2004 Annual Report
PLAN OF WORK

State of Delaware

University of Delaware
College of Agriculture and
Natural Resources

Delaware State University
College of Agriculture and
Related Sciences

April 30, 2005

The annual report on the comprehensive
Plan of Work for the
1890 and 1862 Land Grant University
Research and Extension Programs
Serving the Citizens of the State of Delaware

INTRODUCTION

This is the annual report on the Plan of Work for Delaware's research and extension activities, as required by the Agricultural Research, Extension, and Education Reform Act of 1998 (AREERA), and follows the USDA "Guidelines for Land Grant Institution Plan of Work." This report includes the research and extension activities supported by USDA at Delaware State University and the University of Delaware.

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A. PLANNED PROGRAMS

EXECUTIVE SUMMARY. This report highlights important outcomes and impacts from our work during 2004. We have continued many of our existing programs and have initiated new ones in several areas in accordance with our Plan of Work Revision submitted in April of 2004. The outbreak of avian influenza (AI) on Delmarva during the winter of 2004 was a significant effort on our part, and we have continued our testing and surveillance of this economically important disease. This effort to ensure the profitability of Delmarva's billion dollar poultry industry directly affects many of our stakeholders, including growers and farmers, poultry integrators, the many industries allied to the poultry production, and our colleagues in government such as those working in the Department of Agriculture and the Department of Economic Development. Our work in environmental compatibility and preservation continues to expand and has built a solid foundation for new work on interfaces between the land, water, air, and biota. Our work on nutrient management has benefited farmers, government organizations, and many businesses in the region. We continue to provide services and to reach out to our communities with information on food safety, nutrition and financial counseling, diversification of agribusinesses, risk management, and many other areas. We are providing educational programs designed to give our students rich out-of-classroom activities, including service learning opportunities, undergraduate research opportunities, and student abroad experiences.

NATIONAL GOAL 1. AN AGRICULTURAL SYSTEM THAT IS HIGHLY COMPETITIVE IN A GLOBAL ECONOMY

EXECUTIVE SUMMARY. In 2004, the response of the University of Delaware to two outbreaks of avian influenza (AI) on the Delmarva Peninsula was a remarkable achievement. This response was a coordinated effort between our laboratory diagnosticians, our research scientists, and many others including poultry industry personnel, state and local government personnel, Delmarva Poultry Industry, Inc., USDA/APHIS, and individual growers and farmers. Another highlight of the year was the completion of the Delaware equine survey. In addition, we have continued work in dairy-animal nutrition, crop pest control, providing assistance to vegetable growers, diversification of small farming operations, and promoting Delaware's Agricultural Land Preservation Program.

ANNUAL REPORT ON GOAL. In February 2004, AI threatened the entire Delmarva broiler industry. Fast action on the parts of the UD Poultry Diagnostic Laboratory in close collaboration with state agriculture authorities and the Delmarva Poultry Industry heightened existing biosecurity measures. Containing the virus was a coordinated effort by poultry scientists at the universities of Delaware and Maryland, the Delaware Department of Agriculture, the Delmarva Poultry Industry, Inc., and USDA Veterinary Services.

When the UD Poultry Diagnostic Center identified two AI-infected flocks in northern Sussex County, the lab went into immediate "lock-down mode," and scientists worked around the clock for a week to test the 50 commercial flocks within a five-mile radius of the initial infected flock. The two infected flocks were destroyed and disposed of by UD's Extension poultry specialist in accordance with industry biosecurity. A patent-pending euthanasia procedure using foam is currently under development—a procedure that could greatly reduce biosecurity risk associated with depopulation and reduce the labor and human exposure to the virus during depopulation efforts.

Between February 5, 2004 and April 15, 2004, every chicken house on the Delmarva Peninsula was tested for AI. In total, 2,377 farms and 5,864 houses were tested. This translated into nearly 60,000 tracheal swabbings and 12,000 RRT-PCR reactions. The cost of testing alone was approximately $0.5 million.

