2008 Delaware State University and University of Delaware Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Delaware agriculture faces a period of transition today unlike any encountered in the past. For decades, and still today, the driving force behind Delaware's agricultural economy has been its highly productive and geographically intensified poultry industry. In 2007, poultry and egg sales ($837M) accounted for 77% of the total market value of all Delaware agricultural products ($1B). Most of this income was associated with the production and sale of about 257 million broiler chickens. In turn, cropping systems in Delaware have always been influenced by poultry production because of the need of this industry for a large and readily available supply of feed grains. For decades, most of Delaware's cropland has been used for grain crop production; in 2007, corn, soybeans, and small grains represented about 88% of the 455,695 acres of field, hay, and vegetable crops harvested in Delaware and generated $117M in farm sales. Other major economic components of Delaware agriculture in 2007 were vegetables ($71.5M), dairy ($21.7), and the rapidly growing "Green Industry" (nurseries, floriculture, greenhouses, and turf; $17M). Delaware ranks first in the nation with lima bean acres harvested.

Today, many economic and social changes are in motion that may significantly alter the face of Delaware agriculture in the future. One of the primary reasons for the long-term success of the poultry industry, and Delaware agriculture in general, has been the proximity of the state to major urban markets, such as Baltimore, Philadelphia, New York, and Washington, D.C. However, recent trends in population growth and mobility in the Northeast and Mid-Atlantic regions have begun to markedly influence the nature of land use in Delaware and raise serious questions about the future role of agriculture in the state's economy. Simply put, there has been a population migration into Delaware from other states in response to economic opportunities, desirable retirement settings, and relatively low housing and land costs. The state population grew by nearly 20% from 1990 to 2000, accompanied by decreases in the number of farms and the amount of land in farms. From 2000 to 2006, the population continued to increase at a rate higher than the US average at 8.9%. Projections show Delaware reaching one million persons by the year 2030. In 2002, there were 2,391 farms with a total of 540,080 acres; by 2007 the number of farms increased to 2,546, however overall farm acreage was reduced to 510,253 acres. Agriculture still remains the dominant land use in Delaware with 41% of the state land area. Despite statewide efforts to preserve farmland and natural resource areas, agricultural lands are rapidly being converted into suburban developments, small towns are becoming small cities, and our natural ecosystems are becoming increasingly fragmented. Land use is a politically charged issue, with agriculture firmly in the center of the debate. The value of farmland for development has skyrocketed, and Delaware farmers (average age is 55 and 25% of all principal operators are 65 or older), are regularly offered opportunities to sell their farms for housing, schools, and other urban or suburban land uses. Between 2002 and 2007, farm real estate values more than doubled. The average value per acre increased from $4,054 to $10,347.

Clearly, Delaware agriculture must develop a new vision for the future, one that looks to new products and new markets, while integrating innovations in production and marketing into current agricultural systems, if it is to remain a viable segment of the state's economy. Of equal importance is the need to not only sustain, but improve Delaware's natural ecosystems and environment, including wildlife habitats, biodiversity, air, soil, and water quality.

Our plan of work is organized into the following nine planned programs intended to provide solutions to the complex challenges facing Delaware today. It is important to note that the divisions between these programmatic efforts are artificial. Our research and extension efforts are most commonly conducted by multi-disciplinary teams working across programs, often in collaboration with colleagues in other disciplines. We also regularly plan and work with a wide range of stakeholders in other University departments, other governmental agencies, foundations, community groups, universities, and political or policy-making positions.

Animal Biology, Health, and Production Systems:

Our focus is on sustaining animal agriculture as a major economic engine for Delaware agriculture by advancing our understanding of animal genomics, disease diagnosis and control, and innovative, environmentally friendly production practices. Animal-based agriculture is one of the major components of Delaware's economy and has a major impact on the nature of crop production in the state. Poultry production is a three quarter of a billion dollar per year industry and other livestock sales (dairy, beef, swine) account for $26.6 million annually. The animal industries are also the main economic outlet for Delaware grain farmers who each year produce $70 to $80 million in corn, soybeans, and wheat. However, the fastest growing segment of animal agriculture in Delaware is the equine industry. In 2004, there were 13,000 equine at 2000 operations (horses on private farms, small stables, and at racetracks) in Delaware, utilizing 27,000 acres of land. Delaware ranks third in the U.S.A. in the average number of equine per county. The industry has more than a $360 million annual impact to the State, indicating its economic value to Delaware agriculture. Our main research and extension activities in this program are: diagnosis and control of infectious diseases; improved understanding of avian genomics as related to production and disease; food safety and technology; animal welfare; enhancing the environmental compatibility of animal production with emphasis on nonpoint nutrient

pollution, air quality, pathogens, and emerging issues (e.g., arsenic, antibiotics, endocrine disruptors); improving energy efficiency of poultry production by developing solar-powered poultry houses; expanding extension programs in equine health and nutrition; and building better community relations between animal producers and their suburban, non-agricultural neighbors.

In FY2008, there were 32 FTEs (29 research and 4 extension) associated with our *Animal Biology, Health, and Production Systems* planned program. Outputs of this program included 7 awarded grants (of 14 submitted), mentorship of 13 M.S. and 3 Ph.D. graduate students, 31 refereed publications (scientific articles, books, and book chapters), 48 extension fact sheets, 84 invited and 69 volunteered presentations, 4 websites, and 68 workshops. Examples of research and extension accomplishments include leadership and active participation in programs of the USDA-CREES sponsored Avian Influenza Coordinated Agricultural Project (AI CAP) with goals to: (i) improve the diagnostic tools needed to rapidly identify and respond to an AI outbreak; (ii) develop depopulation techniques to deal with poultry mortality caused by AI; and (iii) educate the poultry industry, other industries associated with poultry production, state and federal agencies, and the public about preventing and controlling this disease. The UD AI team also continued to work closely with the Delaware Department of Agriculture and the Delaware Department of Health and Social Services to coordinate response plans in the event of an AI situation. International efforts included collaborative training sessions on AI prevention, diagnosis and management with scientists from Romania and Bulgaria. Basic research also focused on other potentially devastating poultry diseases, including Marek's, stunting runting syndrome (Cystic Enteritis), and infectious laryngotracheitis. In FY08, research and extension programs on the quick containment of flocks infected with avian flu continued to expand and receive international attention for their success. Most containment procedures involve partial house, whole house, or containerized gassing with carbon dioxide. With containerized approaches, the birds are individually caught and placed into containers for gassing. A multidisciplinary team of engineers and poultry scientists at the University of Delaware have developed a novel foam depopulation method as a tool for fighting avian influenza. Research showed that water-based foam caused cessation of movement as fast as other currently accepted procedures and showed similar stress levels in the birds. The foam procedure, however, can be implemented on a large scale far faster and with fewer people. With fewer technicians needed for decontamination, fewer people are at risk for contracting avian influenza and therefore the human risks associated with the depopulation of diseased poultry are minimized. In addition, the personnel involved perform less physical labor, which makes it easier to provide appropriate protective equipment. Water based foam depopulation went through its trial by fire. In 2007, water-based foam was used to depopulate adult turkeys in two separate incidents in West Virginia and Virginia. In 2008, water-based foam was used to depopulate game birds in Idaho. In October 2008, a University owned patent for the foam depopulation procedure was issued. The University is actively licensing the technology. Animal nutrition research led to major breakthroughs in the modification of poultry diets to reduce phosphorus (P) excretion, dietary practices now widely adopted by the poultry industry that have led to 30+% reductions in the amount of poultry manure P generated each year. Over the past several years, research scientists have analyzed the nutritional requirements of poultry and swine and the effects of phytase-modified diets on the livestock and the environment as part of a "feed-to-field" approach to nutrient management. Research has confirmed that Delaware chickens now digest more of the phosphorus, an essential nutrient, in their feed, thanks to the addition of phytase. As a result, about 23 percent less phosphorus is output in chicken manure. So now when poultry litter is used to fertilize a farm field, much less P is available to potentially leach from the soil or be carried off in storm water to a river or bay. There are now about 19 pounds of P in a ton of Delaware poultry litter compared to 25 to 30 pounds of P per ton of litter just five years ago. The 30-40 percent reduction is credited to phytase-modified diets and other nutrient management practices adopted by poultry farmers under Delaware's Nutrient Management Law of 1999. That reduction means that the P load to the environment has been reduced by some 2 million to 3 million pounds per year. The data have been shared with a nutrient management partnership involving the poultry industry, environmental regulators and the academic community. Poultry genomic research addressed functional mapping of growth regulating genes in broiler chickens and use of an immunogenomics approach to study host innate immunity against intestinal parasites. Research in avian immunology investigated mechanisms that regulate the immune response of broiler chickens to avian pathogens, with emphasis on the histocompatibility complex (MHC), a gene complex whose products restrict T-lymphocyte recognition of foreign antigens. Extension and research programs on the use of solar energy to power poultry houses continued to grow and receive widespread interest by the industry and governmental agencies. Dairy science research focused on use of microbial inoculants and enzymes to stabilize and prolong the quality of silage during fermentation, thereby improving dairy nutrition. Molecular techniques are also being used to investigate growth, metabolism, and effectiveness of these organisms. A novel rapid detection system for dairy cattle that identifies lameness at early stages has been developed. This system is being evaluated worldwide for its ability to provide automated continuous detection of lameness which should allow dairy cows to recover faster and return to maximum productivity. Basic molecular research is studying the genes that control circadian rhythms in dairy cows and how this relates to immune systems, animal productivity and health. Extension programming in the equine area addressed the fact that for decades, the equine industry has recommended grain as the basis of an equine diet with little regard to forages. In 2007, revisions were published of the National Research Council's (NRC) nutritional requirements for horses. These revisions stated the importance of quality pasture and the basis of forages for equine diets. In addition, the increased cost of grain has made horsemen take a greater look at forages as a less expensive option for the equine diet. Two equine conferences were held to review the new NRC guidelines, focused on forage and it being the base of the equine diet. These conferences stressed the need for horsemen to have their forage analyzed prior to feeding to ensure a diet appropriate to the needs of their horses. Cooperative Extension has seen an increase in the number of horsemen requesting assistance in analyzing their forages and conducting pasture consultations, as a result of these conferences. Horsemen are requesting assistance in looking at their analysis results to determine adjustments needed to ensure a balanced diet, based on

the needs of their horses.

Biotechnology and Biotechnology-Based Agribusinesses:

The University of Delaware, in conjunction with the state and private industry, has devoted nearly 25 years to the development of research capacity and expertise in basic and applied biotechnology. Areas of existing strength are avian virology, physiology, and genomics and plant molecular biology and plant breeding. In our avian programs, biotechnology is used at the basic level to improve poultry health and immune competence and to understand fundamental mechanisms of avian diseases. At the applied level, biotechnology efforts are directed toward improving diagnostic testing methods, developing vaccines and other disease control methodologies, surveying for emerging avian disease causing agents, and developing disease resistant breeds of chickens. For plants, basic biotechnology efforts include understanding gene regulation in plants, particularly those associated with RNA turnover or small RNA-mediated gene regulation. Other efforts include understanding disease resistance and signal transduction pathways in plants, understanding nitrogen fixation via the application of molecular and proteomics approaches, and understanding, at the molecular and atomic levels, plant-soil interfacial relations important to nutrient and heavy metal uptake. Key elements of this program include: expanding fundamental, cross-disciplinary research in the avian and plant/soil research areas; applying basic biotechnology research to the development of diagnostic methodologies for plants and animals; investigating new opportunities to apply biotechnology knowledge, such as alternate, bio-based energy sources (e.g., plant species for biofuels) that make economic sense for Delmarva; producing pharmaceuticals, vaccines, nutriceuticals and other products from plants; and a new, high priority - developing biotechnology-based agribusinesses by financial planning, risk management analysis, and evaluation of the marketability and consumer acceptance of biotechnology based products.

In FY2008, there were 21 FTEs (21 research, 1 extension) associated with our *Biotechnology and Biotechnology-Based Agribusinesses* planned program. Outputs of this program included 13 awarded grants (of 32 submitted), mentorship of 26 M.S. and 17 Ph.D. graduate students, 73 refereed publications (scientific articles, books, and book chapters), 45 invited and 12 volunteered presentations, and 11 websites. Some key recent research efforts in plant molecular biology included studies of micro and small ribonucleic acids in crops of global importance, such as rice. Advanced sequencing technologies and high-powered computer-based informatics approaches are being used to study how mRNAs encode proteins and small RNAs regulate plant development and responses to stress. Most recently, research in this area discovered novel molecules, called natural antisense microRNAs (nat-miRNAs) that target the genes sitting directly across from them on the opposite strand of DNA in a rice cell. These molecules act as a genetic switch, turning rice genes on and off, and are providing insight about biochemical pathways and evolution, which are important to the health of a grain that feeds most of the world. Other research on small RNAs is related to stresses such as drought, temperature and nutrient deprivation and their relationship to the emerging genetic code of *Brachypodium distachyon*, a potential biofuel crop and a valuable functional genomic model for energy crops and temperate grasses. For example, researchers at the University of Delaware, working with colleagues at the University of Arizona and South Dakota State University, have identified unusual differences in the natural mechanisms that turn off, or "silence," genes in corn. They found that there are many more RNAs of an unusual class known as "small interfering RNAs" in corn than there are in Arabidopsis. The discovery, which was made by comparing the impact of inactivating a gene that occurs in both corn and in the much-studied laboratory plant Arabidopsis, provides new insight into how one of the world's most important crops protects itself from mutation-causing mobile DNA elements and viruses. The scientific community is sequencing the corn genome currently. Once the genome is available, the work of matching up small RNAs to specific traits in corn will be much easier. This research is helping to better understand the biology of corn--one of the most important plants in the world--and gives new avenues for exploring a novel class of small RNAs. Molecular biology approaches are also being used to sequence small RNAs in *Medicago*, closely related to alfalfa and thus a good model for legumes such as soybeans, to better understand the fundamental mechanisms of biological nitrogen and to elucidate how plant cells communicate through plasmodesmata, by identifying the molecular components involved in these processes and investigating their roles in plant growth and development. Animal molecular biology research is using high throughput sequencing to develop a collection of chicken ESTs which are then used to prepare DNA microarrays for profiling the development of the immune system. Analyses of changes in these profiles during challenges to the immune system are being conducted as a means to predict vaccine efficiency. In addition, the arrays are used for the identification of candidate genes involved in disease resistance. Other ongoing research focuses on the regulation of growth hormone (GH) action in poultry including the identification and characterization of the chicken growth hormone receptor gene, the components of the signaling pathway used by this receptor, and genes regulated by growth hormone. Mutations in the growth hormone receptor gene in sex-linked dwarf chickens have been identified. Molecular techniques are also being used to gain a more fundamental understanding of Marek's disease virus which transforms T lymphocytes in infected chickens. Specific projects are aimed at understanding the functions of viral gene products important for oncogenicity; latency, including studies on the establishment, maintenance, and reactivation of Marek's disease virus from this state; and critical virus-host cell interactions that influence oncogenicity and vaccinal immunity. Viral gene function is being examined by generating loss of function mutants in the genetic background of a highly oncogenic strain of Marek's disease virus.

Ecosystems and Biodiversity:

Our long-term goal is to develop strategies that enhance and restore ecosystems and sustain biodiversity in a state where land use is creating an increasingly fragmented, suburbanized and inhospitable landscape. Key research and extension programs will focus on: learning how to landscape in ways that allow plants and animals to share human dominated spaces;

bettering our understanding of how anthropogenic perturbation of natural ecosystems (forests, wetlands, marshes, ponds) affects their ecological functions and the values they provide to society; developing management strategies that improve natural areas (e.g., forests) and native wildlife habitat, protect endangered species, and increase native biodiversity; developing new agricultural management practices for the control of pests and invasive species that have minimal effects on natural ecosystems and environmental quality.

