiated in the summer of 2010. This included surveying and interviewing of almost 300 farmers, community members and extension personnel to understand regional research, extension and educational needs. A workshop with more than 115 attendees was held in August to launch the program and showcase the four studies undertaken in the summer of 2010.

Results
The short-term impact will be increased regionally appropriate research-based knowledge and education on organic agriculture in western North Carolina. In the long term, this will result in increased farm viability, profitability, labor and other efficiencies, sustainability and increased community support for local food.

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
605	Natural Resource and Environmental Economics

607 Consumer Economics

Outcome #3

1. Outcome Measures

Growers Adopting Improved Business Management Practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3100	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The environment in which agriculture and agribusiness operate is increasingly competitive. If agriculture and agribusiness are to continue to be the important segment of the North Carolina economy that they are today, farmers and other agriculture-based business owners must be knowledgeable of business trends and issues.

What has been done
A seven-week Sustainable Farm Business Planning Class was developed. In addition, a complete farm business planning class curriculum was developed as a resource for extension agents.

Results
Fifteen agriculture-based business owners attended the Sustainable Farm Business Planning Class. The business owners now have the resources and skills they need to address questions they encounter as they develop their businesses.

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
605	Natural Resource and Environmental Economics

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

Brief Explanation

Natural Disasters (drought,weather extremes,etc.)
Economy
Appropriations changes
Public Policy changes
Government Regulations
Competing Public priorities
Populations changes (immigration,new cultural groupings,etc.)
The highly volatile commodities market, rising input costs, and the economic downturn have required that every business management efficiency be exercised in record keeping, production, and financial management to meet the demanding challenges faced in the simple survival of farm units. Further, commodity prices that reached levels almost previously unknown have resulted in the need for highly informed decision making regarding enterprise mix and allocation of resources. Of course, ever advancing technologies have led to the need for increased computer competencies as well as other technological innovations, such as precision farming and the resultant need for accurate decision making regarding the use of such technologies and the exercise of keen marketing skills.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Natural Resources and Environment

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	30%	30%	30%	
111	Conservation and Efficient Use of Water	10%	10%	10%	
112	Watershed Protection and Management	15%	15%	15%	
133	Pollution Prevention and Mitigation	30%	30%	30%	
141	Air Resource Protection and Management	15%	15%	15%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	46.0	2.0	22.0	0.0
Actual	40.0	1.0	15.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
930000	55000	235000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
930000	55000	235000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1400000	25000	1700000	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities will be focused on understanding the processes and situations that create pollution problems from agricultural production (including animal operations, field activities, and processing). With that information in hand, improved management and technological solutions will be proposed and evaluated. Technology transfer will be accomplished through demonstrations, workshops, and publications by Cooperative Extension in concert with the researchers involved.

2. Brief description of the target audience

Agricultural producers, environmental and other governmental agencies (action and regulatory), news media, the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	72000	145000	12000	17000

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

Patent Applications Submitted

Year: 2010

Actual: 1

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	6	26	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Waste Management Certification Programs

Year	Actual
2010	38

Output #2

Output Measure

- Number of Research Projects Completed on Environmental/Natural Resource Issues

Year	Actual
2010	9

Output #3

Output Measure

- Number of non-degree credit environmental activities conducted

Year	Actual
2010	550

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number farms first utilizing precision application technologies
2	Number of farms implementing additional best management practices for animal waste management
3	Number of urban households/small farms with low-literacy individuals implementing and/or adopting best management practices to enhance water quality.
4	Number of Waste Management Certifications Gained or Maintained
5	Number of acres where proper waste analysis was used for proper land application

Outcome #1

1. Outcome Measures

Number farms first utilizing precision application technologies

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	650	793

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Educating farmers about optimum fertilizer management and production practices such as precision agriculture and alternatives to inorganic fertilizers such as legumes and manures improves farm profitability and reduces the likelihood of runoff of nitrogen, phosphorus and sediments from fields.

What has been done
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 and evaluating legume cover crop productivity and feasibility in intensively managed corn/soybean rotations. A research publication describes the nitrogen, phosphorus, and liming effects of three different poultry manure sources. Efforts are ongoing to promote calibration of fertilizer and litter spreaders and more intensive management of water control structures.

Results
These efforts should result in both crop yield and water quality benefits. Collaborations with the North Carolina Department of Agriculture and Consumer Services are enhancing the professional development of extension agents and supporting agriculture by resolving crop yield limitations due to nutrient deficiency. In 2010, 793 North Carolina farms first used precision application technology.

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 of farms implementing additional best management practices for animal waste management

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1500	2282

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Excess nutrient runoff from animal waste operations has been identified as a major contributing factor to eutrophication of fresh and salt water systems in North Carolina, which has substantial negative impact.

What has been done
Courses for wastewater system operators are offered at the Lake Wheeler Land Application Training and Demonstration Unit and across the state. For example, training was delivered in coordination with James Sprunt Community College, which hosted a 6-hour course at the Butterball plant in Mt. Olive, N.C. A 1-week wastewater operators school is also offered once per year and a wastewater irrigation system design course has been offered the past 6 years. Training on animal waste issues is available to producers and livestock associations through coordination with local county extension agents and area specialized agents. Technical assistance has been provided to the North Carolina Department of Environment and Natural Resources on timely waste management issues. Technical input on animal waste issues is also provided via the SB 1217 inter-agency committee on animal waste management, and relevant extension bulletins have been developed.

Results

Wastewater system operators are provided the education and training they need to obtain or retain operators' licenses. Education and training helps operators keep in compliance with regulations and maintain environmental quality while ensuring that animal production systems or industrial processes continue. Soil scientists and engineers receive training in the design of wastewater systems (approximately 20 per year attend the 2-3 day design class). The North Carolina Department of Environment and Natural Resources has technical information upon which to formulate policy and regulations concerning animal waste management. In 2010, 2,282 farms implemented additional best management practices for animal waste management.

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	50	255

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Homeowners in urban settings as well as rural families often are unaware of the impact of over fertilization and inappropriate use of pesticides on ground and surface water. Reducing chemical and fertilizer misuse in these settings will have a major positive impact on local and statewide water quality.