Since the winter of 2004, our poultry diagnostic and surveillance efforts have been at an all-time high. We continue to monitor all flocks with a mortality >4/1000 per day, and we have instituted a continued program of pre-slaughter surveillance of many flocks. We believe that our overall surveillance effort for AI is the most aggressive in the nation.

Much of Delaware's economy is tied up in the state's billion-dollar poultry industry. This makes poultry health a priority for growers and processors. The potential for economic devastation caused by infectious organisms on animal health is

significant. Using biotechnology techniques and animal genomics research to unravel the fundamental mechanisms of poultry diseases, UD researchers develop recombinant vaccines that combat current and emerging infectious diseases in poultry, thus preventing catastrophic losses.

Among the most economically significant pathogens of commercial chickens worldwide is Marek's disease virus, which results in the formation of lymphomas in susceptible chickens. While vaccines for this disease exist, the virus readily mutates, finding new ways to trigger cancer even in vaccinated birds. UD researchers have a chicken genomics project, the goal of which is to identify expressed genes that are critical to the immune response to Marek's. Biological clues revealed by the genome will serve as a bridge to new strategies for producing chickens with resistance. Examining the function of genes directly related to infection by the Marek's disease virus may lead eventually to the prevention of the disease.

Optimizing poultry health is paramount to profit in the poultry industry. Improving production, maximizing poultry health and targeting broiler growth to correspond with consumer preferences have benefited from genomic research at UD. UD researchers have built normalized cDNA libraries from tissues of economic importance to the poultry industry, including those related to immunity, growth, and reproduction. The database and clones are used by laboratories worldwide. The information from these studies will be useful to breeders trying to optimize vaccine responsiveness and other desirable production characteristics.

UD researchers have developed a new, faster test for tracing sources of infection for a respiratory pathogen know as *Mycoplasma gallisepticum* (MG). Time-consuming and often unsuccessful test results are avoided because the new test provides more epidemiological information in hours, rather than days.

Delaware's front line of defense for identifying poultry disease is the UD Poultry Diagnostic Laboratory, at which a team of veterinarians and poultry scientists annually examines approximately 800 disease cases and tests 23,000 blood samples for antibodies in order to monitor for diseases and to assess the effectiveness of vaccination programs.

Dairy-animal nutrition studies at UD have led to proven methods for increasing the quality of silage and improving forage that enhances milk production, lowers feed costs, and reduces environmental waste from spoiled silage. Also, since silage spoils readily when exposed to air, a product that improves the aerobic stability of silage was developed, using research conducted at UD on a new silage inoculant containing the bacteria *Lactobacillus buchneri.*

Flies on dairy farms have been identified as contributing as much as 25 percent to losses in milk production. An IPM program that combines management practices such as fly tapes, residual space spray; alternative bedding, and coir to reduce moisture levels in calf barns can reduce fly populations by 60 to 70 percent. The use

of citric acid in calf barns continues to show promise. After 4 years of observation, the greatest advantage is seen during the first month, when the calves are small. The use of potash in pack areas significantly reduced maggot numbers, especially when used with more frequent cleanouts. The use of a combination of management practices resulted in a 40 percent average reduction in insecticides.

Working with the Delaware Department of Agriculture, our scientists completed a comprehensive analysis of Delaware's equine industry. This study indicated that the equine industry is substantial and growing and that it includes both racing and non-racing sectors. The survey reported on the number of equine operations by type, acreage dedicated to equine operations, number of equine by breed and use, equine-related expenditures, equine-related assets and income, and the number of people employed by the equine industry.

Innovative options for disease control in plant crops are always being explored. Nationwide, crop loss due to disease is more than $10 billion annually. Traditional controls, such as agricultural chemicals and chemical control strategies, have become inadequate and are costly in terms of money and the environment. UD scientists are trying to identify the signaling components that underlie disease resistance, which will lead to greater comprehension of the control structure and, in time, control strategies focused on genetically engineered plant resistance.