In FY2008, there were 14 FTEs (9 research and 4 extension) associated with our *Ecosystems and Biodiversity* planned program. Outputs of this program included 10 awarded grants (of 34 submitted), mentorship of 34 M.S. and 6 Ph.D. graduate students, 19 refereed publications (scientific articles, books, and book chapters), 11 extension fact sheets, 113 invited and 50 volunteered presentations, 7 websites, and 65 workshops. Examples of research and extension accomplishments include: studies of the impact of invasive plants (e.g., "mile-a-minute" weed, kudzu) on agricultural and natural ecosystems; the ecological changes in natural ecosystems caused by widespread use of alien invasive plants in home landscapes; strategies to manage the increasing deer population which is damaging agronomic crops, homes, and natural areas; pollination biology for bees as it relates to the major problem of colony collapse disorder; effects of marsh management strategies (e.g., flood control) and atmospheric deposition of mercury on breeding ecology of coastal birds; population ecology research with the northern bobwhite; estimating habitat carrying capacity for wintering and spring staging American black ducks in coastal areas; and continuation of the longest running ongoing study of the wood thrush, a neo-tropical migrant of conservation concern, that has generated, over the past 31 years, a data set of unparalleled value. Integrated pest management research and extension continue to focus on key pest of crops important to regional vegetable production. In Delaware, and Maryland, pickling cucumbers are grown on approximately 8,000 acres. Each year losses from insect, disease and weed pests can result in reduced returns to producers. Two key pests identified by producers are downy mildew and cucumber beetles. The following high priority research and extension needs were identified as part of a pest management strategic plan for pickling cucumbers : development of a forecasting and predictive system for downy mildew, evaluation of currently available and pipeline fungicides for downy mildew control, development of resistant cultivars, and the evaluation of commercially applied seed treatments for cucumber beetle control. Research and extension programs focused on four main areas: Downy Mildew forecasting as part of a National ipmPipe system, evaluation of new chemistry to control downy mildew, establishment of sentinel plots to detect the first occurrence of downy mildew in DE and MD and the evaluation of seed treatments for cucumber beetle management. Newer seed applied treatments for cucumber beetle control on pickling cucumbers provide economic control , increased worker safety and resulted in a 2 fold reduction in the amount of active ingredients in the environment compared to at planting insecticides. With the recent federal registration of one commercially applied seed treatment (winter 2009), we anticipate a 10% reduction in the number if acres receiving either an at-planting application of insecticide or foliar sprays for cucumber beetles. The Cucurbit Downy Mildew forecasting system in combination with the use of sentinel plots to study pathogen movement helped growers in the region minimize economic and environmental costs of fungicide sprays by helping them time application when and where they were needed. This information was posted throughout the season on our Weekly Crop Update which reaches close to 300 clientele including l pickling cucumber growers, consultants, agri-business and seed company representatives. Since conditions were not extremely favorable for the pathogens (compared to the severe outbreak year of 2004), producers on were able to save at least one fungicide application on at least 50% of the acreage. Current programs also continue to incorporate sustainable strategies including disease scouting; the use of weather based disease forecasting system to time fungicide application and the use of new thresholds and reduced risk chemistry for mite management. Small plot trial and grower trials were used to demonstrate the effectiveness of reduced risk aphid control materials and the effectiveness of natural enemies. Small plot demonstrations were also used to evaluate the effectiveness of perimeter trap crop to control cucumber beetles and reduce insecticide use. The disease management component included in-season diagnostics, the evaluation of reduce risk fungicides, and education on disease resistance management. The current multi-state watermelon IPM program continues to demonstrate the value of using the Melcast Disease Forecasting System on over 2000 acres of watermelons. When using Melcast, growers and consultants continued to report improved disease management resulting from better timing of fungicide applications. Information from small plot research demonstrating the effectiveness of reduced risk chemistry for aphid management in watermelons was by three consultants to make control recommendation on over 200 acres of watermelons resulting in improved control and preservation of natural enemies. The use of a perimeter trap crop for cucumber beetle management in watermelons demonstrated the effectiveness of the trap crop in reducing foliar sprays for cucumber beetle. Initial research results indicated that producers could eliminate 1-2 early season foliar sprays for cucumber beetle control using perimeter trap crops. The use of perimeter trap crops will be evaluated in farm demonstrations in 2009. Extension education continues to thrive and work across state boundaries. Consultants, Agribusiness, Agency Personnel, and Extension Agents have all expressed an interest in receiving cutting edge information on new Integrated Pest, Nutrient and Crop Management strategies. Since this group often has clientele in multiple states, they would like to receive information that has application on a regional basis. They would also like to learn more about finding crop and pest management information on the web. Surveys indicate that this group of clientele would like to receive this information at intensive, multi-day training sessions. The Mid-Atlantic Crop Management School is an excellent example of a multi-state (Delaware, Maryland and West Virginia) and multi-agency (University, NRCS and Department of Agriculture) program which provides new educational information in the areas of Integrated Pest Management, Crop Management and Nutrient Management. The 2008 Mid-Atlantic Crop Management School educated 240 individuals including private consultants, agribusiness personnel, NRCS field staff and extension agents about a wide range of new pest and crop management topics. Survey results indicate that this group consults on over 490,000 acres in the

Mid-Atlantic region. As a direct result of a survey of school participants, this conference expanded topics directly related to safeguarding the environment by using reduced risk pesticides, understanding soybean growth and development to take advantage of alternative pest management strategies, determining if fungicides are needed in field corn and identifying when corn and soybeans are damaged by stink bugs. Mid-Atlantic crop management school participants were surveyed and indicated that new IPM and crop management information presented would result in an increase of $ 26 per acre in income for their clientele. The *Center for Managed Ecosystems*, established in 2007, is expanding its efforts to become a leading interdisciplinary center dedicated to improving the ability of urban, suburban, and agricultural landscapes to support the plants, animals, and physical conditions essential to the long-term productivity of the ecosystems on which humans depend. Collaborative partners in this Center include the U.S. Forest Service, the Delaware Department of Natural Resources and Environmental Control, the UD Botanic Gardens, the Baltimore Ecosystem Studies group, and the Delaware Invasive Species Council.

Family and Youth Development:

The rapid economic and social changes occurring in Delaware today place high demands on families and communities. These problems are not only confined to rural areas where development and urbanization of farmland are changing the nature of communities and the opportunities for youth, but also are found in our towns and cities. Strong families are the basic building unit for our future citizens, yet those charged with this important responsibility often do not have the time, money, or skills to carry out their family roles in a positive, productive manner. Preparing citizens to take prominent roles in shaping their future and the future of their communities is the fundamental goal of this planned program. Cooperative Extension activities are the major component of this program and focus on: helping youth develop the leadership and life skills needed to become productive, independent contributors to our society; increasing the educational opportunities in science, engineering, and technology for youth; providing guidance and training in areas important to financial security of families and to family well-being across the generations; and safe community programs on drug and alcohol prevention and safety training for vehicles, bicycles, pedestrians, farm families, and businesses.

In FY2008, there were 25 FTEs (24 extension, 1 research) associated with our *Family and Youth Development* planned program. Outputs of this program included 17 awarded grants (of 22 submitted), 3 refereed publications (scientific articles, books, and book chapters),62 extension fact sheets, 160 invited and 296 volunteered presentations, 14 websites, and 501 workshops. Ongoing extension efforts in this area include *Great Beginnings* - A series for parents of infants and young children, *eXtension Just in Time Parenting,* and *Families Matter!* - A series for parents of school-age youth. *Just in Time Parenting* – starting prenatally and continuing through adolescence – is available nationwide to every interested parent. JITP readers across all educational and economic levels report that: they feel more confident and competent in raising their children; JITP newsletters are more useful than any other source of information; they share and discuss the newsletters within their family and social networks. In studies in Delaware, those who report they change their behaviors and attitudes most – as a result of reading the newsletters – are youngest, poorest and least educated. One real success story in FY 2008 arose from the fact that Sussex County, Delaware has a rapidly growing population of Hispanic children. Most of the children have only been in this country a few years, or in some cases, just a few months. Their parents brought them here from Guatemala and other Latin American countries to make a new life in Sussex's agricultural community. Children struggle to assimilate, facing everything from language barriers to homesickness and U.S. laws and customs. The La Casita program, coordinated by UD 4-H, offers Hispanic youth club activities range from science experiments to service projects, cooking to crafts. Students visit the club weekly to learn about everything from environmental science to public speaking. Sometimes the acculturation process can be as simple as learning about U.S. law regarding things like bicycle helmets and seat belt use. Club coordinators stress to the children the importance of English language fluency for success in school and daily life, as well as later career success. Fun, interactive activities are used to help them work on their pronunciation skills and comprehension. Tweens and teens are encouraged to open up and talk about their struggles to assimilate. Other major programs include a Financial Management Education Training Program conducted in cooperation with agencies such as the Delaware State Housing Authority, AIDS Delaware, Neighborhood House Community Center, credit unions, housing counseling agencies and the Delaware Division of Emergency Services; After-School outreach programs at nine schools throughout the state that serve some of our lowest income youth by providing activities covering a wide range of topics in Science and Technology, Healthy Lifestyles and Nutrition, Community Service, Leadership, Arts and Crafts, Aerospace, Woodworking and Public Speaking. In addition all the programs offer nutritious snacks and/or hot dinners in collaboration with the Food Bank of Delaware; healthy lifestyles training, teen development workshops, and one of the largest and most successful 4-H programs in the US. More than 65,000 Delaware youth representing 45% market share of 4-H aged youth who reside in the state (more than twice any other state in the union), take part in 4-H clubs, after-school programs in a number of low resource communities, camps and other activities. 4-H helps Delaware youth develop the skills necessary to be marketable in tomorrow's workplace. Key activities in FY 2008 included statewide programs in *Science, Engineering and Technology (SET)* – 4-H youth ages 8-19 are exposed to diverse areas of science, engineering and technology as they participate in hands-on activities in environmental education, biotechnology, computer science, DNA mapping, the use of GPS instruments and manipulation of GIS data, etc.; *Healthy Living* – programming in this area addresses obesity in terms of making healthy eating choices, the importance of exercise, and alcohol and tobacco prevention; *Citizenship* – 4-H youth participate in many community service projects, helping them realize the role they play in making a difference in the lives of others. Delaware 4-H also offers a variety of programs to assist Delaware-based military members and their families; and *Leadership Development* – youth are positioned in leadership roles in every facet of the Delaware 4-H program.

Food Science, Technology, Safety, and Nutrition:

Outbreaks of foodborne illness and human health problems associated with poor or inappropriate diets are areas of national concern and the focus of this planned program. Food safety research will address methods by which we can enhance the safety and wholesomeness of foods by improving our understanding of the means that food pathogens exist, enter, survive, and propagate in foods and actuate disease syndromes in individuals who consume contaminated products. Strategies and technologies to prevent foodborne illness, such as the use of high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage, will be evaluated through multi-disciplinary research. Cooperative Extension outreach programs will increase awareness by producers, processors, food handlers, and consumers of effective strategies for food product safety. Educating the public, particularly youth, minority, and low-income groups, about the relationship between chronic diseases (e.g., cancer, diabetes, heart disease), diet, nutrition, exercise, and how to make choices that reduce the negative effects of diets on health will be another major focus of Extension.

In FY2008, there were 18 FTEs (7 research and 11 extension) associated with our *Food Science, Technology, Safety, and Nutrition* planned program. Outputs of this program included 6 awarded grants (of 19 submitted), mentorship of 8 M.S. and 2 Ph.D. graduate students, 21 refereed publications (scientific articles, books, and book chapters), 10 extension fact sheets, 27 invited and 29 volunteered presentations, and 218 workshops. Food science research focuses on food safety and innovative food technology applications. Specific ongoing areas of research include the use of non-thermal processing and anti-microbial packaging to pasteurize foods, prolong shelf life, and inhibit pathogens; basic research on the ecology and genetics of food pathogens; and the environmental factors associated with the transmission of pathogenic viruses and bacteria in agriculture – from "farm to fork"; and viral contamination of drinking water where an innovative new technology (zero valent iron) has been developed to purify polluted drinking waters. Extension programs focus on nutrition and food safety. In the state of Delaware, more than 25% of the population is obese. In particular, overweight children have become an epidemic in today's culture. In response to this alarming trend, Delaware 4-H is engaged in healthy lifestyles programming to counteract the staggering statistics of obesity and sedentary lifestyles among youth. Multiple programs now in place transfer knowledge about proper eating and exercise habits to youth and their families, so that they will all live a more productive and well nourished life. Examples include the '5-2-1 …Almost None' marketing campaign designed to send the message about eating fruits and vegetables, participating in daily exercise, and limiting the intake of sugary beverages, the "Power of Choice" extension curriculum focused on making healthy eating choices which has been taught at several after-school programs throughout the state, and the "Favorite Foods" competition which engages youth in creating a balanced menu for a day, preparing a dish, and developing them for a proper place setting. Youth also take part in a foods and nutrition judging competition where they demonstrate their knowledge in nutrition facts, consumer education, cooking terminology, and the food pyramid guide and meal comparison. Extension programs on food safety are expanding rapidly. With growing global concerns over the safety of fresh produces, with recent outbreaks of salmonella in spinach, tomatoes, and peppers, Delaware's fruit and vegetable growers are seeking ways to reduce foodborne illness through good agricultural practices on the farm. UD food safety research and extension specialists have joined with agricultural extension specialists to offer food safety training for produce growers and have increased efforts to provide support to growers wanting to implement related practices. Produce growers in Delaware have begun to implement these practices on farm. Additional training is scheduled. Youth are often overlooked as an audience for safe food handling procedures. Teaching students the role of microbes, food contamination, hand washing, and food temperature has the potential to reduce food borne illness. More than 800 youth ranging in age from 8 to 12 participated in week-long "Don't Bug Me" classes emphasizing food safety principles. The curriculum incorporated numerous activities, animations of song parodies, and preparation of one food item per day. The curriculum was divided into five daily segments: bugs--highlighting the role of microbes in making food products, in food spoilage, and in making people ill; bug express--emphasizing that microbes are hitchhikers and identified ways by which foods can become contaminated; wash those bugs away—stressing the role of hand washing in preventing food borne illness; bugs on the hot seat or in the deep freeze—exploring ways and the rationale for keeping foods hot or cold; and a bug free celebration—revisiting important concepts. Improvements between pre- and post-test scores were evident for all behaviors and ranged from 13 to 29 percent.

Plant Biology and Crop Production Systems:

Despite growing pressures to convert farmland to urban/suburban uses, production agriculture in Delaware remains a strong and vital part of the state's economy. Grain and vegetable crop production are cornerstones of Delaware agriculture and many opportunities exist to increase the productivity, profitability, and environmental compatibility of these systems and sustain them as viable land uses for the future. At the same time, interest is growing in new uses for existing crops (biodiesel fuels from soybeans, ethanol from corn) and in alternative, high value plant production systems (greenhouses for producing genetically engineered pharmaceutical and nutriceutical plants, herbs, spices, essential oil plants, exotic specialty vegetables and other niche market, high value plants). Key areas of emphasis are: improving our understanding of plant genomes and the application of genomic information for crop improvement, crop quality, and crop protection; plant-soil interfacial reactions at the molecular scale to increase our knowledge of factors controlling symbiotic relationships between plants and soil microorganisms and plant uptake of nutrients and heavy metals; increasing the efficiency of crop management systems by better cultural techniques, innovations in nutrient and manure management, adoption of improved crop and vegetable varieties, and enhancing the marketing skills of all producers; developing cultural practices and marketing strategies for niche crops and mixed-use farms

(beef and goats on pastures); and research and extension programming on plant management strategies for suburban ecosystems that are environmentally sound and protect water quality and wildlife habitats.

In FY2008, there were 41 FTEs (27 research and 14 extension) associated with our *Plant Biology and Crop Production Systems* planned program. Outputs of this program included 23 awarded grants (of 45 submitted), mentorship of 10 M.S. and 13 Ph.D. graduate students, 24 refereed publications (scientific articles, books, and book chapters), 32 extension fact sheets, 108 invited and 191 volunteered presentations, 9 websites, and 150 workshops. Some of the research programs in this area include projects focused on corn breeding for disease and drought resistance and to improve the availability of phytate-P in corn grain used for animal feeds, thus helping to reduce P concentrations in manures and protect water quality. A major breakthrough in corn breeding was completed in FY 2008. A gene in corn exists which provides resistance to the fungus *Colletotrichum graminicola*, which causes the often devastating disease anthracnose stalk rot (ASR). In the early 1980s, the gene was found only in a "tropical" corn line from Mississippi, which could not be used commercially. UD Scientists have worked for more than 20 years to demonstrate that the gene could be bred into commercial germplasm and developed "near-isogenic lines" that facilitated the genetic characterization of ASR resistance. Last year UD and DuPont scientists teamed up to use cutting-edge technology to "fine map" the gene and develop molecular markers under a Collaborative Research Agreement between DuPont and the University. DuPont scientists are now using those markers in high throughput genetic technology to move the gene into a wide variety of elite commercial germplasm. Intellectual property protection is pending on the discoveries of the collaboration and the corn lines developed by UD. Other novel studies are using plant tissue culture to develop propagation protocols for plants native to the eastern temperate U.S.; interactions between fungal pathogens of rice, barley and potatoes with emphasis on the transcriptional and translational regulation of genes that may play critical roles in the interactions between these destructive pathogens and their hosts; research on the biological significance of root exudation and the root-root, root-microbe, and root-nematode communications that are continuous occurrences in the rhizosphere. This research interfaces plant biology and soil chemistry to unravel the underground communication processes important in agricultural and natural ecosystems; for example recent studies with the invasive strain of *Phragmites australis*, a plant causing major ecological problems in wetlands, have shown these plants exude from their roots an acid so toxic that the structural proteins in the roots of neighboring native plants are disintegrated. This then leads to major losses in biodiversity due to the dominance of *Phragmites* in many wetlands. Extension programs are addressing the interactions between invasive and native plants in natural and managed settings (e.g., Delaware highways); understanding and managing herbicide resistance in weeds impacting important agronomic crops; evaluating soybean varieties resistant to the emerging problem of Asian soybean rust; and developing management practices and plant breeding programs for lima beans, one of Delaware's most important vegetable crops.