What has been done

4-H and general public meetings have been held to educate non-agricultural and low-literacy audiences as to what they can do to improve water quality and reduce the use of common fertilizers and pesticides used around the house.

Results

Over application of fertilizer and other chemicals is being reduced as a result of educational efforts. Information on the number of urban households and small farms where low-literacy individuals live that implemented and/or adopted best management practices to enhance water quality in 2010 was unavailable. However, an indication of the impact of programs in this area may be gained from other statistics for the year. For example, 56,199 program participants gained knowledge of water quality preservation methods; 3,230 program participants were certified to implement natural resource and environmental conservation best management practices; and 127 stream protection practices were implemented.

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 of Waste Management Certifications Gained or Maintained

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3000	4520

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

All individuals who are responsible for waste management at animal production facilities are required by the state to be trained and certified.

What has been done
Extension provides education and certification testing for individuals involved with waste management for the animal production industry in North Carolina

Results
Several thousand certifications (either new or renewed) are issued each year.

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	800000	828000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nitrate-nitrogen leached through drainage systems elevates nitrogen (N) concentrations in ground and surface waters, contaminating drinking water supplies and causing eutrophication and hypoxia in surface waters. The development and application of drainage water management

practices that reduce off-site environmental impacts is vital to achieve sustainable crop production on drained lands.

What has been done

Research has shown that drainage systems can be controlled or managed to reduce N losses to surface waters by 25 to 50 percent, depending on soils and conditions. This controlled drainage practice also conserves water and increases yields.

Results

Controlled drainage has been accepted by the State of North Carolina as one of three Best Management Practices for reducing N and phosphorus (P) loads to surface waters. State and federal cost share programs were established to promote the use of the practice for reduction of nutrient losses in drainage waters. Recent field research has shown that controlled drainage, when managed according to established guidelines, increased corn and soybean yields by an average of 8 to 10 percent on two lower coastal plains sites. The models developed in this research are being used to analyze and develop guidelines for the application of controlled drainage and related water management systems in other states and countries and to develop more effective methods of land treatment of wastewaters on drained soils. In 2010, 328 North Carolina farms implemented improved nutrient 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

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

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

Warmer than usual temperatures combined with a severe drought in the first half of the year stressed both animal and crop production systems and also stressed aquatic and terrestrial wildlife habitat. Forest fires, wild fires, fish kills, and reservoir depletion all took their toll on North Carolina's natural resources and environment. The second half of the year, while normal environmentally, saw higher input costs, tighter credit issues, and reduced government funding, all of which negatively affected producers, program deliverers, and the general public in a number of ways. In spite of these impacts, most of the outcomes chosen for this program were met or exceeded.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Animals and Their Systems, Production and Health

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	20%	20%	20%	
302	Nutrient Utilization in Animals	20%	20%	20%	
303	Genetic Improvement of Animals	17%	17%	17%	
307	Animal Management Systems	18%	18%	18%	
311	Animal Diseases	10%	10%	10%	
312	External Parasites and Pests of Animals	5%	5%	5%	
313	Internal Parasites in Animals	5%	5%	5%	
315	Animal Welfare/Well-Being and Protection	5%	5%	5%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	57.0	3.0	120.0	0.0
Actual	50.0	2.0	85.0	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
900000	500000	1100000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
900000	500000	1100000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1000000	0	8000000	0

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, begining and 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.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	150000	230000	42000	45000

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

Patent Applications Submitted

Year: 2010

Actual: 3

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	48	156	204

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	698

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2010	58

Output #3

Output Measure

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

Year	Actual
2010	56

Output #4

Output Measure

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

Year	Actual

2010 28

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	Income optimized by livestock producers adopting improved nutrition 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	Quantitative Target	Actual
2010	7700000	9500000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small cattle farmers have limited marketing opportunities. Cooperatively marketing cattle in larger groups can improve uniformity resulting in increased sale price.

What has been done
Cooperative Extension agents organized and coordinated feeder calf sales in northeastern North Carolina. This allows small producers to comingle their cattle to sell in more uniform packages and gives them another source to market their cattle.

Results
Cattle typically garnered $3 to $5/cwt or $25 to $50 more than if sold at a public auction barn; 463 head where marketed through six sales, generating $264,005.05. From January 2008 to December 2010, over 1,522 head have participated in these sales, generating more than $795,702.80, with premiums up to $76,100 returned to 33 producers.

4. Associated Knowledge Areas

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

312	External Parasites and Pests of Animals
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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	8000000	8660000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Misdiagnosis of estrus is the most common human error made on sow breeding farms. It is costly, time-consuming and significantly compromises animal welfare and profitability. Sows that are bred at the incorrect time during estrus have poor reproductive performance and are at an increased risk of developing reproductive tract infections, which can permanently impact their fertility.

What has been done
Researchers worked with InterVet, Inc., the North Carolina Pork Council and the National Pork Board to develop management strategies for synchronization of estrus in swine.

Results
This research collaboration resulted in the first FDA approved product for estrus synchronization in mature swine. Implementation of estrus synchronization programs on farms significantly reduced mistakes in detection of estrus. When this occurred, reproductive performance, sow longevity and profitability all increased.

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

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Income optimized by livestock producers adopting improved nutrition practices

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mycotoxins are a diverse group of secondary metabolites of molds (fungi) that, when consumed or otherwise contacted, have negative effects on the growth, performance and/or health of animals and humans.

What has been done
A feeding trial with turkey poults demonstrated that feed additives Biomin BioFix (2 lb/ton), Kemin Kallsil (4 lb/ton) and Nutriad UNIKE (3 lb/ton) indicated that the feed additives alleviated the effect of dietary mycotoxins to some degree.