Lima beans are the cornerstone of the Delaware vegetable processing industry. Delaware and Maryland processors lost millions of dollars in limas to downy mildew disease. UD plant pathologists and extension scientists put together a Lima Bean Disease Research Group to identify the genotypes of the pathogen, to develop lima bean cultivars with resistance to those genotypes, and to assess fungicides as means for control. Researchers remain confident this research data will result in preventatives for downy mildew disease.

Alfalfa is the most important forage species in the United States. A new pest on alfalfa—the tarnished plant bug (*Lygus lineolaris*)—feeds at the same time that beneficial insects are present so chemical spraying is not an option. A joint effort with the USDA-ARS Beneficial Insect Introduction Research Lab (BIRL), Newark, and DSU is assessing the dominant parasite of lygus bugs–*Peristenus howardi.* If the tarnished plant bug can be brought under control with biological methods, an estimated 350 million dollars annually could be saved by producers.

In a state in which farm size is limited, optimization of the herbage productivity per unit area of land is critical to the economic success of grazing and forage operations. Lower precipitation and higher temperatures in summer limit productivity of traditionally used cool-season species. DSU's forage research group is evaluating how to extend the production season and establish grazing management guidelines to optimize pasture resources. One alternative being considered is incorporating small ruminants, such as goats and sheep, into grazing systems typically used in

beef production systems. The goal of mixed grazing is pasture productivity and sustainability of the system.

Understanding how soil microbes influence the ups and downs in crop production is key to designing microbial-control strategies for crop improvement. Many crop plants in the legume family establish a symbiotic relationship with soil microbes called rhizobia, resulting in the development of a new plant organ, the nitrogen-fixing root nodule. Within these nodules, bacteria reduce atmospheric nitrogen into a form that can be used by the host plant. This form of nitrogen minimizes the amount of chemical fertilizers required for productive crop growth. Improving the ability of crop plants to exploit this “natural” source of nitrogen will lower the direct cost of crop production for farmers as well as reduce the long-term deleterious effect of chemical fertilizers on the environment.

Yield losses from pest infestations can range from 10 to 20 percent because of improper sampling and timing of pesticide applications and improper selection of pest control strategies. To improve agricultural profitability and agricultural competitiveness, dissemination of timely information about pest outbreaks is sent out in a *Weekly Crop Update* newsletter distributed throughout the production season. This commercial management tool enhances agricultural profitability and benefits the environment.

Historically, Extension farm-risk programs have been targeted to large-scale farming operations; they lack information specific to the success of small farms, which has contributed to their rapid disappearance. DSU’s Small Farmer Technical Assistance and Outreach Program offers workshops and short courses that provide information and resources critical to success. As a result, small-farm operators are better able to manage their farms. Using what he learned through the program, one farmer retained ownership of his poultry facility, met mortgage responsibilities, and is expanding into alternative crops to generate additional farm income.

Smallholder family poultry operations contribute to a significant sector of the state’s economy and to the quality of rural life. Since good practice, poultry health and niche enterprises are vital, DSU helped to form a regional Smallholder Family Poultry committee with Extension and veterinary personnel from the universities of Delaware, Maryland and Maryland/Eastern Shore, to discuss improvement in management of small flocks. Classes for smallholder family poultry growers included choosing the right stock, nutrition, disease and waste management.

To assist the small farmer, DSU initiated the Small Farmer Technical Assistance and Outreach Program. Workshops, seminars, and short courses, which often are critical for successful operation, have been offered in operating a small farm, innovation and farm entrepreneurship.

UD Extension initiated the Agribusiness Mentor Program to assist farmers with increased profits from niche markets. Volunteer retired and older farmers are teamed with younger ones so they can pass on their life-long experience to growers

just starting out. UD Extension also developed a series of workshops based on making a success of an agribusiness from concept to completed business plan.