Rural Development and Land Use Change: While agriculture remains an important sector of Delaware's economy, continued growth of the banking, recreation, retirement, retail, and wholesale trade industries has led to a growing suburban population and pressures to convert farms to other uses. Land use change is now a major social and political issue. Developers and farmers are pursuing conversion of cropland into housing and related infrastructure, while the state is attempting to restrict land use conversion by preserving farmland and natural resource areas. Loss of farmland will have far-reaching impacts on Delaware agriculture for several reasons. Perhaps most important, the majority of Delaware's cropland is used to produce grain crops for the poultry industry. Loss of this grain supply will create economic pressures on poultry integrators who will have to import grain from other regions at greater costs. Many Delaware farmers also now regularly face challenges as they interact with neighbors who are unfamiliar with farming and complain about odors, dust, noise, machinery on roads, and possible environmental and human health problems of pesticides, fertilizers, and manures. Fragmenting the agricultural landscape into smaller farms interspersed amongst suburban developments is also changing the social fabric of Delaware's rural communities. These demographic changes affect family and community values, political decision-making, the education and skills needed for new types of careers, and the financial stability of individuals and families. Our research and extension efforts focus on: aiding statewide efforts to understand, manage, and revitalize land use change, including reducing conflicts as change occurs; defining the necessary "critical mass" for future agricultural viability and the relationships between urban and rural land uses important to sustaining agriculture in the long-term; working with rural families to respond to changing communities through programs focused on education, career skills, and financial planning; helping to develop land use policies that are protective of the environment; and preserving agriculturally productive land and natural resource areas for future generations.

In FY2008, there were 12 FTEs (8 research and 4 extension) in our *Rural Development and Land Use Change* planned program. Outputs of this program included 6 awarded grants (of 11 submitted), mentorship of 28 M.S. and 7 Ph.D. graduate students, 11 refereed publications (scientific articles, books, book chapters), 2 extension fact sheets, 26 invited and 8 volunteered presentations, 5 website, and 21 workshops. Examples of research efforts for this program include investigations into various policy aspects of farmland preservation such as willingness to pay for land preservation across states and jurisdictional scale and analyses of benefit transfer equivalence policies; research on use of theoretical modeling and optimization to reveal potential agricultural and ecological gains obtained by incorporating optimization into selection methods, including the use of game theory and mechanism design to develop strategies to overcome incentive problems; application of experimental economics techniques to better understand public-buyer private-seller auction markets, directly relevant to Delaware's conservation programs and having national implications for the USDA Conservation Reserve and Conservation Reserve Enhancement Programs and the Wetland Reserve Program; economic analyses of various policies affecting the willingness to pay for green energy; and research on international aspects of trade openness and economic growth and spatial price dynamics

related to poultry and grain production. Extension programs address farm business management skills through programs of the Northeast Center for Risk Management Education (serving New England states, New York, New Jersey, Pennsylvania, Maryland, West Virginia, and Delaware). This center was established at the University of Delaware to educate producers of agricultural products about the range of risk management opportunities available to them in order to maintain profitable businesses; expanding e-Commerce opportunities for farm fresh markets and agri-tourism Industries; and providing targeted risk management and financial programming for women in agriculture, through regular support and an annual statewide conference. Several Extension programs actively addressed the land use and rural development problems in southern Delaware in FY 2008. Sussex County, the largest county in Delaware, 606,000 acres is experiencing rapid growth due to its proximity to the Atlantic Ocean, low property taxes and proximity to a large population centers in the Mid-Atlantic region. The majority of new landowners in Sussex are retirees. Sussex County is the largest broiler producing county in the country which supports the large acreage of grain production. Several conflicts emerge, the classic urban-rural lifestyle, the conversion of agricultural working lands to development and revising rural governments e.g. codes and services to meet the changing demands of the new residents. The community development extension agent has partnered with UD colleagues in from Sea-grant Marine Advisory Service and the Institute for Public Administration through the Coastal Community Enhancement Initiative (CCEI). Several land use educational efforts are underway.Heart & Soul of Sussex County is a program designed to engage residents in identifying the core elements (what we value) of Sussex County. Once these elements are identified and agreed upon, it then becomes the responsibility of Sussex Countians to act on those principles. To date numerous meeting throughout the county have occurred. A list of elements has been identified and revised using town meetings and audience response technology. The second phase of the project that will engage residents in thinking through the implications of how to use those elements e.g. economic development, revision of land use codes etc. is underway. Community Viz is a land use decision-making tool. The CCEI has developed a build out model for Sussex County. A build out indicates the amount of developable land based on County zoning allocations. Because of the permissive agricultural/residential zoning designation (2 dwelling units per acre), the vast majority of agricultural working lands are in play for development. With the strong property rights ideal of county residents, significant creativity will be needed to preserve working lands. The second phase of Community Viz will highlight build out versus land use allocation based on population projection and attempt to surface for public discussion the inherent trade-offs necessary to support a viable agriculture industry and meet the needs of new residents.

Soils and Environmental Quality:

Delaware's soil resources underpin agricultural success and are also linked closely with many of the long-term environmental challenges facing the state today. The major soils related challenges we continue to face are related to land use change, production agriculture, and industrial pollution. We are losing the most productive agricultural soils in the northern part of the state to suburban development at an alarmingly rapid pace. The environmental impacts of increased impervious surface and nutrient and pesticide use by new landowners are not well understood and will require more educational programs by Cooperative Extension in the future. In southern Delaware, the heart of production agriculture and the poultry industry, most soils are sandy, prone to drought and leaching, and overly shallow ground waters that are hydrologically linked to rivers and important coastal estuaries. Nonpoint nutrient (nitrate, phosphate) pollution of groundwater aquifers used for drinking water supplies and aquatic ecosystems, such as our Inland Bays (a national estuary), has been a serious problem for more than 35 years. Recent advances in nutrient management, and the passage of a state nutrient management law, have begun to significantly improve N and P management statewide. However, it is likely that phosphorus which has accumulated in soils and nitrates in shallow aquifers will continue to contribute to water quality degradation for a decade or more, thus there continues to be a need for innovative research and extension programs that can improve nutrient management practices by production agriculture. Other soil problems where we plan research are the remediation of metal and organic chemical contaminated soils in urban brownfields, emissions of gases and particulates from soils and surface applied waste materials (e.g., manures, biosolids) that can affect air quality, climate change, human health and nearby ecosystems; and the fate, transport, and potential human health impacts of pathogens (viruses, bacteria) originating in manures and other by-products.

In FY2008, there were 23 FTEs (18 research and 5 extension) in the *Soils and Environmental Quality* planned program. Outputs of this program included 20 awarded grants (of 27submitted), mentorship of 11 M.S. and 17 Ph.D. graduate students, 36 refereed publications (scientific articles, books, and book chapters), 11 extension fact sheets, 70 invited and 117 volunteered presentations, 8 websites, and 87 workshops. Major research areas included basic soil chemistry research on fate, mobility, and transformation of toxic metals such as arsenic, nickel, and zinc and plant nutrients such as phosphorus and sulfur. Much of this research is conducted at the molecular or atomic scale at synchrotron facilities located at National Research Laboratories; interdisciplinary research on processes regulating nutrient and metal uptake by plants, important for agronomic crops and remediation of metal contaminated soils using hyperaccumlator plants; nutrient cycling and transport in soils amended with manures and municipal biosolids with particular emphasis on managing high phosphorus soils to protect water quality; innovative strategies to enhance the effectiveness of vegetated filter strips (buffers) at mitigating nitrogen and phosphorus pollution of ground and surface waters; fundamental studies of the processes controlling the movement of viruses through soils to ground waters – and practices that can be used to prevent ground water contamination; ecology and diversity of microbial populations in soil-plant systems and microbial community responses to environmental perturbations; effects of soil-borne viruses on microbial communities; soil hydrology and microbial ecology as related to the morphology of hydric soils and functional assessment of wetlands; watershed hydrochemistry research focused on how topographic, hydrologic, and soils conditions in

watersheds control the transport and fate of solutes and chemicals and how riparian and wetland ecosystems impact hydrologic and biogeochemical processes in watersheds; and process-based modeling of geochemical soil formation across diverse landforms. Extension programs in this area focused on nutrient management and are nationally recognized for statewide education and certification of all nutrient users and for on-farm demonstrations of the latest best management practices for efficient nutrient use; other extension efforts include increasing the use and efficiency of irrigation and evaluations of the use of soil testing, plant tissue testing, and remote sensing to improve nutrient efficiencies in corn. One major success story related to nutrients and water quality in FY 2008 was a new strategy to address the problem of derelict poultry houses. These are abandoned poultry production structures that have often been left untouched with the potential to pollute ground and surface waters, while tying up lands that could otherwise be used for tillage or conservation purposes. One option utilizing derelict poultry house sites is to recycle the wood in houses by grinding it and then incorporating it into the pad site. Researchers have determined the amount of nutrients that then remain on site. The ground material can be excavated an used as fertilizer material on corn, soybeans, and turfgrass. Demonstrations showed ways that the materials can be remediated in situ, that when provided with an additional carbon source can maintain perennial grasses or annual small grains. Demonstrations and associated research has shown that this practice recovers nitrogen that would otherwise be lost into the water table, thus serving a nutrient management benefit. Wood that is recovered as a remediation tool means that there is less material making its way into landfills. In addition, traditionally derelict houses were burned; a reduction in this practice means a benefit to air quality. Due to this research, NRCS has altered one of their existing standards to allow cost share monies for the decommissioning of derelict poultry house sites using this technology. NRCS will offer a pilot project allowing a certain number of derelict sites to be remediated and recovered. These monies are available to those who are actively farming. Because of the environmental benefits, future projects include pursuing those who are not still actively farming.

The Science and Practice of Aquaculture:

The development of an aquaculture industry in Delaware has the potential to enhance diversification of farming in this region and increase farm income. Currently, the major obstacles to growth of the aquaculture industry are high (and growing) land costs and the lack of significant examples of aquacultural success in Delaware. Extension programming and research will focus on identification of the best aquaculture crops and management techniques that can minimize disruption of current farming practices and maximize available resources. Other areas of effort will include educating farmers, community leaders and other interested individuals on biological, technological and social issues pertaining to aquaculture.

In FY2008, there were 2 FTEs (all in research) associated with *The Science and Practice of Aquaculture* planned program. Outputs of this program included 12 awarded grants (of 20 submitted), mentorship of 7 M.S. graduate students, 15 refereed publications (scientific articles, books, and book chapters), 13 extension fact sheets, 11 invited and 55 volunteered presentations, 3 websites, and 11 workshops. Examples of continuing research projects include interactions between algae, shellfish, and water quality with an emphasis on how nutrient pollution impacts shellfish ecology; habitat selection and delineation in aquatic systems; population dynamics and conservation of endangered species; migratory behavior of diadromous fishes; and the role of trophic interactions in structuring aquatic communities. Extension programs are closely aligned with ongoing research and address management practices for both freshwater and marine aquaculture; water quality impacts of aquaculture production systems, particularly aquaculture effluents; integrated aquaculture/agriculture systems; and new recirculation technologies.

Total Actual Amount of professional FTEs/SYs for this State

Year:2008	Extension		Research	
	1862	1890	1862	1890
Plan	58.6	11.4	111.9	9.9
Actual	56.5	10.0	108.2	14.0

II. Merit Review Process

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

- Internal University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review
- Other (Northeast Cooperative Extension Directors)

2. Brief Explanation

Scientific Peer Review of Research Programs is conducted in accordance with the *National Standards for Peer Review*

Merit review for Delaware Cooperative Extension consisted of five levels of peer and stakeholder review. Extension professionals submit county plans each year that have been reviewed by their peers within the county and by county stakeholder advisory groups. These stakeholder groups then provide input on critical needs and issues within their communities, which is used to develop the county plans. After county plans are complete, stakeholders review them for inclusion of the previously identified needs and issues, as well as, program delivery and evaluation methodologies. Each of these plans includes specific objectives that are examined for relevance, usefulness, and potential impact of the programs. This feedback is used to refine county plans and develop future plans. The second level of review is by college-wide issue teams that are cross-functional and multi-disciplinary. From this review, county plans are combined into a college-wide plan. The third level of review is both within and outside the university community. Copies of the plan are submitted to university administrators and related agency personnel who function as both present and future partners. These individuals are invited to comment on the objectives identified, areas of collaboration, and potential impacts. University administrators are also asked to comment on ways in which we might work across colleges and schools to increase our outreach efforts. A fourth level is with statewide stakeholder groups, including advisory groups, commodity organizations, volunteers, research partners, and state and local funding agencies. These groups are asked to provide feedback regarding objectives, potential impacts, and how it meets their specific needs. The final level is the Northeast Extension directors, who have agreed to share all state plans among each other. This peer review helps states advise each other on opportunities to strengthen individual state plans and ways that we can collaborate across state lines.state plans and ways that we can collaborate across state lines.

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 specifically with non-traditional groups
- Survey of selected individuals from the general public
- Other (Permanent advisory committees for extension programs and researc)

Brief Explanation

In the State of Delaware, the University of Delaware and Delaware State University use a multi-faceted approach to secure stakeholder input. We believe in direct contact with people and actively solicit input from a wide variety of clientele, users and stakeholders. College administrators, faculty working on research funded by state and federal agencies or industry, and Cooperative Extension staff regularly request input on the relevance of our research and extension priorities to state and regional problems. Numerous formal opportunities for input also exist and include, but are not limited to, the following: extension overall advisory committees, extension issue-based advisory committees, strengthening families statewide advisory committee, 4-H volunteers, 4-H Foundation, LINKS, agriculture commodity groups, environmental interests, the green industry, agribusinesses, agriculture associations (i.e., Farm Bureau, Grange, Pork Producers Association, Delmarva Poultry Industry, Soybean Board, Sheep Producers Association, etc.), Master Gardeners, Master Food Educators, and Master Financial Planners. We meet with these groups on a regular basis and request their input on our programs and encourage their involvement in all of our planning efforts.

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 External Focus Groups
- Open Listening Sessions
- Needs Assessments

Brief Explanation

Stakeholders are identified by a combined effort of college administrators, research and teaching faculty, and Cooperative Extension staff. We are very familiar with our traditional agricultural stakeholders and have established a number of advisory committees, at the county and state levels, to provide input on our research and extension programs. Similarly, we have long-standing contacts and good relations with many individuals, organizations, and agencies involved in the natural resource and environmental matters important to our research and extension programs. We work hard to ensure that these committees represent the range of agricultural production systems present in the state, the interests of those concerned about natural resources and the environment, and the social and economic issues related to communities, families, and youth development. We also take proactive steps to ensure that our advisory committees encompass the increasing diversity (age, gender, background, ethnic group) of our stakeholders. When new issues come forth, or a need for re-organization and re-direction of an existing program arises, we often establish focus groups composed of a mix of individuals internal and external to our universities to help guide our planning and to ensure that all interested parties are contacted for input. As appropriate, we also use surveys and open listening sessions to solicit input from the public.

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
- Meeting with traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Meeting with invited selected individuals from the general public
- Other (Meetings with permanent advisory committees)

Brief Explanation

We hold a variety of regular meetings across the state, which include a diverse mix of clientele, users, and stakeholders. These meetings include such things as: Agriculture Visiting Committee, State Chamber of Commerce, Kids County Advisory Council, Delaware Public Policy Institute Task Force, Friends of Agriculture Breakfast series, Council of Farm Organizations, USDA Food and Agricultural Council, State Agriculture Technical Committee, and user groups like 4-H regular and day camp parents. Students enrolled in our colleges, faculty, professionals, and salaried staff, are all encouraged to provide input on program priorities. We have conducted random surveys of users and non-users of the programs and activities on a variety of issues including land use and economic development. Other tools that we use to get input include visioning processes and focus groups. For the 2008-2012 Plan of Work, specific stakeholder input was obtained via a committee assembled by the Delaware Secretary of Agriculture to participate in the develop of a statewide plan for agricultural research. This committee consisted of leaders in agriculture as well as faculty and administrators from the University of Delaware and Delaware State University. All of these efforts have been focused on both building commitment and getting input from stakeholders such as government agencies, industry partners, and regulatory agencies. Our programs have expanded and input continues to increase. We are recognized as a source of not only useful but also reliable information. We will continue to seek input in a variety of ways. These methods will change as the issues themselves change.

3. A statement of how the input was considered

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

Brief Explanation

Brief Explanation of what you learned from your Stakeholders

While our stakeholders have many and diverse interests and concerns, the following continue to be areas of high immediate importance to them and for the state of Delaware and USDA-CSREES:

1) Energy - as it dramatically affects both the costs of producing agricultural crops and the future of nature and management of cropping systems, the impact of energy, and the economic volatility associated with energy supply, on agriculture is of highest priority today. How will farmers adapt to the competing demands from food and energy markets for their products in a manner that sustains profitability and protects the environment? Land use change - as the economic pressure to convert farmland to suburban and urban uses grows ever-greater, how will we sustain our agricultural land base to produce food, energy, fiber, and other products? How will the ecological and environmental benefits associated with agriculture be provided if crop land is converted to development? Recent major budget cuts to Delaware's nationally recognized farmland preservation program are an immediate concern with serious long-term implications for agriculture.Water and air quality – despite intensive efforts to develop agricultural management practices that protect water quality, nonpoint pollution of ground and surface waters remains a serious problem. Development is competing with agriculture for ground and surface water raising concerns about water supply in the future. Air quality concerns are growing, particularly for animal agriculture. Global climate change offers new opportunities for farmers and foresters as interest in biological approaches to sequester carbon grow rapidly. Will an integrated approach to the water and air quality problems facing agriculture today emerge to support research and guide policies that enhance agriculture in the future? Farm labor – demands and opportunities in other sectors increasingly make it difficult for farmers and other sectors of the agricultural community to hire and retain qualified labor. Many farmers are also concerned about the future of agriculture due to the major economic hurdles faced by young men and women who wish to pursue agriculture as a career. These challenges are directly linked to the need for policies that can preserve farmland, resolve complex immigration issues, and more rapidly advance the mechanization of agriculture. How will national policies affect our ability to sustain a viable population of farmers, maintain a stable farm labor base, and increase investments in the innovative technologies needed to increase agricultural productivity in the face of all these challenges? Irrigation – major droughts in 2 of the past 5 years have emphasized the need for a statewide, long-term strategy to increase the amount of irrigated acreage. This will both increase agricultural profitability and help protect water quality by increasing nutrient utilization efficiency by irrigated crops, particularly with respect to corn and nitrogen management. Extension education programs on the latest advances in irrigation technology and research on nutrient management for irrigated grain and vegetable crops are priority areas for the next decade.