Results
This information will be disseminated to the poultry industry so that farmers and company managers can make informed decisions when determining feeding strategies to lessen the negative impacts of potential feed-borne mycotoxins.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

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

The following factors affected North Carolina animal agriculture to some degree, even though the impact may be difficult to determine. Increases in commodity prices, the declining economy, changes in program funding, public policy changes, new rules and regulations, public priorities, competing programs, and population increases (especially along the I-85 corridor) all impacted farmers' abilities to remain sustainable. Most of these impacts have been negative, especially increased population and the economy (fuel prices in particular). Our farmers will face continuous challenges to remain profitable and sustainable.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Agricultural, Natural Resource, and Biological Engineering

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation	10%	10%	10%	
401	Structures, Facilities, and General Purpose Farm Supplies	5%	5%	5%	
402	Engineering Systems and Equipment	20%	20%	20%	
403	Waste Disposal, Recycling, and Reuse	15%	15%	15%	
404	Instrumentation and Control Systems	15%	15%	15%	
405	Drainage and Irrigation Systems and Facilities	5%	5%	5%	
503	Quality Maintenance in Storing and Marketing Food Products	10%	10%	10%	
511	New and Improved Non-Food Products and Processes	15%	15%	15%	
512	Quality Maintenance in Storing and Marketing Non-Food Products	5%	5%	5%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	19.0	1.0	12.0	0.0
Actual	14.0	1.0	6.0	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**
1640000	30000	115000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1640000	30000	115000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
8000000	0	400000	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension activities will focus on applying and adapting knowledge gained from basic research to agricultural production systems and natural resource pollution prevention. Both "soft" engineering (e.g. unit process engineering) and "hard engineering" (e.g., machines, hardware and sensors and controls) will be a part of the Research and Extension activity. Technology transfer will be achieved through workshops, demonstrations and field days, and publications.

2. Brief description of the target audience

The target audience will be: agricultural producers, manufacturers of agricultural machinery and food processing and storage equipment, state agencies, watershed stakeholders, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12000	20000	1400	4000

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

Patent Applications Submitted

Year: 2010

Actual: 2

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total

Actual	12	30	42

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Research Projects Completed in Agricultural, Biological and Natural Resource Engineering

Year	Actual
2010	28

Output #2

Output Measure

- Number of Workshops and Trainings Completed in Agricultural, Biological and Natural Resource Engineering

Year	Actual
2010	85

Output #3

Output Measure

- Relevant Non-degree credit group activities completed

Year	Actual
2010	48

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of growers implementing stream protection practices e.g. buffers, fencing, etc.
2	Number of stormwater systems installing BMPs
3	Number of farms adopting use of biofuels
4	Number of growers implementing improved irrigation and drainage systems

Outcome #1

1. Outcome Measures

Number of growers implementing stream protection practices e.g. buffers, fencing, etc.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	300	280

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Stream restoration is an important watershed management practice that improves 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.

What has been done
N.C. State University 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 4,000 professionals have learned about stream assessment, design, construction and monitoring. N.C. State 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 demonstrate and evaluate stream restoration practices in a variety of watershed conditions.

Results
The quality of stream restoration projects has improved 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. During 2010, approximately 20 miles of stream were restored.

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 #2

1. Outcome Measures

Number of stormwater systems installing BMPs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	35	16

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Treatment of urban stormwater runoff has become a primary concern to local leaders throughout North Carolina. A series of state and national rules impact more than 150 North Carolina communities. Each of these regulations require communities to implement stormwater education programs in addition to requiring new and innovative practices be used to clean stormwater runoff.

What has been done
More than 100 stormwater demonstration sites have been established throughout North Carolina. Monitoring and evaluation of several of these sites have shown the effectiveness of certain stormwater practices and provided data from which to develop new design recommendations and publications.

Results

State regulatory agencies have used research results to develop North Carolina design standards for bioretention cells, level spreaders, stormwater treatment wetlands, permeable pavement, green roofs, water harvesting systems and combinations of these practices called Low Impact Development. Research findings have also been shared with the design and maintenance community through more than 150 workshops across North Carolina. In 2010, 16 stormwater control practices were installed at demonstration sites. These included level spreader and vegetated filter strip systems, water harvesting systems, a stormwater wetland and permeable paving.

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 #3

1. Outcome Measures

Number of farms adopting use of biofuels

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of growers implementing improved irrigation and drainage systems

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	25	943

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Irrigation-related water use is increasing in North Carolina, and it is important that sound water management principles be applied in order to optimize yield and to conserve and protect the water resource. Additionally, emerging technologies such as subsurface drip irrigation, which have the potential for better water use efficiencies, have had minimal testing on North Carolina soils. Water management in urban areas is becoming increasingly important, and with increasing competition for and development of water resources, sound planning and management are required. Technical support is necessary for communities to make sound urban water management decisions.

What has been done

Irrigation and water management presentations have been made to growers and certified crop advisors and to conference and workshop attendees. The annual irrigation society conference provides education opportunities and credits for irrigation professionals. Conversation with and education of local water conservation officers communities is ongoing. Two current applied research projects have brought smart irrigation technology into residential settings and educated local water conservation officials. More than 100 Certified Irrigation Contractors have received recertification hours from N.C. State in the first 1.5 years of the certification requirement, while trainings provided by N.C. State through the auspices of other green industry organizations have reached hundreds more.

Results

Growers have been given information to evaluate their irrigation options and to efficiently manage their water resource. Extension bulletins developed on subsurface drip irrigation based on local applied research allow growers to make informed decisions on the application of this technology to their cropping systems. Agricultural groups and state agencies have received technical input to help formulate options and guide policy makers regarding water legislation. Local urban officials are turning to N.C. State for answers to questions regarding adoption of smart irrigation technology as a way to conserve water in the urban landscape. In 2010, 943 growers implemented improved irrigation and drainage systems.

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

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

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	20%	20%	20%	
502	New and Improved Food Products	15%	15%	15%	
503	Quality Maintenance in Storing and Marketing Food Products	10%	10%	10%	
504	Home and Commercial Food Service	5%	5%	5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%	10%	10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	40%	40%	40%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	54.0	0.0	63.0	0.0
Actual	45.0	0.0	51.0	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**
1330091	0	571285	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1330091	0	571285	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1000000	0	3200000	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Multible research and educational outreach programs will be conducted that fit under the broad 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. A very important aspect of this plan of work is to transfer technology and knowledge to our stakeholders and clientele. Therefore, an extensive outreach effort will involved campus and field faculty located in local communities. Direct outreach efforts will include engaging stake-holders in workshops, conferences, discussion groups, one-on-one teaching, demonstrations, field trials, short courses, continuing education classes, and scientific meetings. Indirect methods will include internet sites and courses, newsletters, press releases, television and radio interviews and programming, trade journals, scientific journals and popular press articles. Participants and programs will be evaluated at least annually for success, progress, and impact.