Delaware grain farmers generate about $100 million dollars annually in the sale of soybeans, corn, wheat and barley. Timing is everything when selling grain crops for the highest price in the marketplace. UD Extension specialists have put together an historical basis record for grain and soybeans in Delaware for grain growers to access via the Web. Since market prices are always changing, this report helps to track trends for greatest profit.

For limited-resource and minority farmers have lost sources of income to increased exports from South American countries. Diversification as a means of profit sustainability makes sense. DSU Extension is working with small farmers to find ways to add value and provide innovative products to market at roadside stands and supermarkets, thus enabling the farmer to capture a niche area to maximize profits. Two examples are ethnic vegetables and goats grown for meat. Due to the influx of immigrants to the Delmarva, demand for these products is growing rapidly. DSU demonstration plots identify the vegetables that grow best in our climate, and goat meat is becoming a profitable niche staple for small and minority farmers.

Delaware's Agricultural Land Preservation Program offers farmers financial incentives to preserve their land against development. To date, more than 75,000 acres of farmland statewide have been permanently preserved under this voluntary program that uses tax revenues to preserve farms, forestland and wetlands for nonagricultural uses. UD food and resource economists conducted a random survey to determine the level of public support for farmland preservation. The study is said to be on the "cutting-edge" nationwide as a way to view and assess the value of land-preservation initiatives.

White-tailed deer are overabundant in Delaware and Maryland, which impacts farmers and results in damage to agronomic crops exceeding $100 million annually. Hunter effort and harvest restrictions do not prevent population reduction to levels at which damage would be considered tolerable. Identifying the time when deer damage has the greatest impact on yield will allow repellent application to be timed for maximum benefit. This research will provides a basis for application timing and the amount of a field that must be treated, thus increasing the feasibility of chemical repellents for reducing deer damage to agronomic crops.

Operating a farm for profit in Delaware becomes more challenging each year. Delaware's direct farm marketers are beating the odds through innovative approaches learned at the Mid-Atlantic Direct Marketing Conference and Trade Show. Co-sponsored by Extension at UD, Virginia, Maryland, New Jersey, and Pennsylvania, this educational event provides opportunities for growers to network with others, visit successful farm markets, and learn how to improve the bottom line.

The total expenditures by source of funds and FTE's for goal 1 are:

Hatch Act Funds	$732,181
Smith-Lever Act Funds	$472,763
State Matching Funds	$1,574,035
Full-Time Equivalents	37.5

NATIONAL GOAL 2. A SAFE AND SECURE FOOD AND FIBER SYSTEM

EXECUTIVE SUMMARY. The AI outbreak during the winter of 2004 has focused our attention on the relationship between poultry health and the safety of food for human consumption. An increased emphasis on biosecurity as a result of this outbreak is related to enhancing the security of poultry production operations. The Claude E. Phillips Herbarium and Herb Research Center remains one of the few sources of information on herbs, dried botanicals, and essentials oils.

REPORT ON GOAL. A catastrophic poultry disease outbreak such as avian influenza can have severe implications to poultry-producing areas such as Delmarva by disrupting exports from the region and posing a potential human health concern. Rapid and effective eradication of this pathogenic disease is critical in minimizing the economic impact to the poultry industry and potential public health risk.

We have provided information on biosecurity of poultry operations and are working with numerous other state experiment stations and national laboratories to study AI and to work toward its control. These efforts are directly applicable to security of the nation's food supply.

Culinary herbs and essential oils continue to be one of the premier programs at Delaware State University. Claude E. Phillips Herbarium and Herb Research Center at DSU analyzes both living plants, dried botanicals, and essential oils to help small farmers, manufacturers and distributors of herbs who have no means of certifying their products as safe. DSU's unique combination of botanical and chemical facilities assures quality food and other products. A national collection scheme of living herbs has been started to not only preserve materials but also to provide correctly labeled herbs to gardeners, farmers, nurseries, and researchers. DSU is also a primary source of information on herbs and nomenclature for a worldwide audience, including manufacturers of dietary supplements and other food products.