2)

3)

4)

5)

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1157072	1066154	1336633	1088882

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1157072	1066154	1336633	1088882
Actual Matching	1392088	1066154	1562080	1088882
Actual All Other	1928814	402651	5929944	1886999
Total Actual Expended	4477974	2534959	8828657	4064763

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

V. Planned Program Table of Content

Program #1

V(A). Planned Program (Summary)

1. Name of the Planned Program

ANIMAL BIOLOGY, HEALTH, AND PRODUCTION 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
301	Reproductive Performance of Animals	5%	5%	5%	5%
302	Nutrient Utilization in Animals	15%	15%	15%	15%
304	Animal Genome	20%	20%	20%	20%
305	Animal Physiological Processes	10%	10%	10%	10%
307	Animal Management Systems	10%	10%	10%	10%
311	Animal Diseases	30%	30%	30%	30%
401	Structures, Facilities, and General Purpose Farm Supplies	5%	5%	5%	5%
402	Engineering Systems and Equipment	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	3.2	0.0	29.1	0.0
Actual	2.9	0.4	27.5	1.5

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
93958	138748	520991	30808
1862 Matching	1890 Matching	1862 Matching	1890 Matching
107145	138748	572514	30808
1862 All Other	1890 All Other	1862 All Other	1890 All Other
589044	0	217361	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Poultry Health and Disease Prevention and Control - understanding mechanisms of disease induction, host genetic resistance and immune responses in broiler chickens emphasizing respiratory diseases and oncogenic and immunosuppressive diseases. Disease prevention and control will focus on diagnostic surveillance methodology, vaccination and biocontainment procedures; (2) Poultry Growth and Development - understanding basic molecular and cellular mechanisms regulating poultry growth, development and meat yield; (3) Avian Genomics - development and application of avian microarrays for: disease diagnosis, resistance, and control; growth and development; and optimization of desired production traits; (4) Alternative Production Systems - evaluation of alternative production systems that reduce disease, mortality, and waste production, minimize antibiotic use, integrate solar power into poultry production systems and become more energy efficient, and foster compatibility between animal production, environmental quality, and the expanding urban population; (5) Nutrient Utilization in Poultry and Ruminants - increased nutrient utilization from an improved understanding of animal biology via the use of chemical and biological inputs and via improved management techniques to improve milk production, weight gain and feed efficiency; and (6) Equine Health and Management Systems – outreach on equine health and management systems needed for growth of the industry.

2. Brief description of the target audience

Poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers and allied industries; livestock commodity groups; forage producers, equine owners, producers and interest groups; state and federal agencies; federal research laboratories; peer scientists, and environmental and community groups.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	15000	15000	10000	2000
2008	12203	124920	6333	775

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	3	20	
2008	2	26	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	30	14

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	10	7

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2008	1	44

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	22	50

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	15	13

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2008	3	3

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2008	3	1

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	23	28

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2008	7	3

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2008	3	515

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	4	48

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	30	84

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	52	69

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	4

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	5	68

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increased awareness of the need to produce and utilize diets for all animal species that prevent unnecessary overfeeding of nutrients, especially nitrogen and phosphorus.
2	Education programs for the livestock and equine industries on equine nutrition and health practices, fiscal management, and beneficial use of the by-products of animal agriculture.
3	Establishment of an Avian Biosciences Center to conduct research, outreach, and K-12 educational programs on avian disease and production, food safety and technology, and the environmental compatibility of poultry production.
4	Increased number of poultry producers participating in surveillance, diagnostic testing, and vaccination programs for infectious avian diseases. Implementation of statewide plans to address major outbreaks of avian diseases.
5	Sustainable production practices for the dairy and beef industries that link forage and pasture production practices with animal health, performance, and meat and milk quality.
6	Improved economic competitiveness of the poultry and allied industries relative to other poultry producing regions in the U.S. and global competitors.
7	Increased number of poultry and dairy farmers using feed management practices that increase nutrient utilization, and feeding diets with lower concentrations of nitrogen and phosphorus.
8	Increased use of air quality best management practices that prevent odor, ammonia, and particulate emissions from poultry farms.
9	Increased number of diagnostic laboratories capable of using advances in avian genomics and state-of-the art instrumentation to rapidly diagnose infectious diseases
10	Disease Prevention and Control: basic and applied research on mechanisms of poultry disease processes will translate into useable tools and strategies for improved disease surveillance, diagnosis, prevention, and control in broiler chicken production. Knowledge will be extended to commercial poultry and allied industries.
11	Genomics: increased understanding of gene function and expression and targeting of candidate genes affecting economically important traits in broiler chicken growth and production, disease resistance and immunity. Improvements in classical poultry breeding programs by use of marker assisted selection (MAS) and technology transfer.
12	Nutrition: research will lead to improved understanding of nutritional requirements for poultry and ruminants and adoption of recommended dietary strategies by practicing nutritionists and producers. Specifically, the results of poultry directed research will aim to minimize nutrient contamination of the environment from manure. Results from ruminant based research will lead to improved management of forages to maximize nutritional value, safe use, and minimize spoilage during storage. Research will also result in enhanced collaboration between University and industry partners. Findings will help to increase the efficiency of livestock production and new technology will be transferred to stakeholders.
13	Environmental Compatibility: poultry industry and commercial nutritionists will adopt and implement recommendations for broiler diet modification – including such practices as reducing diet nutrient concentrations to more closely meet the animal's requirements, utilization of phytase and other diet additives shown to improve nutrient utilization, and incorporation of low phytate grains – in feed formulations to reduce nutrient emissions to the environment. Reduced emissions will be measured by reduced nutrient concentrations in manures and litters, reduced application of nutrients to cropland and other soils, and reduced movement of nutrients from soils to ground and surface waters. Other environmental issues related to animal agriculture include the fate and transport of trace elements (arsenic, copper, zinc) found in poultry manures; widespread national concerns about air quality associated with ammonia, hydrogen sulfide, volatile organic compounds, and fine particulates originating from poultry houses; environmental and human health impacts of endocrine disruptors (estrogen, testosterone) found in manures; the fate and transport of viruses and other pathogens during disease outbreaks and subsequent disposal of poultry mortality, and the environmental and human health effects of antibiotics used in poultry production.
14	Equine science: contribute to improved equine care, disease prevention, responsible land management, barn safety, and effective business practices using proven outreach channels for the dissemination of peer reviewed knowledge and practices to equine professionals and enthusiasts.
15	Improved statewide strategies to prevent the spread of avian diseases and dispose of the mortality resulting from disease outbreaks.
16	Cost-effective solar power technology to heat and cool poultry houses will allow farmers to reduce their reliance on natural gas, oil, and purchased electricity, increasing the energy efficiency of poultry production.

Outcome #1

1. Outcome Measures

Increased awareness of the need to produce and utilize diets for all animal species that prevent unnecessary overfeeding of nutrients, especially nitrogen and phosphorus.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Poultry have traditionally been fed a diet of seeds and grains, often high in phosphorous. However, two-thirds of the phosphorous in this food is phytic acid or phytate, which is a form of phosphorus that poultry cannot digest, leading to high phosphorous levels in manure, with ramifications for environmental and agricultural nutrient management. However, phytase is an enzyme that can be added to poultry feed at the mill that helps broilers and other poultry utilize more indigestible phosphorus.

What has been done

Results

Over the past several years, research scientists have analyzed the nutritional requirements of poultry and swine and the effects of phytase-modified diets on the livestock and the environment as part of a 'feed-to-field' approach to nutrient management. Research has confirmed that Delaware chickens now digest more of the phosphorus, an essential nutrient, in their feed, thanks to the addition of phytase.
As a result, about 23 percent less phosphorus is output in chicken manure. So now when poultry litter is used to fertilize a farm field, a lot less phosphorus is available to potentially leach from the soil or be carried off in storm water to a river or bay. There are now about 19 pounds of phosphorus in a ton of Delaware poultry litter compared to 25 to 30 pounds of phosphorus per ton of litter just five years ago. The 30-40 percent reduction is credited to phytase-modified diets and other nutrient management practices adopted by poultry farmers under Delaware's Nutrient Management Law of 1999. That reduction means that the phosphorus load to the environment has been reduced by some 2 million to 3 million pounds per year. The data have been shared with a nutrient management partnership involving the poultry industry, environmental regulators and the academic community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems

Outcome #2

1. Outcome Measures

Education programs for the livestock and equine industries on equine nutrition and health practices, fiscal management, and beneficial use of the by-products of animal agriculture.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

For decades, the equine industry pushed grain as the basis of an equine diet with little regard to forages. In 2007, revisions were published of the National Research Council's (NRC) nutritional requirements for horses. These revisions stated the importance of quality pasture and the basis of forages for equine diets. In addition, the increased cost of grain has made horsemen take a greater look at forages as a less expensive option for the equine diet.

What has been done

Results

Two equine conferences were held to review the new NRC guidelines, focused on forage and it being the base of the equine diet. These conferences stressed the need for horsemen to have their forage analyzed prior to feeding to ensure a diet appropriate to the needs of their horses. Cooperative Extension has seen an increase in the number of horsemen requesting assistance in analyzing their forages and conducting pasture consultations, as a result of these conferences. Horsemen are requesting assistance in looking at their analysis results to determine adjustments needed to ensure a balanced diet, based on the needs of their horses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
401	Structures, Facilities, and General Purpose Farm Supplies
311	Animal Diseases
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals

Outcome #3

1. Outcome Measures

Establishment of an Avian Biosciences Center to conduct research, outreach, and K-12 educational programs on avian disease and production, food safety and technology, and the environmental compatibility of poultry production.

Not reporting on this Outcome for this Annual Report

Outcome #4

1. Outcome Measures

Increased number of poultry producers participating in surveillance, diagnostic testing, and vaccination programs for infectious avian diseases. Implementation of statewide plans to address major outbreaks of avian diseases.

Not reporting on this Outcome for this Annual Report

Outcome #5

1. Outcome Measures

Sustainable production practices for the dairy and beef industries that link forage and pasture production practices with animal health, performance, and meat and milk quality.

Not reporting on this Outcome for this Annual Report

Outcome #6

1. **Outcome Measures**
   Improved economic competitiveness of the poultry and allied industries relative to other poultry producing regions in the U.S. and global competitors.
   Not reporting on this Outcome for this Annual Report

Outcome #7

1. **Outcome Measures**
   Increased number of poultry and dairy farmers using feed management practices that increase nutrient utilization, and feeding diets with lower concentrations of nitrogen and phosphorus.
   Not reporting on this Outcome for this Annual Report

Outcome #8

1. **Outcome Measures**
   Increased use of air quality best management practices that prevent odor, ammonia, and particulate emissions from poultry farms.
   Not reporting on this Outcome for this Annual Report

Outcome #9

1. **Outcome Measures**
   Increased number of diagnostic laboratories capable of using advances in avian genomics and state-of-the art instrumentation to rapidly diagnose infectious diseases
   Not reporting on this Outcome for this Annual Report

Outcome #10

1. **Outcome Measures**
   Disease Prevention and Control: basic and applied research on mechanisms of poultry disease processes will translate into useable tools and strategies for improved disease surveillance, diagnosis, prevention, and control in broiler chicken production. Knowledge will be extended to commercial poultry and allied industries.
   Not reporting on this Outcome for this Annual Report

Outcome #11

1. **Outcome Measures**
   Genomics: increased understanding of gene function and expression and targeting of candidate genes affecting economically important traits in broiler chicken growth and production, disease resistance and immunity. Improvements in classical poultry breeding programs by use of marker assisted selection (MAS) and technology transfer.
   Not reporting on this Outcome for this Annual Report

Outcome #12

1. **Outcome Measures**

Nutrition: research will lead to improved understanding of nutritional requirements for poultry and ruminants and adoption of recommended dietary strategies by practicing nutritionists and producers. Specifically, the results of poultry directed research will aim to minimize nutrient contamination of the environment from manure. Results from ruminant based research will lead to improved management of forages to maximize nutritional value, safe use, and minimize spoilage during storage. Research will also result in enhanced collaboration between University and industry partners. Findings will help to increase the efficiency of livestock production and new technology will be transferred to stakeholders.

Not reporting on this Outcome for this Annual Report

Outcome #13

1. **Outcome Measures**

Environmental Compatibility: poultry industry and commercial nutritionists will adopt and implement recommendations for broiler diet modification – including such practices as reducing diet nutrient concentrations to more closely meet the animal's requirements, utilization of phytase and other diet additives shown to improve nutrient utilization, and incorporation of low phytate grains – in feed formulations to reduce nutrient emissions to the environment. Reduced emissions will be measured by reduced nutrient concentrations in manures and litters, reduced application of nutrients to cropland and other soils, and reduced movement of nutrients from soils to ground and surface waters. Other environmental issues related to animal agriculture include the fate and transport of trace elements (arsenic, copper, zinc) found in poultry manures; widespread national concerns about air quality associated with ammonia, hydrogen sulfide, volatile organic compounds, and fine particulates originating from poultry houses; environmental and human health impacts of endocrine disruptors (estrogen, testosterone) found in manures; the fate and transport of viruses and other pathogens during disease outbreaks and subsequent disposal of poultry mortality, and the environmental and human health effects of antibiotics used in poultry production.

Not reporting on this Outcome for this Annual Report

Outcome #14

1. **Outcome Measures**

Equine science: contribute to improved equine care, disease prevention, responsible land management, barn safety, and effective business practices using proven outreach channels for the dissemination of peer reviewed knowledge and practices to equine professionals and enthusiasts.

Not reporting on this Outcome for this Annual Report

Outcome #15

1. **Outcome Measures**

Improved statewide strategies to prevent the spread of avian diseases and dispose of the mortality resulting from disease outbreaks.

Not reporting on this Outcome for this Annual Report

Outcome #16

1. **Outcome Measures**

Cost-effective solar power technology to heat and cool poultry houses will allow farmers to reduce their reliance on natural gas, oil, and purchased electricity, increasing the energy efficiency of poultry production.

Not reporting on this Outcome for this Annual Report

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)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

Key Items of Evaluation

Program #2

V(A). Planned Program (Summary)

1. Name of the Planned Program

BIOTECHNOLOGY AND BIOTECHNOLOGY-BASED AGRIBUSINESS

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	25%	25%	25%	25%
304	Animal Genome	25%	25%	25%	25%
601	Economics of Agricultural Production and Farm Management	10%	10%	10%	10%
602	Business Management, Finance, and Taxation	10%	10%	10%	10%
603	Market Economics	10%	10%	10%	10%
604	Marketing and Distribution Practices	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	18.5	0.0
Actual	0.0	0.2	19.9	1.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	55114	193702	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	55114	437081	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
3052	0	3341811	530101

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension programs will target avian and plant biotechnology. In the avian arena, these projects will be aimed at understanding basic mechanisms of disease etiology and control and emergence of new disease causing agents. Research will continue and expand on sequencing of the chicken genome, as well as the genome of many poultry pathogens, to help provide the tools needed to advance our understanding of poultry growth, health and disease. We plan to apply these tools to diagnosis and treatment of disease and screening for desirable production traits. We also seek to develop genome based diagnostic methods, and study the molecular basis of disease resistance and susceptibility. Some specific avian biotechnology research areas planned include: identification of genomic factors influencing pathogenesis of avian herpesviruses and mycoplasmas; evolution of virulence of Marek's Disease virus; interaction of MDV proteins with host cells; regulation of the immune response to avian pathogens; and gene expression profiles in growth-selected chickens. With regard to plant biotechnology, projects will focus on understanding basic mechanisms of gene control in plants, disease resistance, nitrogen fixation, and plant/environment interactions. Areas of particular interest for basic plant biotechnology research include: RNA turnover or small RNA-mediated gene regulation; understanding disease resistance and signal transduction pathways in plants; understanding and enhancing symbiotic nitrogen fixation via the application of molecular and proteomics approaches; developing biotechnology-based diagnostic methods for major plant diseases; and understanding processes controlling plant/soil interfacial relations at the molecular and atomic levels to enhance crop utilization of nutrients and the effectiveness of plants at remediation of soils contaminated with metals and organics. For both avian and plant biotechnology, findings will be applied as much as possible to existing issues in agriculture with the goal of integrating biotechnology research into new agribusinesses such as those producing plants better adapted to environmental and biological stress, plants used for the production of pharmaceuticals and nutriceuticals, and plant with bioenergy uses.