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).

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3000	6400	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 4

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	15	70	85

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	420

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2010	46

Output #3

Output Measure

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

Year	Actual
2010	16

Output #4

Output Measure

- Number of firms adopting quality and safety strategies

Year	Actual
2010	241

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

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	Quantitative Target	Actual
2010	1300	837

3c. Qualitative Outcome or Impact Statement

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

What has been done
Food safety certification courses 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 2010, 837 food service employees received ServSafe program certification while 140 program participants completed National Seafood HACCP Alliance education and other food safety HACCP workshops.

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	Quantitative Target	Actual
2010	350	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Foodborne illnesses account for 128,000 hospitalizations and 3,000 deaths annually in the United States. Efforts to reduce human illnesses by the U.S. Food and Drug Administration mandate a risk-based preventive approach on the principles of Hazard Analysis Critical Control Point (HACCP) inspections.

What has been done
North Carolina Cooperative Extension and Sea Grant specialists along with NC Food and Drug Protection and NC Shellfish Sanitation investigators provide education and training workshops for industry and regulatory personnel.

Results
In 2010, six seafood HACCP workshops were organized with 73 participants receiving their AFDO certificates of course completion. This brings the total number of individuals trained in North Carolina on seafood HACCP principles to 909 since 1997, with over 26,000 trained nationwide through efforts of the National Seafood HACCP Alliance. Impacts are compliance with state and federal seafood safety requirements, increased knowledge of seafood safety and reduced risks for consumers.

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
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	70	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Aquaculture is one of the fastest expanding sectors in agribusiness around the globe. However, environmental issues are a significant roadblock to aquaculture development, especially in coastal regions where brackish and saltwater aquaculture production could have substantial economic impacts on local economies. Finding ways to produce seafood in environmentally sustainable ways at coastal sites is critical to the expansion of this industry.

What has been done
For more than a decade, the NC State Fish Barn program has conducted pioneering research to develop innovative waste treatment technology for aquaculture. Most of this research was done with freshwater. In 2008, the program began focusing on ways to modify this technology to be used in brackish and saltwater aquaculture. In 2009 this technology was used in the construction of the new NC State Marine Aquaculture Research Center near Marshallberg, NC. While research on the production of marine species is ongoing at that research lab, a graduate PhD research program has developed further the technologies to treat and render harmless the waste coming

from marine aquaculture production.

Results

In 2010, Marshallberg Farms erected a large (27,000 ft2) aquaculture Fish Barn structure. The facility is located adjacent to the NC State Marine Aquaculture Research Center. Marshallberg Farms has enlisted the assistance of the NC State aquaculture extension program in the design and implementation of a novel production facility for sturgeon. The project is unique in that it will produce sturgeon for meat (a 24 - 36 month process) rather than eggs leading to caviar (a 60 - 84 month process). We know of no other facility dedicated to the production of sturgeon meat within the United States. When fully implemented by 2012, the facility will create at least six full- and part-time jobs, represent more than a $2 million investment in agribusiness and serve as a model for the future of an environmentally sensitive aquaculture industry in coastal 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
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	10	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Recent interest in healthy food resulted in significant market potential for sweet potatoes as a functional food ingredient. However, for the food processing industry an irregular supply of raw product and the requirements for special storage conditions for sweet potatoes are impediments to the development of product lines. Therefore, there is a need to develop processing technologies to convert sweet potatoes into puree forms that are shelf-stable and readily incorporated into processed products.

What has been done

A continuous-flow microwave heating process that can commercially sterilize difficult-to-process food materials such as sweet potato purees was developed. Coupled with aseptic packaging, this innovative process can produce aseptic sweet potato puree with high nutritional retention and desirable flavor exceeding all other existing conventional methods of thermal processing. The process has been jointly patented by North Carolina State University, USDA-Agricultural Research Service and Industrial Microwave Systems with a local entity (Yamco, LLC of Snow Hill, NC) holding the end-user licensing rights for commercialization.

Results

Yamco completed a $6 million facility in the city of Snow Hill, N.C., in 2007 and received the first FDA Letter of Non-objection for a continuous low-aseptic process utilizing microwave as a primary mode of heating within the United States. This Yamco factory produces millions of pounds of aseptic sweet potato purees annually for various food companies, which manufacture numerous products, including baked goods, baby foods, snack foods, pet foods and nutraceutical products. This is the first commercial venture on this innovative technology in the world to produce shelf-stable sweet potato purees for use as functional ingredients with high carotene, natural color, fat-replacing, thickening and gelling properties. In 2010, the USAID Office of Food for Peace approved Yamco's aseptic sweet potato purees for use in emergency feeding programs around the world. Also in 2010, another company, Empire Foods, broke ground for a processing plant that will use the technology to process a variety of fruits and vegetables.

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

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

Educational and applied research efforts have targeted specific industries and operations affected by illnesses associated with food and animal products. New and revised food policies and further need for process and product validation studies are expected. Many of these studies are likely to involve state research and extension personnel.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Human Nutrition and Health

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	15%	15%	15%	
703	Nutrition Education and Behavior	25%	25%	25%	
721	Insects and Other Pests Affecting Humans	10%	10%	10%	
724	Healthy Lifestyle	50%	50%	50%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	35.0	2.5	17.0	0.0
Actual	25.0	1.0	10.0	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
850000	123000	130000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
850000	123000	130000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
730000	5000	1130000	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Nutrition and Health program will promote optimum nutrition and health through diet and lifestyle in all North Carolinians regardless of gender, income, age, or race/ethnicity. Education programs addressing diet, healthy, and chronic disease prevention will be offered to North Carolinians of diverse income levels, age groups, genders, and/or cultural backgrounds across the state. Programs offered will include Give Your Heart A Healthy Beat, Project Eat Right: Add to Life Program, Color Me Healthy, Moving Towards a Healthier You, Dining with Diabetes, SyberShop, Women Living Healthy - Women Living Well, and Families Eating Smart and Moving More. Programs will be held in many different settings including congregate nutrition sites, senior centers, schools, churches, government buildings, businesses, daycare centers, work sites and outdoors. Various methods will be employed including using the Internet, computers, mailed materials, media, one-on-one contact, and public meeting. Research projects will continue or be undertaken to seek scientific discoveries that will enhance the quality of living for the states' and nation's human population.