The total expenditures by source of funds and FTE's for goal 2 are:

Hatch Act Funds	---
Smith-Lever Act Funds	$206,333
State Matching Funds	$561,900
Full-Time Equivalents	7.2

NATIONAL GOAL 3. A HEALTHY, WELL-NOURISHED POPULATION

EXECUTIVE SUMMARY. We continue well-established efforts of the Delaware Expanded Food and Nutrition Education Program (EFNEP). Programs on nutrition for diabetics and on preparing and handling food safely are available to many and are very effective at changing behaviors for the better.

REPORT ON GOAL. While low-resource families with young children can depend upon the UD EFNEP program to help them improve their families' diets, encourage good lifelong eating habits, and employ smart shopping and budgeting practices, single low-resource youths were overlooked until the initiation of Extension's "Boning up on Health," a series of classes that emphasized the importance of daily calcium consumption and exercise.

Delaware EFNEP celebrated the 35th anniversary of the program. Thousands of Delawareans have been touched by this program since its inception in 1969. EFNEP continues to provide essential information on nutrition counseling throughout the state.

Delaware's rate of diabetes is one of the highest in the nation; more than one in 20 Delawareans has been diagnosed with this disease. Proper nutrition and meal planning help control diabetes. Sound nutritional programming that increases knowledge of healthy food choices and cooking techniques is offered through the UD *Dining with Diabetes* program. In 2003, ten *Dining with Diabetes* programs were held in Delaware, reaching 206 participants statewide: 96 white, 34 African American, four Native American and three Latino attendees.

Food safety is an issue of primary concern for restaurants and commercial and noncommercial food service operations. In-depth employee training is needed to better protect against foodborne illness. For the past seven years, UD Extension educators have offered the ServSafe® Manager Certification Course. Participants have come from a range of facilities that offer food service, including restaurants, state facilities, nursing homes and child care providers. Participants are employed as chefs, restaurant managers and front-line employees. If food safety education helps an establishment avoid even just one foodborne illness outbreak, it saves that operation $75,000.

The total expenditures by source of funds and FTE's for goal 3 are:

Hatch Act Funds	---
Smith-Lever Act Funds	$214,790
State Matching Funds	$286,400
Full-Time Equivalents	7.7

NATIONAL GOAL 4. AN AGRICULTURAL SYSTEM WHICH PROTECTS NATURAL RESOURCES AND THE ENVIRONMENT

EXECUTIVE SUMMARY. We are addressing the quality of Delaware's environment using both basic and applied approaches. Delaware's compliance with nutrient management legislation is outstanding, and we continue to provide information access on this topic. We continue to study and work to improve water quality. Programs in biodiversity and ecosystem balance are enhanced by new hires that have been made that offer increased opportunity to address critical issues.

REPORT ON GOAL. The contamination of soils and water with metals such as nickel, zinc, arsenic, and cobalt is of great concern because of their injurious effects on plants, animals, and human health. UD soil scientists continue to discover new ways to reduce the toxicity of metals. Researchers have found that metal (Zn and Ni) hydroxide precipitates form in field soils under conditions of higher metal contents and soil pHs that exceed 6.5. The formation of these precipitates isolates the metals, enhances binding, diminishes leaching, and reduces the bioavailability of the metal. This will ensure that remediation efforts are more effective and less costly.

Delaware's Nutrient Management Act requires that agricultural waste management practices be developed in poultry-producing areas that are "high" in phosphorus and a potential threat to surface and shallow ground waters. UD researchers have conducted studies that provide scientific justification for these regulations, specifically rapid, accurate soil test methods that can predict when soils are sufficiently saturated with phosphorus to be of environmental concern.