2. Brief description of the target audience

Farmers, landowners, state agencies (Delaware Development Office, Departments of Agriculture, Health and Human Services, Natural Resources and Environmental Control, Transportation), federal agencies (USDA, USEPA), land use organizations, environmental organizations, business and community leaders, families, students, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	100	300	100	500
2008	175	20	9	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	11	
2008	0	66	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	12	32

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	4	13

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2008	2	16

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	4	42

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	1	26

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2008	3	17

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2008	3	16

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	11	66

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2008	2	7

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2008	0	5

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	0	0

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	12	45

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	8	12

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	11

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	1	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.
2	Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.
3	Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.
4	Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.
5	Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.
6	Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.
7	Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.
8	Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.
9	Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

Outcome #1

1. **Outcome Measures**
   Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.
   Not reporting on this Outcome for this Annual Report

Outcome #2

1. **Outcome Measures**
   Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.
   Not reporting on this Outcome for this Annual Report

Outcome #3

1. **Outcome Measures**
   Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.
   Not reporting on this Outcome for this Annual Report

Outcome #4

1. **Outcome Measures**
   Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.
   Not reporting on this Outcome for this Annual Report

Outcome #5

1. **Outcome Measures**
   Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.
   Not reporting on this Outcome for this Annual Report

Outcome #6

1. **Outcome Measures**
   Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.
   Not reporting on this Outcome for this Annual Report

Outcome #7

1. **Outcome Measures**
   Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.
   Not reporting on this Outcome for this Annual Report

Outcome #8

1. Outcome Measures

Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Understanding how small RNAs work is a continuing quest for geneticists seeking to breed plants with improved crop yields, disease resistance and other characteristics. Small RNAs act like biochemical switches that shut off genes, thus playing a fundamental role in plant development. Studies of Arabidopsis thaliana, a small flowering plant of the mustard family that is easy to grow in the lab, have provided a lot of what scientists know about gene silencing in plants.

What has been done

Results

Researchers at the University of Delaware, working with colleagues at the University of Arizona and South Dakota State University, have identified unusual differences in the natural mechanisms that turn off, or 'silence,' genes in corn. They found that there are lots more RNAs of an unusual class known as 'small interfering RNAs' in corn than there are in Arabidopsis. The discovery, which was made by comparing the impact of inactivating a gene that occurs in both corn and in the much-studied laboratory plant Arabidopsis, provides new insight into how one of the world's most important crops protects itself from mutation-causing mobile DNA elements and viruses. The scientific community is sequencing the corn genome currently. Once the genome is available, the work of matching up small RNAs to specific traits in corn will be much easier. This research is helping to better understand the biology of corn--one of the most important plants in the world--and gives new avenues for exploring a novel class of small RNAs.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.
Not reporting on this Outcome for this Annual Report

V(H). Planned Program (External Factors)

External factors which affected outcomes

- 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)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #3

V(A). Planned Program (Summary)

1. Name of the Planned Program

ECOSYSTEMS AND BIODIVERSITY

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	10%	10%	10%	10%
123	Management and Sustainability of Forest Resources	10%	10%	10%	10%
135	Aquatic and Terrestrial Wildlife	20%	20%	20%	20%
136	Conservation of Biological Diversity	15%	15%	15%	15%
215	Biological Control of Pests Affecting Plants	15%	15%	15%	15%
216	Integrated Pest Management Systems	20%	20%	20%	20%
306	Environmental Stress in Animals	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	3.8	0.0	6.7	3.4
Actual	3.8	0.5	6.9	2.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
286305	84095	25775	132367
1862 Matching	1890 Matching	1862 Matching	1890 Matching
5763	84095	0	132367
1862 All Other	1890 All Other	1862 All Other	1890 All Other
203214	0	582998	228789

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Integrated Pest Management - developing and delivering integrated pest management (IPM) programs, a "systems" approach using chemical, cultural, mechanical, and biological control to increase profits to producers and protect the environment; (2) Sustainable Agriculture/Forestry - developing and promoting efficient and sustainable agricultural, forestry, and other resource conservation practices and policies that ensure sustained ecosystem function and provide food and habitat for biodiversity, including crop diversification, agroforestry, native windbreaks, cover crops, living mulches, field border systems, and conservation buffers; (3) Wildlife, Woodlands, and Aquatic Resources - understanding and mitigating the impact of agricultural practices and urbanization on biodiversity, woodlands, and aquatic resources. Focus will be on human impacts on the fundamental processes that create and maintain biodiversity, such as atmospheric nitrification of ecosystems, minimal habitat requirements, speciation, predator-prey interactions, community and ecosystem structure, and extinction processes. Approaches to develop and sustain biodiversity in agriculture, suburban landscapes, and natural habitats, will be studied. Nonpoint source nutrient pollution models will assess impacts of land use/cover change from agriculture to urban on water quality and quantity on local ponds and creeks; (4) Wetlands Ecosystems - improve understanding of wetlands restoration, protection, and preservation. Emphasis will be on seasonally saturated and non-seasonally saturated wetlands, the wildlife species that inhabit them, and the importance of sedges in wetland habitats; (5) Protection of Delaware's Native Species - research on non-indigenous invasive species, a leading cause of plant and animal extinction in Delaware, will focus on impacts of invasive species on ecosystem function and on methods of restoration after their removal; (6) Master Gardener Training - Extension programs will be developed and delivered on Wildlife Habitat Gardening, Waterwise Gardening, and use of native landscape plants in suburban gardens; (7) Human Activities and the Natural Environment - coupled environmental and socioeconomic modeling methodologies will highlight interactions between human activities (drivers), environmental impacts from those activities (stressors), potential changes to valued ecosystem components, and feedbacks experienced from the changes; (8) Wildlife Management - effects of human activity on migratory shore birds, box turtles in suburban habitat fragments, neotropical bird migrants in Delaware, Bobwhite quail in warm season grasslands, horseshoe crab ecology in the Delaware Bay, insect biomass production in suburban habitats, habitat restoration for bats and White-tailed deer populations and lead to recommendations for improved habitat management; (9) Fisheries - population status, spawning areas, and management of Atlantic sturgeon in the Delaware River.

2. Brief description of the target audience

Farm owners and operators, aquaculture producers, recreational fisheries, seafood consumers, water quality managers, agribusiness and private consultants, horticultural professionals, city land use planners and other policy-makers, home gardeners, childcare providers, environmental educators.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

Year	Direct Contacts Adults Target	Indirect Contacts Adults Target	Direct Contacts Youth Target	Indirect Contacts Youth Target
Plan	750	750	750	750
2008	5170	320	990	4

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	2	10	
2008	1	15	16

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	8	34

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	3	10

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2008	3	18

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	10	24

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	6	34

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2008	3	6

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2008	2	0

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	12	16

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2008	2	3

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2008	8	10

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	6	11

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	16	113

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	15	50

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	7

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	4	65

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increased number of farmers and other producers aware of the principles of integrated pest management and familiar with the practices and technologies needed for a systems-based approach to prevent and control problems with insects, weeds, and plant pathogens.
2	Educational programs for K-12 youth and teachers on ecosystems and natural resources that emphasize the importance of sustaining biodiversity for natural and managed land uses.
3	Establish a Center for Suburban Biodiversity to conduct research and outreach programs on restoring and enhancing biodiversity and wildlife habitat in suburbanized landscapes.
4	Increased number of farmers and other land managers adopting integrated approaches to pest management for insects, weeds, alien invasive plants, and plant pathogens in agricultural and natural ecosystems.
5	Increased participation by all stakeholders in educational programs on responsible environmental management of natural resources, nutrients, and pesticides.
6	Increases in the amount of agricultural and suburban land where wildlife habitat has been restored or enhanced.
7	Integrated Pest Management: basic and applied research will increase the effectiveness of a systems-based approach to prevent or control pests (insects, weeds, plant pathogens) that threaten agricultural productivity and damage natural, urban, and suburban landscapes. Extension programs will promote adoption of IPM by farmers and other land managers.
8	Ecosystem restoration: fundamental research on ecosystem processes will provide evidence of the full range of ecological, water quality, and economic benefits associated with sustaining and enhancing natural ecosystems such as wetlands, forests, riparian corridors, and tidal marshes, and lead to greater restoration and expansion of areas important for wildlife habitat and biodiversity.
9	Wildlife habitat and management: research will assess the impacts of human activity on wildlife habitats and develop management practices that can protect threatened or endangered species and lead to policies that protect and enhance wildlife populations.
10	Protection of native species: research and extension programs will quantify the ecological and economic benefits of protecting indigenous plant species and restricting the spread of invasive plants and animals.

Outcome #1

1. Outcome Measures

Increased number of farmers and other producers aware of the principles of integrated pest management and familiar with the practices and technologies needed for a systems-based approach to prevent and control problems with insects, weeds, and plant pathogens.

2. Associated Institution Types

•1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In Delaware, and Maryland, pickling cucumbers are grown on approximately 8,000 acres. Each year losses from insect, disease and weed pests can result in reduced returns to producers. Two key pests identified by producers are downy mildew and cucumber beetles. The following high priority research and extension needs were identified as part of a pest management strategic plan for pickling cucumbers : development of a forecasting and predictive system for downy mildew, evaluation of currently available and pipeline fungicides for downy mildew control, development of resistant cultivars, and the evaluation of commercially applied seed treatments for cucumber beetle control.

What has been done

Results

Research and extension programs focused on four main areas: Downy Mildew forecasting as part of a National ipmPipe system, evaluation of new chemistry to control downy mildew, establishment of sentinel plots to detect the first occurrence of downy mildew in DE and MD and the evaluation of seed treatments for cucumber beetle management. Newer seed applied treatments for cucumber beetle control on pickling cucumbers provide economic control , increased worker safety and resulted in a 2 fold reduction in the amount of active ingredients in the environment compared to at planting insecticides. With the recent federal registration of one commercially applied seed treatment (winter 2009), we anticipate a 10% reduction in the number if acres receiving either an at-planting application of insecticide or foliar sprays for cucumber beetles. The Cucurbit Downy Mildew forecasting system in combination with the use of sentinel plots to study pathogen movement helped growers in the region minimize economic and environmental costs of fungicide sprays by helping them time application when and where they were needed. This information was posted throughout the season on our Weekly Crop Update which reaches close to 300 clientele including l pickling cucumber growers, consultants, agri-business and seed company representatives. Since conditions were not extremely favorable for the pathogens (compared to the severe outbreak year of 2004), producers on were able to save at least one fungicide application on at least 50% of the acreage.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
112	Watershed Protection and Management
215	Biological Control of Pests Affecting Plants
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educational programs for K-12 youth and teachers on ecosystems and natural resources that emphasize the importance of sustaining biodiversity for natural and managed land uses.
Not reporting on this Outcome for this Annual Report

Outcome #3

1. Outcome Measures

Establish a Center for Suburban Biodiversity to conduct research and outreach programs on restoring and enhancing biodiversity and wildlife habitat in suburbanized landscapes.

2. Associated Institution Types

•1862 Extension
•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Much concern has been raised about the long-term sustainability of biodiversity in the eastern U.S.

What has been done

Results

The Department of Entomology and Wildlife Ecology at the University of Delaware, in collaboration with the Northern Research Station of the U.S. Forest Service, initiated the Center for Managed Ecosystems. The Center includes members of the UD Department of Entomology and Wildlife Ecology, the UD Department of Plant and Soil Science, Stroud Water Research Center, Delaware Invasive Species Council, Delaware Department of Natural Resources and Environmental Control, Delaware Nature Society, University of Delaware Botanical Garden, and the U.S. Forest Service.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery
135	Aquatic and Terrestrial Wildlife

Outcome #4

1. Outcome Measures

Increased number of farmers and other land managers adopting integrated approaches to pest management for insects, weeds, alien invasive plants, and plant pathogens in agricultural and natural ecosystems.

2. Associated Institution Types

•1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

: Consultants, Agribusiness, Agency Personnel, and Extension Agents have all expressed an interest in receiving cutting edge information on new Integrated Pest, Nutrient and Crop Management strategies. Since this group often has clientele in multiple states, they would like to receive information that has application on a regional basis. They would also like to learn more about finding crop and pest management information on the web. Surveys indicate that this group of clientele would like to receive this information at intensive, multi-day training sessions.

What has been done

Results

The Mid-Atlantic Crop Management School is an excellent example of a multi-state (Delaware, Maryland and West Virginia) and multi-agency (University, NRCS and Department of Agriculture) program which provides new educational information in the areas of Integrated Pest Management, Crop Management and Nutrient Management. The 2008 Mid-Atlantic Crop Management School educated 240 individuals including private consultants, agribusiness personnel, NRCS field staff and extension agents about a wide range of new pest and crop management topics. Survey results indicate that this group consults on over 490,000 acres in the Mid-Atlantic region. As a direct result of a survey of school participants, this conference expanded topics directly related to safeguarding the environment by using reduced risk pesticides, understanding soybean growth and development to take advantage of alternative pest management strategies, determining if fungicides are needed in field corn and identifying when corn and soybeans are damaged by stink bugs. Mid-Atlantic crop management school participants were surveyed and indicated that new IPM and crop management information presented would result in an increase of $ 26 per acre in income for their clientele.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
216	Integrated Pest Management Systems
123	Management and Sustainability of Forest Resources
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Increased participation by all stakeholders in educational programs on responsible environmental management of natural resources, nutrients, and pesticides.

Not reporting on this Outcome for this Annual Report

Outcome #6

1. Outcome Measures

Increases in the amount of agricultural and suburban land where wildlife habitat has been restored or enhanced.

Not reporting on this Outcome for this Annual Report

Outcome #7

1. Outcome Measures

Integrated Pest Management: basic and applied research will increase the effectiveness of a systems-based approach to prevent or control pests (insects, weeds, plant pathogens) that threaten agricultural productivity and damage natural, urban, and suburban landscapes. Extension programs will promote adoption of IPM by farmers and other land managers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Current programs focusing on a multi state approach to total crop management system have demonstrated significant impacts related to disease and insect management. However, there is still a need for new information on alternative strategies for foliar and soil born diseases, weed management, cucumber beetle and aphid management. This new information is needed to further reduce crop loss from pests, increase the use of reduced risk pesticides, reduce the development of pest resistance and increase net profit associated with current melon IPM programs.

What has been done

Results

Current programs continue to incorporate sustainable strategies including disease scouting; the use of weather based disease forecasting system to time fungicide application and the use of new thresholds and reduced risk chemistry for mite management. Small plot trial and grower trials were used to demonstrate the effectiveness of reduced risk aphid control materials and the effectiveness of natural enemies. Small plot demonstrations were also used to evaluate the effectiveness of perimeter trap crop to control cucumber beetles and reduce insecticide use. The disease management component included in-season diagnostics, the evaluation of reduce risk fungicides, and education on disease resistance management. The current multi-state watermelon IPM program continues to demonstrate the value of using the Melcast Disease Forecasting System on over 2000 acres of watermelons. When using Melcast, growers and consultants continued to report improved disease management resulting from better timing of fungicide applications. Information from small plot research demonstrating the effectiveness of reduced risk chemistry for aphid management in watermelons was by three consultants to make control recommendation on over 200 acres of watermelons resulting in improved control and preservation of natural enemies. The use of a perimeter trap crop for cucumber beetle management in watermelons demonstrated the effectiveness of the trap crop in reducing foliar sprays for cucumber beetle. Initial research results indicated that producers could eliminate 1-2 early season foliar sprays for cucumber beetle control using perimeter trap crops. The use of perimeter trap crops will be evaluated in farm demonstrations in 2009.

4. Associated Knowledge Areas

KA Code	Knowledge Area
903	Communication, Education, and Information Delivery
216	Integrated Pest Management Systems

Outcome #8

1. Outcome Measures

Ecosystem restoration: fundamental research on ecosystem processes will provide evidence of the full range of ecological, water quality, and economic benefits associated with sustaining and enhancing natural ecosystems such as wetlands, forests, riparian corridors, and tidal marshes, and lead to greater restoration and expansion of areas important for wildlife habitat and biodiversity.
Not reporting on this Outcome for this Annual Report

Outcome #9

1. **Outcome Measures**

Wildlife habitat and management: research will assess the impacts of human activity on wildlife habitats and develop management practices that can protect threatened or endangered species and lead to policies that protect and enhance wildlife populations.
Not reporting on this Outcome for this Annual Report

Outcome #10

1. **Outcome Measures**

Protection of native species: research and extension programs will quantify the ecological and economic benefits of protecting indigenous plant species and restricting the spread of invasive plants and animals.
Not reporting on this Outcome for this Annual Report

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

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

1. **Evaluation Studies Planned**
   - Retrospective (post program)
   - During (during program)

Evaluation Results

Key Items of Evaluation

Program #4

V(A). Planned Program (Summary)

1. Name of the Planned Program

FAMILY AND 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
801	Individual and Family Resource Management	10%	10%	10%	10%
802	Human Development and Family Well-Being	10%	10%	10%	10%
806	Youth Development	60%	60%	60%	60%
903	Communication, Education, and Information Delivery	20%	20%	20%	20%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	**Extension**		**Research**	
	1862	**1890**	**1862**	**1890**
Plan	19.6	3.0	0.0	0.0
Actual	20.5	3.4	0.0	1.5

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

Extension		**Research**	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
155881	255491	0	87662
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
387806	255491	0	87662
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
156367	40265	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Volunteer Leadership Development programs will be delivered on public policy education; volunteer leadership development (e.g., 4-H adult and teen volunteers and camp counselors, master gardeners, master food educators; T.R.Y. (Teens reaching youth), middle management volunteers (volunteers managing volunteers); and extension advisory committees; (2) Family Well-Being Across the Lifespan Educational Programming, including Just in Time Parenting (Great Beginnings and the Brown Bag program for parents of young children) and Families Matter! (for parents of school-age children), interactive web sites, newsletter series, workshops, worksite seminars and classes focusing on positive parenting and care giving, family stress management, child development, healthy relationships and marriage education, savvy decision-making, anger management and conflict resolution, healthy communication, intergenerational well-being, teamwork, leadership, and community involvement skills; 3) Safe Communities - programs will include drug and alcohol prevention education, bicycle safety education, pedestrian safety education, farm safety, and car seat safety; (4) Family Economic Well-Being and Consumer Decision Making educational programs will be developed and delivered focusing on strategies for effective consumer decision making, financial planning, financial management counselor training, basic budgeting, credit management, and retirement planning; (5) 4-H Youth Development programs will focus on life skills development, positive life choices, leadership development, citizenship/community involvement, and career exploration with emphasis on science, engineering and technology knowledge. Appropriate settings including clubs, camps, school enrichment and after school will use the latest technology to deliver the sustained opportunities.