2. Brief description of the target audience

Audiences reached included children, adults and the elderly, day care workers, hospital employees, housing authorities, Head Start, Red Cross, food banks, daycare home providers, food stamp and WIC recepients and community coalitions. No time is more important than childhood to promote healthy eating and health practices. Children in North Carolina do not consume enough fruits or vegetables and have diets that are low in fiber and higher in fat than recommended. Children in North Carolina 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 in North Carolina continues to rise. Treatment of overweight and obesity is difficult. Preventing overweight and obesity in children is essential to address this issue. Demographic changes in North Carolina's population continue to impact nutrition and health issues. The fastest growing age group in the state is the 65 years-and-over segment. The elderly run disproportionate risks of malnutrition and poverty as well as poor overall health status. In fact, over 85% of older adults suffer from chronic diseases and could benefit from dietary intervention. The general nutrition needs of the well elderly must be addressed; however, the needs of the elderly for prevention of malnutrition and chronic disease actually begin much earlier in life. Programs addressed to young adults and the middle-aged consumers will continue to impact the health of the population as it "ages." Women are employed in greater numbers, and many of them are among the ranks of the working poor. Over 80% of women who had school-aged children were working outside the home; 67% of women with 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 are a major concern.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	250000	600000	70000	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	12	4	16

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2010	3200

Output #2

Output Measure

- Targeted audiences participate in workshops on food and nutrition

Year	Actual
2010	22000

Output #3

Output Measure

- Conduct research projects on vectors, their influences on human health and their control.

Year	Actual
2010	5

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	Educational program participants make one or more positive dietary change
4	Program participants 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.
8	Research projects produce findings that can and will have an impact on the knowledge of and control of vectors that impact human health and safety.

Outcome #1

1. Outcome Measures

Program participants increase knowledge that will promote a healthier diet

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	20700	126000

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 five of the 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 delivery 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 126,000 North Carolinians who participated in programs conducted by NC Cooperative Extension increased knowledge of how to promote a healthy diet. While knowledge does not indicate behavior change, it is a step in moving toward lifestyle changes in diet that promote optimal health.

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 #2

1. Outcome Measures

Program participants increase skills that will promote a healthier diet

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	20700	34000

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 five of the 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 delivery 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
Nearly 34,000 North Carolinians who participated in programs conducted by NC Cooperative Extension acquired skills needed to have a healthy diet. While acquiring skills does not indicate behavior change, it is a step in moving toward lifestyle changes in diet that promote optimal health.

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 #3

1. Outcome Measures

Educational program participants make one or more positive dietary change

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	16700	125000

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 five of the 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 delivery 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 125,000 North Carolinians 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 recommendations per mypyramid.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 participants decrease body weight.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1300	1250

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overweight and obesity are issues 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 is billions of dollars each year in health care costs and loss of productivity.

What has been done
NC Cooperative Extension, in partnership with 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
The Eat Smart, Move More, Weigh Less program was in its second full year of implementation in 2010. 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). Average weight loss is 7 pounds during the 15-week program.

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	Quantitative Target	Actual
2010	1500	800

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
More than 800 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

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2000	19000

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, and can help control weight.

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 19,000 participants increased their physical activity. While this is the first step, we need to encourage participants to meet or exceed the minimum of 30 minutes of activity on most days. To that end, 10,105 participants met the minimum recommended physical activity guidelines, while 5,462 participants adopted behaviors exceeding the minimum recommended physical activity guidelines.

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2000	20000

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
Nearly 20,000 participants across North Carolina increased their fruit and vegetable consumption by at least one serving.

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 #8

1. **Outcome Measures**

Research projects produce findings that can and will have an impact on the knowledge of and control of vectors that impact human health and safety.

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

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 and Data Collection)

Evaluation Results

In 2010, 5,086 families enrolled in EFNEP, while 15,889 participated in 4-H EFNEP.

The following data were compiled from pre- and post-evaluation surveys administered to participants by EFNEP program assistants across the state. Completing the series of lessons improved nutrition, food behavior, and food safety practices. As a result of participation in EFNEP 76% improved in one or more food safety practices, 90% improved in one or more food resource management practices, 41% of participants increased amount of physical activity, 57% increased fruit consumption, 53% increased vegetable consumption, and 55% increased consumption of calcium rich foods.

Key Items of Evaluation

Eat Smart, Move More, Weigh Less (ESMMWL) is a weight-management program that uses research-based strategies for weight loss/weight maintenance. This 15-week program informs, empowers, and motivates participants to live mindfully as they make choices about heating 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 # 8

1. Name of the Planned Program

Families and Communities

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
801	Individual and Family Resource Management	34%	34%	34%	
802	Human Development and Family Well-Being	33%	33%	33%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	33%	33%	33%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	25.0	5.0	11.0	0.0
Actual	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
459310	500000	380000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
459310	500000	380000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
8750000	0	1400000	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

In response to the needs of families and communities, N.C. State- and N.C. A&T State-based faculty and county based field faculty working with NC Cooperative Extension are teaching the skills and helping to provide the tools that families need to endure the current economic and social climate. Educational outreach efforts addressing family resource management, budgeting and record keeping, debt reduction, retirement planning, foreclosure prevention and credit management address the economic challenges facing families.

2. Brief description of the target audience

Families and communities continue to face challenges. Economic concerns, military deployments, substance abuse, family violence and job losses all place enormous stress on the family unit and in turn on community resources. As a basic unit of society, it is essential that families have access to information and education that assist them in addressing the real-life challenges that they face every day.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	45000	125000	3500	9600

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	13	0	13

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Develop and conduct Family Resource Management training and workshops.

Year **Actual**

2010	28

Output #2

Output Measure

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

Year	Actual
2010	32

Output #3

Output Measure

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

Year	Actual
2010	62

Output #4

Output Measure

- Conduct Healthy Homes trainings for health and housing professionals.

Year	Actual
2010	8

Output #5

Output Measure

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

Year	Actual
2010	325

Output #6

Output Measure

- Develop and conduct financial education workshops for community based finanical educators.

Year	Actual
2010	25

Output #7

Output Measure

- Conduct educational workshops related to energy efficiency and conservation.