2. Brief description of the target audience

Youth ages 5-19, 4-H members, 4-H volunteers, new 4-H volunteers, Master Gardeners, Community Leaders, at-risk youth and families, court appointed and incarcerated youth and adults, parents of children (from birth through school-age), families with members in the second ½ of the lifespan, youth agency professionals, key decision-makers, human service professionals, child care/after school providers, family day home providers, social clubs, church groups, private and public school youth and teachers, after school 4-H clubs and school age child care programs.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	4275	214350	49300	2100
2008	26350	364000	52950	46450

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	1	0	
2008	1	1	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	13	22

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	4	17

Output #3

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	10	62

Output #4

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	10	160

Output #5

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	30	296

Output #6

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	14

Output #7

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	150	501

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Leadership development programs for volunteers interested in improving the quality of life for youth, families and communities.
2	Greater knowledge by Delaware youth of the importance of academic performance, social skills, and job preparedness to their future careers.
3	Educational programming for K-12 teachers and youth emphasizing the development of positive life skills related to parenting, family financial planning, and safe communities.
4	Number of youth adopting behaviors that reduce their risk of using alcohol, tobacco and related substances.
5	Number of youth participating in extension programs who demonstrate improved academic, social, and job preparedness skills.
6	Number of parents/families participating in extension programming who demonstrate positive parenting skills.
7	Number of youth and adults adopting increased leadership, communication, conflict management and decision-making skills
8	Number of program participants adopting skills for balancing work and family and stress management that promote healthy, well-functioning individuals and families
9	Number of youth and adults adopting bike, pedestrian and traffic safety rules and regulations.
10	Dollars saved through volunteer interventions.
11	Number of families who adopt best practices in financial management, retirement planning and consumer decision-making.
12	Number of adults adopting best practices in child development, business development, educational program development in child care settings.
13	Number of youth who have increased science, engineering, and technology skills.
14	Number of youth with greater involvement in citizenship and community service programs.
15	An enhanced capacity for families and youth to improve their quality of life because of increased skills in parenting and family relationships, academic preparedness, career development, family financial planning, leadership and volunteerism, and citizenship and community involvement.

Outcome #1

1. Outcome Measures

Leadership development programs for volunteers interested in improving the quality of life for youth, families and communities.

Not reporting on this Outcome for this Annual Report

Outcome #2

1. Outcome Measures

Greater knowledge by Delaware youth of the importance of academic performance, social skills, and job preparedeness to their future careers.

2. Associated Institution Types

•1862 Extension
•1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Sussex County, Delaware, has a rapidly growing population of Hispanic children. Most of the children have only been in this country a few years, or in some cases, just a few months. Their parents brought them here from Guatemala and other Latin American countries to make a new life in Sussex's agricultural community. Children struggle to assimilate, facing everything from language barriers to homesickness and U.S. laws and customs

What has been done

The La Casita program, coordinated by UD 4-H, offers Hispanic youth club activities range from science experiments to service projects, cooking to crafts. Students visit the club weekly to learn about everything from environmental science to public speaking. Sometimes the acculturation process can be as simple as learning about U.S. law regarding things like bicycle helmets and seat belt use. Club coordinators stress to the children the importance of English language fluency for success in school and daily life, as well as later career success. Fun, interactive activities are used to help them work on their pronunciation skills and comprehension. Tweens and teens are encouraged to open up and talk about their struggles to assimilate.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
903	Communication, Education, and Information Delivery
806	Youth Development

Outcome #3

1. Outcome Measures

Educational programming for K-12 teachers and youth emphasizing the development of positive life skills related to parenting, family financial planning, and safe communities.

Not reporting on this Outcome for this Annual Report

Outcome #4

1. **Outcome Measures**
   Number of youth adopting behaviors that reduce their risk of using alcohol, tobacco and related substances.
   Not reporting on this Outcome for this Annual Report

Outcome #5

1. **Outcome Measures**
   Number of youth participating in extension programs who demonstrate improved academic, social, and job preparedness skills.
   Not reporting on this Outcome for this Annual Report

Outcome #6

1. **Outcome Measures**
   Number of parents/families participating in extension programming who demonstrate positive parenting skills.
   Not reporting on this Outcome for this Annual Report

Outcome #7

1. **Outcome Measures**
   Number of youth and adults adopting increased leadership, communication, conflict management and decision-making skills
   Not reporting on this Outcome for this Annual Report

Outcome #8

1. **Outcome Measures**
   Number of program participants adopting skills for balancing work and family and stress management that promote healthy, well-functioning individuals and families
   Not reporting on this Outcome for this Annual Report

Outcome #9

1. **Outcome Measures**
   Number of youth and adults adopting bike, pedestrian and traffic safety rules and regulations.
   Not reporting on this Outcome for this Annual Report

Outcome #10

1. **Outcome Measures**
   Dollars saved through volunteer interventions.
   Not reporting on this Outcome for this Annual Report

Outcome #11

1. **Outcome Measures**
   Number of families who adopt best practices in financial management, retirement planning and consumer decision-making.
   Not reporting on this Outcome for this Annual Report

Outcome #12

1. **Outcome Measures**

Number of adults adopting best practices in child development, business development, educational program development in child care settings.

Not reporting on this Outcome for this Annual Report

Outcome #13

1. **Outcome Measures**

Number of youth who have increased science, engineering, and technology skills.

Not reporting on this Outcome for this Annual Report

Outcome #14

1. **Outcome Measures**

Number of youth with greater involvement in citizenship and community service programs.

Not reporting on this Outcome for this Annual Report

Outcome #15

1. **Outcome Measures**

An enhanced capacity for families and youth to improve their quality of life because of increased skills in parenting and family relationships, academic preparedness, career development, family financial planning, leadership and volunteerism, and citizenship and community involvement.

2. **Associated Institution Types**

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Working with Extension colleagues throughout the nation, Delaware has the capacity to reach millions of parents with key messages to help their children grow up healthy and ready for success. Reaching parents early is crucial to setting the foundation for kids who grow up healthy and ready for success. As parents establish their routines and feeding practices, children get a healthy start, and the cumulative impact can make a real difference in the lives of children and their families.

What has been done

Results

With Extension's grassroots capabilities, multiple delivery formats (including face-to-face programs) can be used to provide the ongoing support parents need to build the healthy habits and skills needed to prevent childhood obesity. Steady progress is being made toward our goal: Just in Time Parenting - starting prenatally and continuing through adolescence - available nationwide to every interested parent. JITP readers across all educational and economic levels report that: they feel more confident and competent in raising their children; JITP newsletters are more useful than any other source of information; they share and discuss the newsletters within their family and social networks. In studies in Delaware, those who report they change their behaviors and attitudes most - as a result of reading the newsletters - are youngest, poorest and least educated

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
903	Communication, Education, and Information Delivery
801	Individual and Family Resource Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #5

V(A). Planned Program (Summary)

1. Name of the Planned Program

FOOD SCIENCE, TECHNOLOGY, SAFETY, AND NUTRITION

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%	20%
502	New and Improved Food Products	10%	10%	10%	10%
702	Requirements and Function of Nutrients and Other Food Components	10%	10%	10%	10%
703	Nutrition Education and Behavior	20%	20%	20%	20%
704	Nutrition and Hunger in the Population	10%	10%	10%	10%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%	10%	10%	10%
724	Healthy Lifestyle	15%	15%	15%	15%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	8.0	2.5	5.7	0.0
Actual	7.8	3.6	4.9	2.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
4290	137705	0	339266
1862 Matching	1890 Matching	1862 Matching	1890 Matching
283862	137705	0	339266
1862 All Other	1890 All Other	1862 All Other	1890 All Other
233668	100663	135073	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research efforts involve using high pressure processing to reduce bacteria, viruses, protozoan oocysts, and bacterial endospores; inactivation of pathogenic bacterial species with high pressure and mild heat; using various antimicrobial films to control bacteria, such as Listeria monocytogenes; physiological and genetic analysis of pressure-resistant Listeria monocytogenes; testing of activity of antimicrobial films against native and inoculated bacteria on foods and surfaces; effects and mechanisms of non-thermal processes (ozone, UV, oxidative chemicals, iron, and/or high pressure processing) on protozoa, human pathogenic viruses, and bacteriophage, and increase understanding of basic biochemistry of these microorganisms. Extension efforts include conducting Keep Food Safe, ServSafe®, Don't Give Kids a Tummy Ache, Food Safety for Entrepreneurs, Keep'em Down on the Farm, Chances and Choices, Operation Risk, Microbial Contamination, Don't Bug Me!, Families First Nutrition Education and Wellness System (FFNEWS), Power of Choice, Dining With Diabetes, Give Your Heart A Healthy Beat!, Boning Up On Health, Strive For 5, Intelligent Eaters Club, Dietary Effects On Cancer Risks, Stretch, Flex, And Endure, Snacks to Please!, Planning Meals for Children, Create A Healthy Environment, Putting Good Nutrition To Work for Children, FoodSkills, and Expanded Food and Nutrition Education workshops; training volunteers including Master Food Educators, 4-H leaders, agency personnel, and teachers; providing Great Beginnings and Families Matter newsletters; publishing a quarterly nutrition newsletter for general audiences and giving handouts to parents of children in targeted schools as well as to other school personnel; developing and delivering programs on Kids Cooking (1890 EFNEP), Food Safety for Youth, Eat Smart, Play Hard, and Diet and Cancer; conducting favorite foods and 4-H foods contests; developing web-based information and fact sheets; distributing information to media; developing a marketing campaign to expand program participation; developing a marketing strategy with state and local government partners, faith-based groups, parents, social workers, childcare providers, low income housing managers, and corporate wellness centers to collectively deal with low income and socially disadvantaged individuals.

2. Brief description of the target audience

Restaurant workers, volunteer food handlers, delicatessen workers, day care providers, institutional foodservice workers, school foodservice personnel, caterers/private chefs, food entrepreneurs, retail food owners/managers, food producers, youth ages 5 to 18, parents and caregivers of children from birth to 18, limited-resource individuals and families, 4-H leaders and clubs, Boys and Girls clubs, teachers and other school personnel, youth in low-income schools, adults at risk for chronic disease (diabetes, osteoporosis, heart disease, certain cancers), adults with chronic diseases (diabetes, heart disease) policy makers, and media.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	2860	46300	6250	6585
2008	2385	10000	3865	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	1	5	
2008	5	16	21

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	6	17

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	2	6

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2008	4	3

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	3	3

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	4	8

Output #6

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2008	1	2

Output #7

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	6	21

Output #8

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2008	1	0

Output #9

Output Measure

- Number of Technical Reports

Year	Target	Actual
2008	1	0

Output #10

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	12	10

Output #11

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	2	27

Output #12

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	8	29

Output #13

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	0

Output #14

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	215	218

Output #15

Output Measure

- Number of Newsletters Distributed

Not reporting on this Output for this Annual Report

Output #16

Output Measure

- Number of New Program Partners

Year	Target	Actual
2008	15	11

Output #17

Output Measure

- Number of Ph.D.Graduate Students

Year	Target	Actual
2008	{No Data Entered}	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increased number of farmers, processors, food handlers, and families who are aware of food safety and nutrition issues that can lead to illness and long-term health problems and of the practices and technologies needed to ensure a safe and healthy food supply.
2	Educational programs for K-12 youth and teachers on food safety and nutrition that will help reduce the likelihood of food-borne illness, develop good nutritional and dietary habits, avoid obesity, and prevent chronic illnesses related to poor nutrition.
3	Increased number of farmers and food processors adopting research-based advances in food science technology that will prevent the incidence and spread of foodborne illnesses.
4	Safe, new food products that are preserved using innovative technologies designed to maintain food quality and nutrient content.
5	Increased number of program participants improving in one or more safe handling practices.
6	Increased number of participating youth increasing understanding of safe food handling procedures.
7	Increased number of program participants improving one or more nutrition practices.
8	Increased number of program participants improving one or more food resource management practices.
9	Increased number of program participants increasing or maintaining appropriate physical activity level.
10	Food science and technology: basic and applied research will lead to optimization of intervention strategies incorporating high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage to eliminate or significantly reduce the source of foodborne disease in food products. Applied food science research and extension programs in these areas will increase awareness to food producers and consumers of the most effective strategies for food product safety.
11	Food safety: research and extension programs will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.

Outcome #1

1. Outcome Measures

Increased number of farmers, processors, food handlers, and families who are aware of food safety and nutrition issues that can lead to illness and long-term health problems and of the practices and technologies needed to ensure a safe and healthy food supply.

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
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

With growing global concerns over the safety of fresh produces, with recent outbreaks of salmonella in spinach, tomatoes, and peppers, Delaware's fruit and vegetable growers are seeking ways to reduce foodborne illness through good agricultural practices on the farm.

What has been done

Results

UD food safety research and extension specialists have joined with agricultural extension specialists to offer food safety training for produce growers and have increased efforts to provide support to growers wanting to implement related practices. Produce growers in Delaware have begun to implement these practices on farm. Additional training is scheduled

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
703	Nutrition Education and Behavior
903	Communication, Education, and Information Delivery
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Educational programs for K-12 youth and teachers on food safety and nutrition that will help reduce the likelihood of food-borne illness, develop good nutritional and dietary habits, avoid obesity, and prevent chronic illnesses related to poor nutrition.

Not reporting on this Outcome for this Annual Report

Outcome #3

1. Outcome Measures

Increased number of farmers and food processors adopting research-based advances in food science technology that will prevent the incidence and spread of foodborne illnesses.

Not reporting on this Outcome for this Annual Report

Outcome #4

1. Outcome Measures

Safe, new food products that are preserved using innovative technologies designed to maintain food quality and nutrient content.

Not reporting on this Outcome for this Annual Report

Outcome #5

1. Outcome Measures

Increased number of program participants improving in one or more safe handling practices.

Not reporting on this Outcome for this Annual Report

Outcome #6

1. Outcome Measures

Increased number of participating youth increasing understanding of safe food handling procedures.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	800

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth are often overlooked as an audience for safe food handling procedures. Teaching students the role of microbes, food contamination, hand washing, and food temperature has the potential to reduce food borne illness

What has been done

More than 800 youth ranging in age from 8 to 12 participated in week-long 'Don't Bug Me' classes emphasizing food safety principles. The curriculum incorporated numerous activities, animations of song parodies, and preparation of one food item per day. The curriculum was divided into five daily segments: bugs--highlighting the role of microbes in making food products, in food spoilage, and in making people ill; bug express--emphasizing that microbes are hitchhikers and identified ways by which foods can become contaminated; wash those bugs away--stressing the role of hand washing in preventing food borne illness; bugs on the hot seat or in the deep freeze--exploring ways and the rationale for keeping foods hot or cold; and a bug free celebration--revisiting important concepts. Improvements between pre- and post-test scores were evident for all behaviors and ranged from 13 to 29 percent. Students responded to free response questions appropriately about microbes and the need for hand washing.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #7

1. **Outcome Measures**
   Increased number of program participants improving one or more nutrition practices.
   Not reporting on this Outcome for this Annual Report

Outcome #8

1. **Outcome Measures**
   Increased number of program participants improving one or more food resource management practices.
   Not reporting on this Outcome for this Annual Report

Outcome #9

1. **Outcome Measures**
   Increased number of program participants increasing or maintaining appropriate physical activity level.
   Not reporting on this Outcome for this Annual Report

Outcome #10

1. **Outcome Measures**
   Food science and technology: basic and applied research will lead to optimization of intervention strategies incorporating high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage to eliminate or significantly reduce the source of foodborne disease in food products. Applied food science research and extension programs in these areas will increase awareness to food producers and consumers of the most effective strategies for food product safety.
   Not reporting on this Outcome for this Annual Report

Outcome #11

1. **Outcome Measures**
   Food safety: research and extension programs will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.
   Not reporting on this Outcome for this Annual Report

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

- Retrospective (post program)
- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #6

V(A). Planned Program (Summary)

1. Name of the Planned Program

PLANT BIOLOGY AND CROP PRODUCTION 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
201	Plant Genome, Genetics, and Genetic Mechanisms	10%	10%	10%	10%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%	10%	10%	10%
205	Plant Management Systems	20%	20%	20%	20%
206	Basic Plant Biology	10%	10%	10%	10%
212	Pathogens and Nematodes Affecting Plants	10%	10%	10%	10%
213	Weeds Affecting Plants	10%	10%	10%	10%
216	Integrated Pest Management Systems	10%	10%	10%	10%
402	Engineering Systems and Equipment	5%	5%	5%	5%
601	Economics of Agricultural Production and Farm Management	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	14.1	5.5	28.1	3.9
Actual	12.6	1.4	23.5	3.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
469059	127888	365455	242624
1862 Matching	1890 Matching	1862 Matching	1890 Matching
387472	127888	245060	242624
1862 All Other	1890 All Other	1862 All Other	1890 All Other
455056	161060	210672	454170

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Agronomic, Vegetable and Horticultural Crop Production - improving varietal selection, disease and pest resistance, seed technology, cultural production practices, and marketing practices and skills for the many and diverse types of crop producers in Delaware; (2) Culinary Herbs and Essential Oils - management practices for propagation of plants of flavor, fragrance, and medicine will be developed and techniques for production, harvesting, and distillation will be demonstrated and disseminated; the Herb Research Center, along with the Claude E. Phillips Herbarium, will continue to analyze living plants, dried botanicals, and essential oils to help small farmers, processors, and distributors of these products when they otherwise have no means of certifying their products as safe in the American food supply; a national collection scheme of living herbs will be continued, as formulated under the aegis of the Herb Society of America, to not only preserve germplasm but also to provide correctly labeled material to gardeners, farmers, nurseries, and researchers. We will also continue to be the primary source of information on herbs and nomenclature for a worldwide audience, including manufacturers of culinary herbs and dietary supplements; (3) New Crops - financial and environmental impacts of growing new varieties of existing crops (Fordhook lima beans), new crops (greenhouse vegetables, crowder peas, garbanzo beans), horticultural varieties (herbaceous perennials), and turfgrass will be investigated. The potential of organic production of crops for processing will be evaluated; (4) Value-added Agricultural By-Products - we will evaluate the feasibility of using agricultural by-products (crop residues, manures, municipal composts, yard wastes, biosolids, and industrial materials) for fuel, feed, and litter for poultry houses; (5) Integrated Pest Management - improved methods for control of insect pests, weeds, and plant pathogens, understanding pesticide movement and interactions within the soil, and identifying herbicide combinations that improve weed control and reduce active ingredient application are priorities; (6) Nutrient Management - nutrient recommendations and nutrient management best management practices will be reviewed and research will be targeted at improving the efficiency of nitrogen and phosphorus use by agronomic, vegetable, and horticultural crops will be priorities; (7) Engineering Technologies - improvements in mechanical harvesting and automated guidance systems for harvesters will be sought and water resource protection will be enhanced by research on irrigation management and will develop irrigation scheduling strategies that are effective and easy to implement. Advances in remote sensing, tillage, and pesticide application are emerging research priorities; (8) Plant Breeding, Crop Genomics, Proteomics, and Bioinformatics to Genetically Engineer Plants - research that improves our understanding of plant genomes and the application of genomic information for crop improvement and crop protection will be continued and expanded. Basic studies on how plants adapt to their environments and manage stress, including disease, will be conducted. Studies that address soil microorganism-plant symbiotic relationships and plant/soil interfacial reactions, such as rhizosphere effects, to enhance crop growth and quality will be undertaken. The feasibility of growing genetically engineered crops and greenhouse plants in Delaware will be evaluated; (9) Urban/Suburban Horticulture - developing guidelines for safe establishment of community gardens in impoverished neighborhoods will be a priority, particularly for areas where soils may be contaminated by heavy metals such as lead and arsenic; demonstration gardens, workshops, and training programs for agriculture science teachers will focus on landscape diversity, exotic invasive species, water quality and conservation; (and 10) Pasture and Forage Management - research on animal production systems in pastures will expand with an emphasis on meat goats and beef cattle and forage research will emphasize improving biological control systems for alfalfa.

2. Brief description of the target audience

Existing and prospective crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, trade associations (e.g., Delaware Herb Growers & Marketers Association), the "green industry" (e.g., horticulture, nurseries, landscapers), certified crop advisors, private agricultural consultants, state (DDA, DNREC, DELDOT) and federal agencies (USDA), national laboratories (e.g., Argonne), chemical/seed/fertilizer companies, agricultural equipment companies, peer scientists, growers, processors, marketers of plants of flavor, fragrance, and medicine in Delaware, educators, policy-makers, the U.S., and international countries.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	4415	11500	1250	3450
2008	20450	269215	7070	1330

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

Patent Applications Submitted

Year	Target
Plan:	0

2008 : 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	4	26	
2008	8	13	21

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	13	45

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	4	24

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2008	2	122

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	4	24

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	4	10

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2008	6	13

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2008	4	3

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	30	21

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2008	3	3

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2008	14	15

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	45	35

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	35	111

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	50	193

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	9

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	20	150

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increased number of farmers, other producers, and land managers aware of latest advances in cultural management practices, crop varieties, irrigation technologies, and integrated pest management strategies for agronomic, vegetable, and horticultural crop production.
2	Targeted educational programs for farmers focused on cultural practices, marketing, and environmental aspects of new, high value cropping systems for niche markets, such as culinary herbs and essential oil plants, greenhouse grown pharmaceutical and nutriceutical plants, and plants grown as renewable bioenergy sources.
3	Educational programs for K-12 teachers and youth on advances in plant molecular biology and applications of the basic plant sciences to the production of plants used for food, fiber, landscaping, timber, bioenergy, and pharmaceutical and nutriceutical purposes.
4	Increased adoption of new innovations in marketing and risk management for farmers and other producers of plants and plant-based products.
5	Increased number of farmers adopting new crop varieties and integrating innovations in cultural practices, biological and chemical pest management, harvesting equipment, and irrigation management into their production systems.
6	Increase in the number of farmers implementing comprehensive nutrient management plans that are profitable and protective of ground and surface water quality.
7	Increased adoption of recommended practices for plant production, management, and environmental protection by the "Green Industry" (greenhouses, nurseries, landscapers).
8	Increased amount of land used to produce high value, niche market crops, such as culinary herbs, spices and essential oils.
9	Expansion in amount of land and increased adoption of best management practices for pasture and forage production systems for the beef, goat, and equine industries.
10	Commercial scale feasibility studies of greenhouses to produce high value plants that have been genetically modified, such as those intended for pharmaceutical or nutriceutical uses.
11	Plant Biology: basic research will lead to improved understanding of plant molecular biology and allow genetic manipulation of physiological processes important to increasing crop yields and quality and crop resistance to biotic and abiotic stresses.
12	Agronomic and Vegetable Crops: applied research and extension programs on cultural practices, crop varieties, fertilizer and manure use, precision agriculture, and integrated pest management will increase crop yields, minimize costs, and protect environmental quality.
13	Horticultural Systems: Extension programs will provide guidance on management practices for horticultural plants produced and installed by the "Green Industry" and for homeowners, important because of the rapid conversion of farmland to urban and suburban uses.
14	New Markets: advances in plant molecular biology and genomics will provide new markets for farmers and commercial-scale horticulture, such as plants for bioenergy, pharmaceutical and nutriceutical uses. New and creative marketing programs will stimulate diversification and growth in the production of value-added and niche market crops, such as culinary herbs, spices, essential oil plants, and specialty vegetables for urban and suburban markets.

Outcome #1

1. **Outcome Measures**

   Increased number of farmers, other producers, and land managers aware of latest advances in cultural management practices, crop varieties, irrigation technologies, and integrated pest management strategies for agronomic, vegetable, and horticultural crop production.

   Not reporting on this Outcome for this Annual Report

Outcome #2

1. **Outcome Measures**

   Targeted educational programs for farmers focused on cultural practices, marketing, and environmental aspects of new, high value cropping systems for niche markets, such as culinary herbs and essential oil plants, greenhouse grown pharmaceutical and nutriceutical plants, and plants grown as renewable bioenergy sources.

   Not reporting on this Outcome for this Annual Report

Outcome #3

1. **Outcome Measures**

   Educational programs for K-12 teachers and youth on advances in plant molecular biology and applications of the basic plant sciences to the production of plants used for food, fiber, landscaping, timber, bioenergy, and pharmaceutical and nutriceutical purposes.

   Not reporting on this Outcome for this Annual Report

Outcome #4

1. **Outcome Measures**

   Increased adoption of new innovations in marketing and risk management for farmers and other producers of plants and plant-based products.

   Not reporting on this Outcome for this Annual Report

Outcome #5

1. **Outcome Measures**

   Increased number of farmers adopting new crop varieties and integrating innovations in cultural practices, biological and chemical pest management, harvesting equipment, and irrigation management into their production systems.

   Not reporting on this Outcome for this Annual Report

Outcome #6

1. **Outcome Measures**

   Increase in the number of farmers implementing comprehensive nutrient management plans that are profitable and protective of ground and surface water quality.

   Not reporting on this Outcome for this Annual Report

Outcome #7

1. **Outcome Measures**

   Increased adoption of recommended practices for plant production, management, and environmental protection by the "Green Industry" (greenhouses, nurseries, landscapers).

   Not reporting on this Outcome for this Annual Report

Outcome #8

1. **Outcome Measures**

   Increased amount of land used to produce high value, niche market crops, such as culinary herbs, spices and essential oils.

   Not reporting on this Outcome for this Annual Report

Outcome #9

1. **Outcome Measures**

   Expansion in amount of land and increased adoption of best management practices for pasture and forage production systems for the beef, goat, and equine industries.

   Not reporting on this Outcome for this Annual Report

Outcome #10

1. **Outcome Measures**

   Commercial scale feasibility studies of greenhouses to produce high value plants that have been genetically modified, such as those intended for pharmaceutical or nutriceutical uses.

   Not reporting on this Outcome for this Annual Report

Outcome #11

1. **Outcome Measures**

   Plant Biology: basic research will lead to improved understanding of plant molecular biology and allow genetic manipulation of physiological processes important to increasing crop yields and quality and crop resistance to biotic and abiotic stresses.

   Not reporting on this Outcome for this Annual Report

Outcome #12

1. **Outcome Measures**

   Agronomic and Vegetable Crops: applied research and extension programs on cultural practices, crop varieties, fertilizer and manure use, precision agriculture, and integrated pest management will increase crop yields, minimize costs, and protect environmental quality.

   Not reporting on this Outcome for this Annual Report

Outcome #13

1. **Outcome Measures**

   Horticultural Systems: Extension programs will provide guidance on management practices for horticultural plants produced and installed by the "Green Industry" and for homeowners, important because of the rapid conversion of farmland to urban and suburban uses.

   Not reporting on this Outcome for this Annual Report

Outcome #14

1. **Outcome Measures**

New Markets: advances in plant molecular biology and genomics will provide new markets for farmers and commercial-scale horticulture, such as plants for bioenergy, pharmaceutical and nutriceutical uses. New and creative marketing programs will stimulate diversification and growth in the production of value-added and niche market crops, such as culinary herbs, spices, essential oil plants, and specialty vegetables for urban and suburban markets.

Not reporting on this Outcome for this Annual Report

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

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

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #7

V(A). Planned Program (Summary)

1. Name of the Planned Program

RURAL DEVELOPMENT AND LAND USE 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
112	Watershed Protection and Management	20%	20%	20%	20%
131	Alternative Uses of Land	20%	20%	20%	20%
605	Natural Resource and Environmental Economics	20%	20%	20%	20%
608	Community Resource Planning and Development	20%	20%	20%	20%
803	Sociological and Technological Change Affecting Individuals, Families and Communities	10%	10%	10%	10%
805	Community Institutions, Health, and Social Services	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	**Extension**		**Research**	
	1862	**1890**	**1862**	**1890**
Plan	5.1	0.0	7.8	0.0
Actual	4.1	0.2	8.1	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**
147579	56775	228499	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
141670	56775	66911	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
281947	0	47539	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension programs will target: (1) Rural Revitalization and Community Development - the process of change in rural economies will be monitored and opportunities for rural revitalization and community development identified; (2) Individual Academic and Family Financial Success - factors that encourage individual academic and family financial success will be identified and strategies developed to enhance those assets; (3) Social and Economic Development for All Family Members - programs to assist communities in building the social and economic capital important for civic, social, emotional and educational development of all family members including youth and the elderly will be developed and delivered; (4) Economic Growth for Rural Communities - business expansion and retention strategies for rural communities that encourage and/or manage economic growth will be developed and delivered; (5) Minimizing Land Use Conflicts and Protecting Natural Amenities - strategies to minimize land use conflicts and protect natural amenities in an urbanizing environment will be investigated, including use of integrated conceptual models that aid those responsible for resource management decisions; (6) Benefits and Costs of Alternative Surface and Ground Water Quality Protection - a framework will be developed to examine the economic benefits and costs of alternative approaches to protect surface and ground water quality; (7) Protection and Preservation of Agricultural Land - current strategies to protect and preserve agricultural land will be evaluated and promising new approaches will be investigated and assessed; (8) Rural Communities - social and economic structures of rural communities will be studied and used to formulate strategies for sustainable development; (9) Training Programs - Training programs in land use change will be developed and delivered to provide farmers, landowners, and community members decision-making tools for land use and preservation issues; (10) Critical Mass and the Urban Interface - the economic, social and cultural impacts of land fragmentation, increased spatial interfaces with urban uses and effects on agricultural support industries will be used to assess the necessary "critical mass" for future agricultural viability; and the web of relationships between urban and rural land uses will be documented.

2. Brief description of the target audience

Farmers, landowners, state agencies (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources and Environmental Control; Department of Transportation; Economic Development Office), federal agencies (USDA, NRCS, USEPA), land use organizations (Conservation Districts, AFT), environmental organizations, business and community leaders, families, students, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	3000	3000	200	300
2008	2850	11025	20	1000

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	1	4	
2008	1	6	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	3	11

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	1	6

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2008	1	7

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	3	5

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	4	28

Output #6

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	5	7

Output #7

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2008	1	4

Output #8

Output Measure

- Number of Technical Reports

Year	Target	Actual
2008	3	23

Output #9

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	2	2

Output #10

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	2	26

Output #11

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	5	8

Output #12

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	5

Output #13

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	3	21

Output #14

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2008	{No Data Entered}	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Rural families and communities will be provided with the knowledge and skills needed to adapt to the changing social, economic, and political conditions associated with conversion of agricultural land to suburban and urban land uses.
2	Educational programs for K-12 teachers and youth on the relationship between land use and major societal issues, such as economic development, community and family adaptation to changing social and political conditions, and the value of sustaining ecosystems and protecting environmental quality.
3	Increase in the number of rural families participating in extension education programs on preparing for academic success, identifying new career options, and family financial planning.
4	Increased training for rural families in establishing and achieving success with small businesses in rural, agricultural situations and in settings where land use change creates new economic opportunities beyond agriculture.
5	Increased number of farmers and other landowners trained in the social, political, economic, and environmental aspects of land use change and farmland preservation.
6	Increased interactions and long-range strategic planning efforts between research and extension staff and the diverse stakeholders (state and federal agencies, community groups, not-for-profit organizations, developers, farmers, etc.) involved in farmland preservation and land use conversion from agriculture to suburban and urban uses.
7	Rural Development: extension programming will provide rural families and communities with the personal, educational, social, and financial skills needed to thrive economically during a period of changing land use. These programs will sustain traditional agribusinesses that now support rural families and communities; identify new economic opportunities as land use changes; and assist rural communities and families in building the social and economic capital needed for success.
8	Land Use Change: research will identify strategies needed to manage land use change in a state where preserving farmland is a major goal, but economic and social forces are resulting in steady conversion of agricultural lands to suburban and urban uses. The economic, social, and cultural impacts of land fragmentation, suburban sprawl, and the "critical mass" of land and businesses needed to sustain agriculture in the long-term will be determined. Research knowledge and extension programs will help to guide long-term land use planning in cooperative efforts

Outcome #1

1. **Outcome Measures**

Rural families and communities will be provided with the knowledge and skills needed to adapt to the changing social, economic, and political conditions associated with conversion of agricultural land to suburban and urban land uses.

Not reporting on this Outcome for this Annual Report

Outcome #2

1. **Outcome Measures**

Educational programs for K-12 teachers and youth on the relationship between land use and major societal issues, such as economic development, community and family adaptation to changing social and political conditions, and the value of sustaining ecosystems and protecting environmental quality.

Not reporting on this Outcome for this Annual Report

Outcome #3

1. **Outcome Measures**

Increase in the number of rural families participating in extension education programs on preparing for academic success, identifying new career options, and family financial planning.

Not reporting on this Outcome for this Annual Report

Outcome #4

1. **Outcome Measures**

Increased training for rural families in establishing and achieving success with small businesses in rural, agricultural situations and in settings where land use change creates new economic opportunities beyond agriculture.

Not reporting on this Outcome for this Annual Report

Outcome #5

1. **Outcome Measures**

Increased number of farmers and other landowners trained in the social, political, economic, and environmental aspects of land use change and farmland preservation.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

U.S. military bases across the nation are under increasing pressure from suburban sprawl. Sprawl pushes to the boundaries of bases; neighbor complaints and legislative concerns have already closed bases in California and Nevada, and have restricted military operations on others. At the same time, many bases are also some of the last remaining areas for endangered species due to the vast expanses of preserved lands. Currently there are more endangered species on military bases than on any other federal properties.
The fastest growing federal program for land preservation is the U.S. military. The Army Compatible Use Buffer program (ACUB) supports the Army's responsibility as a federal agency to comply with all environmental regulations, including endangered species habitat protection. By working in partnership with conservation organizations, ACUBs can coordinate habitat conservation planning at the ecosystem level to ensure that greater benefits are realized towards species and habitat recovery.