Year	Actual
2010	38

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/families will reduce debt.
5	Individuals/families will participate in retirement planning.
6	Individuals, businesses, industries and governments engaging in best managment practices related to energy use/conservation.
7	Individuals participating in the Healthy Homes Specialist certification exam.

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	Quantitative Target	Actual
2010	2000	1150

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Basic skills and socialization and educational motivation are first taught in the home. Many youth, however, are growing 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, including gang membership, 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 on parenting and family life issues. Agents direct educational workshops, conferences, camping experiences, and other outreach efforts focused on positive parenting skills. These efforts address the importance of family time and identify real life concerns of parents

Results
As a result of educational programs, 335 fathers increased their involvement with their children at home, in school and in the community, and 182 incarcerated parents implemented strategies for staying involved in their children's lives. Parents (1,150) adopted appropriate guidance and supervision practices, and 657 court mandated and agency referred parents consistently used positive parenting strategies.

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	Quantitative Target	Actual
2010	1500	2080

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 skills 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, 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 lifespan.

Results
As a result of educational efforts, 2,080 individuals and families have developed a household budget, and 1,278 have developed a household record keeping system. In addition, individuals and families developed other financial management skills, including 3,153 program participants who now use cost comparison skills, and 1,753 program participants who now follow a budget.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

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

Outcome #3

1. Outcome Measures

Individuals and families will increase savings.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1100	634

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Savings are an essential element in overall financial well-being. When individuals and families have savings, they are able to better weather difficult economic circumstances such as a reduction in income, loss of a job, or health crisis.

What has been done
Family and Consumer Science agents in North Carolina conducted workshops and trainings to assist limited resource and non-limited resource individuals in improving their financial management skills. Skills such as budgeting, debt reduction, and credit management have helped consumers develop the essential tools for improving their financial situation.

Results
Six hundred thirty four individuals and families reported increasing their savings accounts, and 872 families and individuals reported achieving their financial goals.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Individuals/families will reduce debt.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	500	530

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A symptom of increased indebtedness of working class and middle class families is the rise in the number of personal bankruptcies. In addition, in recent years, home foreclosures have seen alarming increases. A high level of indebtedness among households not only threatens the economic health of families but also the state's economy at large.

What has been done
Family and Consumer Science Agents along with partners in various agencies, organizations, and institutions developed and implemented educational programs related to debt reduction and foreclosure prevention.

Results
Individual and families used information provided to achieve a number of money management goals. For example, 530 individuals paid their bills on time; four IDA participants purchased homes; and 1,575 individuals budgeted their basic monthly expenses. In addition, 13 individuals and families used strategies to prevent home foreclosure.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Individuals/families will participate in retirement planning.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	800	1300

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent economic circumstances have resulted in decreases in some individual's retirement savings. As a result, some individuals have elected to postpone retirement until the volatility of the financial markets subsides, and they have a more secure financial situation. Others have returned to work after experiencing a significant drop in their retirement income.

What has been done
Family and Consumer Science agents conducted workshops, conferences, and other educational programs focused on retirement planning, estate planning, financial management, and insurance plans in order to assist individuals in planning for their retirement future.

Results
Regardless of circumstances, thoughtful retirement planning is essential for security in later years. Thirteen individuals planned for their retirement; 716 gained knowledge about retirement planning; and 586 gained skills in retirement planning. In addition to those planning for retirement, 2,766 families and individuals reviewed insurance plans for adequate coverage, and 115 individuals and families implemented estate planning strategies.

4. Associated Knowledge Areas

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

Outcome #6

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Individuals participating in the Healthy Homes Specialist certification exam.

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

Brief Explanation

A number of factors contributed to the adoption of practices as they relate to family resource management, parenting, and home safety. Overall, the economy of the state and nation plays a significant role. In 2010, the North Carolina economy continued to struggle. Tightened lending, declining job markets and industry closings all influenced individual income. Foreclosures and bankruptcies continued to be problems. Normal stressors of maturity, communication, and family dynamics are often compounded by external forces, including the economy. In addition to economic forces, families must cope with concerns such as deployment of one or both parents, substance abuse, incarceration and violence.

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Evaluation of Family and Community programs is on-going. The methods and timing of evaluation depend on each individual program and each Family and Consumer Science agent's plan of work. Evaluation of programs reveal that 2,080 families and individuals developed a household budget; 643 families and individuals increased their savings, 827 families and individuals achieved their financial goals; 1,150 parents adopted appropriate guidance and supervision practices; 335 fathers increased involvement with their children;

and 1,997 adults increased their conflict resolution and anger management skills.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Youth Development

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
806	Youth Development	100%	100%	100%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	51.0	7.0	0.0	0.0
Actual	45.0	4.5	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
620000	175000	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
620000	175000	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1800000	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Objectives listed under the six Long Range Focus Areas are accomplished by teams of campus/field based youth development educators. Each team continuously works to accomplish three related, over lapping focus area/objectives specific processes. Each team works to build youth development professional practices and expand the impact of evaluations as they: 1) Scan the environment for emerging focus area specific and deliver programs responsive for those existing and emerging needs. 2) Design and deliver programs responsive to those existing and emerging needs. 3) Design evaluation tools

to facilitate program impacts for reporting into the Extension Reporting System. Each team will produce, share and implement the following program-wide set of elements: Focus/Objectives Teaching Points Situation Statement Evaluation strategies: 1) Measures of Progress;2) Impact Indicators Related Research Programming Resources Target Audiences. Youth development professionals and volunteers working with low income and minority youth will be engaged in various phases of the program design and development.They will also assist with pilot testing developed educational products.Strategies to increase access to 4-H programs in local communities will be built by matching income youth.This strategy will promote the building of a strong network of individuals equipped to address the unique needs of the

2. Brief description of the target audience

The Development Responsible Youth Initiative is designed to drive collaboration with and among all agencies, programs and organizations dedicated to the well being of young people in our state. Our initiative activity engages youth, volunteers, stakeholders and youth development professionals "to create helping relationships, to enable youths to become responsible, productive citizens."

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	25000	145000	250000	800000

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	8	0	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Healthy Eating, Physical Activity and Chronic Disease Risk Reduction

Year	Actual
2010	23000

Output #2

Output Measure

- Preparing Youth for an Employable Future and Economic Success

Year	Actual
2010	7600

Output #3

Output Measure

- Building Community through Volunteerism

Year	Actual
2010	14000

Output #4

Output Measure

- Building Citizen Leaders

Year	Actual
2010	12000

Output #5

Output Measure

- Developing Life Skills

Year	Actual
2010	25000

Output #6

Output Measure

- K-12 Academic Achievement and Educational Success

Year	Actual
2010	2300

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Healthy eating, physical activity and chronic disease risk reduction
2	Youth Involved: 4-H Clubs, School Enrichment, Special Interest, and Resident/Day Camps Preparing youth for an employable future and economic success
3	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Building community through volunteerism
4	Youth Involved: 4-H Clubs, School Enrichment, Special Interest and Resident/Day Camps Building citizen leaders
5	Youth Involved: 4-H Clubs, School Enrichment, Special Interest, Resident and Day Camps Developing life skills
6	Youth Involved: 4-H Clubs, School Enrichment, Special interest, and Resident and Day Camps K-12 Academic Achievement and Educational Success

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	18000	15351

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina's youth and families continue to discover the world through 4-H camp and child care education programs. Camps and educational conference center operations continue to grow in celebration of being exemplary units in the certification system managed by the American Camping Association. In addition, child care education centers continue to be a foundational layer of community development as more and more families move to a two parent working household model.

What has been done
In 2010, 15,351 youth participated in 4-H day and residential camping. In addition, 10,361 youth participated in 4-H child care education programs, and 139,622 youth participated in school enrichment programs.

Results
Camp and child care education center participants gained significantly in both life skills and knowledge. Knowledge gains were seen in the following areas: safety, environment, personal responsibilities, making wise decisions, and healthy food/physical activity choices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	8000	12000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To successfully face rigorous higher education coursework, career challenges, and a globally competitive workforce, 4-H aligns its academic programs with real world environments by infusing 21st century skills.

What has been done
Youth benefited from involvement in community based programs that focused on the Preparing for an Employable Future (School to Work) Initiative, which includes career pathways, entrepreneurship, K-12 programs and STEM. The career pathways program reported 54,300 youth increased their knowledge of career pathways.

Results
Some indicators of progress included 831 youth gaining basic financial management skills and 45,022 youth increasing their knowledge of employability skills. In addition, 8,018 youth aspired to pursue post secondary education and 1,333 youth applied for, obtained employment and/or participated in service learning, job shadowing or internship programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	15000	1844

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Through active 4-H participation, youth learn to manage relationships, make decisions, become resilient enough to overcome risks they face, become better communicators, and serve their communities. 4-H's hands-on, learn-by-doing approach reaches hundreds of thousands of North Carolina's youth in schools, in community clubs, camps, and other settings.

What has been done
A total of 239,904 youth participated in 4-H programs across the state, with 166,523 involved in 4-H Clubs and School Enrichment (K-12) programs and 104,003 participating in Special Interest programs.

Results
4-H professionals worked with youth and adult volunteers in a variety of program areas, including: citizenship, civic engagement, global education, and cultural education. The volunteer programs reported that 28,709 participants indicated an increase in knowledge of volunteerism; and that over 1,844 participants served in new roles on community boards or councils. In addition, 7,171 participants reported aspirations to serve as new volunteers in their community. In 2010, the volunteerism initiative had an estimated value to society of more than $47 million dollars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	10000	9500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The true value of 4-H comes not from short-term results or even the effects over a few years. It comes from the program's influence on the lifelong pathway of development. Just as inoculations protect children from harmful diseases, 4-H programs have similar inoculation effects.

What has been done
Youth benefited from participation in community based programs that focused on developing life skills, which includes problem solving, communication, decision making, critical thinking, and goal setting. Problem solving programs reported 12,134 youth developing problem-solving skills, and 8,270 youth using appropriate gained goal-setting strategies.

Results
Some indications of progress included 54,550 youth using appropriate communication techniques, 9,531 youth increasing their knowledge of critical thinking skills, and 9,480 youth using appropriate decision-making strategies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	20000	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina's youth and families continue to discover the world through 4-H camp and child care education programs. Camps and educational conference center operations continue to grow in celebration of being exemplary units in the certification system managed by the American Camping Association. In addition, child care education centers continue to be a foundational layer of community development as more and more families move to a two parent working household model.

What has been done
In 2010, 15,351 youth participated in 4-H day and residential camping. In addition, 10,361 youth participated in 4-H child care education programs, and 139,622 youth participated in school enrichment programs.

Results
Camp and child care education center participants gained significantly in both life skills and knowledge. Knowledge gains were seen in the following areas: safety, environment, personal responsibilities, making wise decisions, and healthy food/physical activity choices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #6

1. Outcome Measures

Youth Involved: 4-H Clubs, School Enrichment, Special interest, and Resident and 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	Quantitative Target	Actual
2010	2500	26445

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Once upon a time, a person did not need a college education to fully participate in the economy. A high school diploma was good enough to get a decent job that could support a family and provide a decent pension. That is no longer the case. Today, high school is the pathway to higher education, career success, and a productive adulthood. Nationally, 70% of all students in public schools graduate yet, only 32% of graduates leave high school qualified to attend a four-year college.

What has been done
Youth benefited from involvement in Extension K-12 academic achievement programs, which included information on homework completion, EOG/EOC test scores, study skills and test taking. Homework completion programs reported 21,507 youth increased the quality of their homework, while 26,445 youth adopted positive study skills as a result of 4-H programs.

Results
Some indications of progress included 24,889 youth increasing their knowledge related to homework completion, 31,012 youth increasing their knowledge of study skills, and 5,241 teachers using Cooperative Extension as a resource.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

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 (NC DPI Regulations)

Brief Explanation

The national budget crisis and its trickle down impact on the state of North Carolina have affected some of our program outcomes. As the economy tightens, communities and families stay closer to home and are less inclined to participate in educational programs. Despite Extension's footing in communities, when parents struggle with holding down a job and making a living wage, their youth are certainly impacted.