What has been done

Results

: Faculty are working with the Army and its ACUB program to provide recommendations for how to use their financial resources more effectively to do a better job with conservation efforts, in terms of 'bang-for-buck' with land preservation. A joint white paper was developed with recommendations for how to use federal funds to expand conservation buffers, serving a two-fold purpose: expanding boundaries away from core activities to help mitigate neighbor concerns and extending the environmental value to protection of endangered species. Currently the Army is considering a pilot project that will either look at select bases, best suited for the research, or to do a simultaneous review of all bases. One specific project has already provided recommendations to Camp Lejeune--a Marine base in South Carolina--for the protection of the Red-Cockaded Woodpecker. The base is implementing these recommendations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery
131	Alternative Uses of Land
803	Sociological and Technological Change Affecting Individuals, Families and Communities

Outcome #6

1. Outcome Measures

Increased interactions and long-range strategic planning efforts between research and extension staff and the diverse stakeholders (state and federal agencies, community groups, not-for-profit organizations, developers, farmers, etc.) involved in farmland preservation and land use conversion from agriculture to suburban and urban uses.

2. Associated Institution Types

•1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Sussex County, the largest county in Delaware, 606,000 acres is experiencing rapid growth due to its proximity to the Atlantic Ocean, low property taxes and proximity to a large population centers in the Mid-Atlantic region. The majority of new landowners in Sussex are retirees. Sussex County is the largest broiler producing county in the country which supports the large acreage of grain production. Several conflicts emerge, the classic urban-rural lifestyle, the conversion of agricultural working lands to development and revising rural governments e.g. codes and services to meet the changing demands of the new residents.

What has been done

Results

The community development extension agent has partnered with UD colleagues in from Sea-grant Marine Advisory Service and the Institute for Public Administration through the Coastal Community Enhancement Initiative (CCEI). Several land use educational efforts are underway.

Heart & Soul of Sussex County is a program designed to engage residents in identifying the core elements (what we value) of Sussex County. Once these elements are identified and agreed upon, it then becomes the responsibility of Sussex Countians to act on those principles. To date numerous meeting throughout the county have occurred. A list of elements has been identified and revised using town meetings and audience response technology. The second phase of the project that will engage residents in thinking through the implications of how to use those elements e.g. economic development, revision of land use codes etc. is underway.

Community Viz is a land use decision-making tool. The CCEI has developed a build out model for Sussex County. A build out indicates the amount of developable land based on County zoning allocations. Because of the permissive agricultural/residential zoning designation (2 dwelling units per acre), the vast majority of agricultural working lands are in play for development. With the strong property rights ideal of county residents, significant creativity will be needed to preserve working lands. The second phase of Community Viz will highlight build out versus land use allocation based on population projection and attempt to surface for public discussion the inherent trade-offs necessary to support a viable agriculture industry and meet the needs of new residents.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
903	Communication, Education, and Information Delivery
608	Community Resource Planning and Development
605	Natural Resource and Environmental Economics
112	Watershed Protection and Management

Outcome #7

1. Outcome Measures

Rural Development: extension programming will provide rural families and communities with the personal, educational, social, and financial skills needed to thrive economically during a period of changing land use. These programs will sustain traditional agribusinesses that now support rural families and communities; identify new economic opportunities as land use changes; and assist rural communities and families in building the social and economic capital needed for success.

Not reporting on this Outcome for this Annual Report

Outcome #8

1. Outcome Measures

Land Use Change: research will identify strategies needed to manage land use change in a state where preserving farmland is a major goal, but economic and social forces are resulting in steady conversion of agricultural lands to suburban and urban uses. The economic, social, and cultural impacts of land fragmentation, suburban sprawl, and the "critical mass" of land and businesses needed to sustain agriculture in the long-term will be determined. Research knowledge and extension programs will help to guide long-term land use planning in cooperative efforts

Not reporting on this Outcome for this Annual Report

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

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

1. Evaluation Studies Planned

- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Case Study
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.

Evaluation Results

Key Items of Evaluation

Program #8

V(A). Planned Program (Summary)

1. Name of the Planned Program

SOILS AND ENVIRONMENTAL QUALITY

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	10%	10%	10%	10%
102	Soil, Plant, Water, Nutrient Relationships	20%	20%	20%	20%
104	Protect Soil from Harmful Effects of Natural Elements	10%	10%	10%	10%
112	Watershed Protection and Management	10%	10%	10%	10%
133	Pollution Prevention and Mitigation	30%	30%	30%	30%
141	Air Resource Protection and Management	5%	5%	5%	5%
403	Waste Disposal, Recycling, and Reuse	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	4.8	0.0	16.0	0.0
Actual	4.8	0.3	17.4	1.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	135963	2211	107618
1862 Matching	1890 Matching	1862 Matching	1890 Matching
78370	135963	240514	107618
1862 All Other	1890 All Other	1862 All Other	1890 All Other
6466	0	1394490	217180

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Fate, Transport, and Reaction Mechanisms - understanding the fate, transport and reaction mechanisms of plant nutrients (nitrate, phosphate), metals (copper, chromium, arsenic, mercury, other heavy metals), wastes (manures, sludges, industrial by-products and co-products) and organic chemicals (pesticides, industrial organic chemicals) in soils and soil components, and their effects on soil and water contamination using multi-spatial and multi-temporal scale approaches; (2) Cost-Effective, In-Situ Remediation - developing cost-effective, in-situ methods for the remediation and speciation of contaminated soils, including phytoremediation, bioremediation, and atomic and molecular approaches. Molecular environmental and biological approaches will be applied to study the mechanisms used by plants to take up, transport, and tolerate metals. Emphasis will be placed on the role of plant/soil/microbial interfacial reactions on contaminant accumulation and bioavailability; (3) Nutrient Management/Water Quality/Air Quality - develop fertilizer and waste management programs that ensure economic and environmental sustainability while considering crop needs, soil fertility, application technology, alternative fertilizer sources, and government policies. Research on non-point source pollution of surface and ground water by nutrients will continue. Best management practices for phosphorous will be developed with animal scientists, soil scientists, hydrologists, and environmental engineers. Education/certification programs in nutrient management and water quality will continue. Research on air emissions from poultry operations and methods to control these emissions will be started. (4) Irrigation Water Management – continue extension education and demonstration programs on more efficient water management practices.

2. Brief description of the target audience

Crop producers, poultry growers, state agencies (DDA, DNREC), federal agencies (USDA, USGS, EPA, NSF, DOE), environmental groups, peer scientists, industries with soil contamination problems, and commodity groups.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	1500	2000	200	400
2008	4650	11300	1160	250

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	4	28	
2008	2	30	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2008	24	39

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2008	7	15

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2008	3	58

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	8	19

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	4	11

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2008	16	17

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2008	3	7

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	32	32

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2008	5	4

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2008	15	19

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	26	11

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2008	65	70

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	105	117

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2008	1	8

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	35	87

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Soil management programs and best management practices for soil use in agricultural, natural, suburban/urban, and disturbed or contaminated settings will incorporate latest advances in research and be disseminated via extension programming to farmers and other land managers.
2	Educational programs for K-12 teachers and youth on soils as a critical natural resource vital to civilization, including the many functions of soils in agricultural and natural ecosystems, the importance of soil management to environmental quality, and the role of soils in sustaining aesthetically pleasing managed landscapes in suburban and urban settings.
3	Increased number of farmers and other land managers adopting advances in soil management practices that will build soil quality, increase plant productivity, enhance the beneficial re-use of agricultural, municipal, and industrial by-products (manures, biosolids, residuals) in a variety of land use settings, and prevent nonpoint nutrient pollution of ground and surface waters, particularly for phosphorus and nitrogen.
4	Increased number of farmers and others using soil testing to provide site-specific guidance to increase agricultural profitability, prevent soil loss by erosion, mitigate nonpoint pollution of surface and ground waters, and more efficiently use soils and nutrients in suburban settings.
5	Increased use of watershed scale modeling to predict changes in the functions and environmental impacts of soils in mixed-used watersheds (agriculture, suburban, urban, forests) as land use changes from agricultural to suburban and urban uses.
6	Soils and Environment: basic research will provide increased understanding of the physical, chemical, and biological factors influencing the fate and transport of nutrients, metals, organics, and pathogenic organisms in soils. Applied research will lead to the development of nutrient management strategies and recommendations that minimize nonpoint nutrient pollution from all land uses. Remediation practices for soils contaminated by metals, organics, and nutrients will use innovative, research-based measures to prioritize risk to the environment and human health based on the speciation, mobility, and bioavailability of contaminants in soils. Mitigation approaches for polluted soils will combine soil chemistry, physics, and soil/plant molecular biology to enhance removal (phytoremediation) or in-situ degradation or stabilization of pollutants in soils.
7	Environmental Quality: applied research and extension programming will provide guidance on profitable, environmentally sound management of soils at all spatial scales, from the individual field to the watershed. The emphasis will be on cost-effective strategies and management practices that can prevent nonpoint nutrient pollution, soil erosion, and contaminant transport (metals, organics, pathogens) from agriculture and suburbanized landscapes.

Outcome #1

1. Outcome Measures

Soil management programs and best management practices for soil use in agricultural, natural, suburban/urban, and disturbed or contaminated settings will incorporate latest advances in research and be disseminated via extension programming to farmers and other land managers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Derelict poultry houses are often left untouched with the potential to pollute ground and surface waters, while tying up lands that could otherwise be used for tillage or conservation purposes.

What has been done

Results

One option utilizing derelict poultry house sites is to recycle the wood in houses by grinding it and then incorporating it into the pad site. Researchers have determined the amount of nutrients that then remain on site. The ground material can be excavated an used as fertilizer material on corn, soybeans, and turfgrass. Demonstrations showed ways that the materials can be remediated in situ, that when provided with an additional carbon source can maintain perennial grasses or annual small grains. Demonstrations and associated research has shown that this practice recovers nitrogen that would otherwise be lost into the water table, thus serving a nutrient management benefit. Wood that is recovered as a remediation tool means that there is less material making its way into landfills. In addition, traditionally derelict houses were burned; a reduction in this practice means a benefit to air quality. Due to this research, NRCS has altered one of their existing standards to allow cost share monies for the decommissioning of derelict poultry house sites using this technology. NRCS will offer a pilot project allowing a certain number of derelict sites to be remediated and recovered. These monies are available to those who are actively farming. Because of the environmental benefits, future projects may include pursuing those who are not still actively farming.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
112	Watershed Protection and Management
903	Communication, Education, and Information Delivery
102	Soil, Plant, Water, Nutrient Relationships

Outcome #2

1. Outcome Measures

Educational programs for K-12 teachers and youth on soils as a critical natural resource vital to civilization, including the many functions of soils in agricultural and natural ecosystems, the importance of soil management to environmental quality, and the role of soils in sustaining aesthetically pleasing managed landscapes in suburban and urban settings.

Not reporting on this Outcome for this Annual Report

Outcome #3

1. **Outcome Measures**

   Increased number of farmers and other land managers adopting advances in soil management practices that will build soil quality, increase plant productivity, enhance the beneficial re-use of agricultural, municipal, and industrial by-products (manures, biosolids, residuals) in a variety of land use settings, and prevent nonpoint nutrient pollution of ground and surface waters, particularly for phosphorus and nitrogen.

   Not reporting on this Outcome for this Annual Report

Outcome #4

1. **Outcome Measures**

   Increased number of farmers and others using soil testing to provide site-specific guidance to increase agricultural profitability, prevent soil loss by erosion, mitigate nonpoint pollution of surface and ground waters, and more efficiently use soils and nutrients in suburban settings.

   Not reporting on this Outcome for this Annual Report

Outcome #5

1. **Outcome Measures**

   Increased use of watershed scale modeling to predict changes in the functions and environmental impacts of soils in mixed-used watersheds (agriculture, suburban, urban, forests) as land use changes from agricultural to suburban and urban uses.

   Not reporting on this Outcome for this Annual Report

Outcome #6

1. **Outcome Measures**

   Soils and Environment: basic research will provide increased understanding of the physical, chemical, and biological factors influencing the fate and transport of nutrients, metals, organics, and pathogenic organisms in soils. Applied research will lead to the development of nutrient management strategies and recommendations that minimize nonpoint nutrient pollution from all land uses. Remediation practices for soils contaminated by metals, organics, and nutrients will use innovative, research-based measures to prioritize risk to the environment and human health based on the speciation, mobility, and bioavailability of contaminants in soils. Mitigation approaches for polluted soils will combine soil chemistry, physics, and soil/plant molecular biology to enhance removal (phytoremediation) or in-situ degradation or stabilization of pollutants in soils.

   Not reporting on this Outcome for this Annual Report

Outcome #7

1. **Outcome Measures**

   Environmental Quality: applied research and extension programming will provide guidance on profitable, environmentally sound management of soils at all spatial scales, from the individual field to the watershed. The emphasis will be on cost-effective strategies and management practices that can prevent nonpoint nutrient pollution, soil erosion, and contaminant transport (metals, organics, pathogens) from agriculture and suburbanized landscapes.

   Not reporting on this Outcome for this Annual Report

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

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

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

Key Items of Evaluation

Program #9

V(A). Planned Program (Summary)

1. Name of the Planned Program

AQUACULTURE

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	25%	25%	25%	25%
302	Nutrient Utilization in Animals	25%	25%	25%	25%
307	Animal Management Systems	40%	40%	40%	40%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

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

Year: 2008	**Extension**		**Research**	
	1862	**1890**	**1862**	**1890**
Plan	0.0	0.4	0.0	2.6
Actual	0.0	0.5	0.0	2.0

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

Extension		**Research**	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	74375	0	148537
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	74375	0	148537
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	100663	0	456759

V(D). Planned Program (Activity)

1. Brief description of the Activity

In addition to aquaculture research trials that will be conducted at the Delaware State University Aquaculture Research and Demonstration Facility, a series of informational workshops and on-farm demonstration/field days will be held. One-on-one technical assistance will be provided through telephone, e-mail and site visits as needed. Furthermore, research findings will be disseminated through the publication of extension fact sheets, and peer-reviewed publications. A display will be set up at pertinent regional events, including the University of Delaware Coast Day, the Maryland Watermen's East Coast Commercial Fisherman's and Aquaculture Trade Exposition and Delaware Ag Week, to highlight our aquaculture research and extension program activities.

2. Brief description of the target audience

As designed, this program will primarily target existing and perspective aquaculture producers, although the information generated and planned activities will also benefit educators, policy makers and consumers.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	175	325	2000	100
2008	1050	830	2400	50

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	3	
2008	0	15	15

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2008	3	15

Output #2

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2008	3	13

Output #3

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2008	3	55

Output #4

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2008	2	11

Output #5

Output Measure

- Number of websites established

Year	Target	Actual
2008	0	3

Output #6

Output Measure

- Grants Submitted

Year	Target	Actual
2008	{No Data Entered}	27

Output #7

Output Measure

- Grants Awarded

Year	Target	Actual
2008	{No Data Entered}	20

Output #8

Output Measure

- Research Projects Completed

Year	Target	Actual
2008	{No Data Entered}	12

Output #9

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2008	{No Data Entered}	7

Output #10

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2008	{No Data Entered}	16

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Increased knowledge by the public, the food processing and restaraunt industries, state and regional economic development agencies, and state and federal technical and advisory agencies about the potential economic benefits of expanding aquaculture production.
2	Educate K-12 teachers and youth about aquaculture's role in world food security, the fundamental scientific and technological components of aquaculture production systems, and the financial and marketing aspects of aquaculture as a business.
3	Greater adoption of improved best management practices for recreational and farm ponds to increase profitability and minimize any environmental impacts of aquaculture.
4	Increased ability of aquaculturists to manage production and financial risks.
5	A comprehensive approach to increase and sustain the role of aquaculture in Delaware's economy, including the development of research-based management practices for the production aspects and environmental compatibility of aquaculture, wider use of innovative marketing strategies, and providing ongoing training on the sound business and financial management skills needed by aquaculturists

Outcome #1

1. **Outcome Measures**
   Increased knowledge by the public, the food processing and restaraunt industries, state and regional economic development agencies, and state and federal technical and advisory agencies about the potential economic benefits of expanding aquaculture production.
   Not reporting on this Outcome for this Annual Report

Outcome #2

1. **Outcome Measures**
   Educate K-12 teachers and youth about aquaculture's role in world food security, the fundamental scientific and technological components of aquaculture production systems, and the financial and marketing aspects of aquaculture as a business.
   Not reporting on this Outcome for this Annual Report

Outcome #3

1. **Outcome Measures**
   Greater adoption of improved best management practices for recreational and farm ponds to increase profitability and minimize any environmental impacts of aquaculture.
   Not reporting on this Outcome for this Annual Report

Outcome #4

1. **Outcome Measures**
   Increased ability of aquaculturists to manage production and financial risks.
   Not reporting on this Outcome for this Annual Report

Outcome #5

1. **Outcome Measures**
   A comprehensive approach to increase and sustain the role of aquaculture in Delaware's economy, including the development of research-based management practices for the production aspects and environmental compatibility of aquaculture, wider use of innovative marketing strategies, and providing ongoing training on the sound business and financial management skills needed by aquaculturists
   Not reporting on this Outcome for this Annual Report

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

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

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

Key Items of Evaluation