V(I). Planned Program (Evaluation Studies and Data Collection)

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 objective/goal in the context of the Long Range Focus Area Team Plans. These impacts are reported in the following separate, related systems: Extension Service Report 237; the NC Extension Reporting System; and knowledge, attitude, skill, and aspiration assessments for individual program teams.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Global Food Security and Hunger

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
205	Plant Management Systems	60%	60%	60%	
307	Animal Management Systems	40%	40%	40%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	25.0	2.0	32.0	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
250000	25000	200000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
250000	25000	200000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Conducting discovery research on plants and plant systems using tools genomics, metabolomics, and proteomics;
• Developing improved crop varieties using traditional and genomic approaches;

• Introduction/discovery of new plants for food use and the green industry;
• Developing systems for production of plants for biofuels;
• Seeking new uses for plants and plant byproducts;
• Developing production systems for organic farmers;
• Developing diagnostic techniques for indigenous and introduced pathogens; Partnering with industry;
• Developing sustainable production systems for both large scale and limited resource farmers;
• Enhancing IPM programs through new techniques and strategies;
• Setting up applied research/demonstration plots;
• Writing papers for the scientific community;
• Preparing publications for grower and homeowner audiences;
• Developing Web sites to deliver information to grower and homeowner audiences; and
• Conducting workshops, meetings, and other focused educational programs for farmers, commodity groups, and industry.

2. Brief description of the target audience

Target audiences included 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, and other public agency staff.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	420	4200	1460	5600

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

Patent Applications Submitted

Year: 2010
Actual: 3

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	12	32	44

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Programs directed toward minimizing food systems disruptions

Year	Actual
2010	25

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of programs on potential food system disruptions

Outcome #1

1. Outcome Measures

Number of programs on potential food system disruptions

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A safe and reliable supply of food is essential.

What has been done
Extension programs are focused on minimizing disruptions to the food system.

Results
About 250 participants have learned about potential threats to the food system.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
307	Animal Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Sustainable Energy

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
403	Waste Disposal, Recycling, and Reuse	100%	100%	100%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	2.0	0.0	10.0	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
125000	0	750000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
125000	0	750000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The primary goal of this program is to contribute to energy suficiency and sustainability based on the production of biofuels and other alternative energy sources and effective conservation and use of available energy supplies by consumers, farmers, manufacturers and processors.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4500	20000	0	0

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	10	22	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- New bioproducts identified

Year	Actual
2010	25

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of waste disposal, recycling and reuse meetings

Outcome #1

1. Outcome Measures

Number of waste disposal, recycling and reuse meetings

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The general public is interested in minimizing ecological footprints.

What has been done
About 25 training sessions have been held around the state.

Results
Scientists, commerical and limited resource farmers, regulatory entities, homeowners, general public and agribusinesses have learned about waste disposal, recycling and reuse.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 12

1. Name of the Planned Program

Climate Change

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	100%	100%	100%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	12.0	3.0	5.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
500000	75000	200000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
500000	75000	200000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This program generates and provides knowledge to develop and maintain highly productive agricultural and ecological systems in the context of climate changes.

2. Brief description of the target audience

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

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	20000	50000	1000	5000

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	12	35	47

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of farms utilizing precision application technologies

Year	Actual
2010	32

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of farms utilizing precision application technologies

Outcome #1

1. Outcome Measures

Number of farms utilizing precision application technologies

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	800

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina is a state of diverse and remarkable physical and natural resources. A strong agriculture is critical to the economy of the state. At the same time, the preservation of the environment and the health of our citizens is of paramount concern

What has been done
This program generates and provides knowledge to develop and maintain highly productive agricultural and ecological systems in the context of climate changes. Strategies will help producers and managers plan for and make decisions to adapt to changing environments and sustain economic vitality, and take advantage of emerging economic opportunities offered by climate change mitigation technologies

Results
About 800 farms are utilizing precision application technologies.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 13

1. Name of the Planned Program

Childhood Obesity

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
724	Healthy Lifestyle	100%	100%	100%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	20.0	10.0	3.0	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
250000	500000	35000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
250000	500000	35000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The childhood obesity program is designed to ensure that nutritious foods are affordable and available to consumers, especially children, and to provide guidance and education so that individuals and families ar able to make informed, science-based decisions about how their food choices impact their health and well-being.

2. Brief description of the target audience

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.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	75000	85000	15000	20000

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	4	4	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Program participants increase knowledge that will promote a healthier diet

Year	Actual
2010	2500

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

Outcome #1

1. Outcome Measures

Program participants increase knowledge that will promote a healthier diet

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	8000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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.

What has been done

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.

Results

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 Healthyis 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.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 14

1. Name of the Planned Program

Food Safety

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	100%	100%	100%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

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

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	20.0	1.0	30.0	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
1000000	350000	500000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1000000	350000	500000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Assist food producers and processors to strive to efficiently produce an abundant sypply of high-quality, safe and nutritious supply of affordable food products.

2. Brief description of the target audience

Primary food producers, food processors, foodservice operators, county extension agents, state and federal regulatory agencies, commodity asociations, news media and consumers.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2500	10000	20	50

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

Patent Applications Submitted

Year: 2010

Actual: 4

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	20	30	50

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Highly focused non-degree credit group training activities conducted

Year	Actual
2010	200

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of companies adopting new technologies

Outcome #1

1. Outcome Measures

Number of companies adopting new technologies

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Food producers and processors will continue to strive to efficiently produce an abundant supply of high quality, safe, and nutritious supply of affordable food products. Even with the food industry's best efforts, new challenges and heightened expectations of consumers are naturally present and so will require the assistance from the land grant university system. The public's expectations of a safe and secure food system have put enormous pressure on the food industry, especially in light of several significant fresh produce contamination induced recalls in recent years that impact growers and suppliers economically and undermine other positive forces to encourage increased consumption of fresh fruits and vegetable for health benefits.

What has been done

To assure an abundant supply of high quality, safe, secure, nutritious, and affordable food products required the expanded utilization and improvement of raw food materials, development of new efficient processing technologies, improved food quality, safety, security and traceability monitoring procedures, and methods for preventing, eliminating or reducing to an acceptable level microbiological and chemical safety hazards.

Results

About 20 companies adopted a variety of new recommended technologies

4. Associated Knowledge Areas

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

Naturally Occurring Toxins

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Government Regulations
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

Evaluation Results

Key Items of Evaluation