Poultry litter is frequently applied to Delaware farmland in regions of intensive poultry production. As a result, large quantities of phosphorous and arsenic are in the soil. While phosphorous occurs naturally in litter, arsenic is a poultry-feed additive used for disease control. UD researchers are working to understand the stability, mobility and toxicity of phosphorous. UD researchers find that soluble phosphorous is reduced with the addition of alum and that the phosphorous is in an adsorbed phase, which is desirable in terms of minimizing phosphorous mobility. In addition, it is encouraging that there is no large build up of arsenic in Delaware soils.

One of the more critical impacts of agricultural activity in Delaware is fertilizer use, which can result in nutrient enrichment of water supplies and eutrophication of streams and ponds. In a state with large areas of shallow water tables and sandy soil and a history of hundreds of years of human occupation, it can be difficult to separate surface water impacts and groundwater impacts as well as atmospheric impacts for a body of water. Research at DSU is sorting out such a combination of impacts at Trap Pond, a Delaware State Park, where recreational use has been affected by algal blooms and high bacterial counts, yet the source of nutrients is unknown. Through field-based surface and groundwater measurements in combination with state precipitation data, DSU researchers hope to ascertain the potential sources of nutrient loading.

Irrigation consumes large amounts of water and energy and, if poorly managed, can adversely affect the environment. Competition for high-quality water resources for other uses, such as municipal and recreational, has put pressure on irrigated agriculture to manage water resources. Relatively small reductions in water can mean large savings. With a savings of just one half an inch of irrigation water over a season, the grower could realize more than 13,000 gallons per acre—that's 500,000 gallons for a typical 40- acre irrigated field. Two areas for potential improvement in irrigation management are how much water and when to apply it, as well as distribution efficiency.

Recognizing environmental changes in Delaware estuaries such as elevated phytoplankton biomass are caused by nutrient-driven eutrophication, DSU researchers are gathering data on the amount of food consumed by suspension-feeding bivalves to determine the filtration rate and efficiency of particle retention by the gill—which acts as both a water-transporting and a particle-retaining organ. While studies have shown that benthic suspension-feeding bivalves such as oysters play an important role in countering the effects of eutrophication in estuaries and rivers, years of harvesting, habitat destruction, pollution, and disease have caused a decrease in oyster populations. If better restoration activities can be determined to increase the growth of the oyster reef habitat, this will aid in sequestering nutrients from the water column, thus increasing water quality.

The actions of humans present a potential stress upon natural systems. It is essential to devise methods to predict the likely affects of human activities on the environment, so they can be minimized. DSU scientists are developing environmental/socioeconomic modeling methodologies for use on the St. Jones River watershed (Delaware). These models will monitor interaction between human activities and environmental impact. Identifying these connections will mean more accurate prediction of potential impacts so informed decisions about resource management and use can be made.

While mile-a-minute weed (*Polygonum perfoliatum* L.) is widely distributed in Asia, it is not considered a noxious species there. Accidentally introduced in a nursery in Pennsylvania in the 1930s, this alien species has since become established in the northeast from Virginia to New York and west to Ohio. Its annual vines grow rapidly to form dense mats that can out-compete and displace native plant species. Because of its rampant growth, undesirability, and limited control options, *P. perfoliatum* has been targeted by the U.S. Forest Service for biological control. UD entomologists are studying the host range of insects that feed on mile-a-minute weed in China. One stem-boring weevil, *Rhinoncomimus latipes*, has been shown to be host-specific to *P. perfoliatum*. If approved, the weevil was released in summer 2004. Short-term monitoring suggests success on a limited level.

UD soil scientists are studying the inactivation and transport mechanisms of viruses in porous media under relevant environmental conditions. This research will provide

scientific basis for developing regulations to protect water resources from contamination by microbial pollutants.

Natural areas in Delaware are under increasing pressure for change, creating fragmentation of open spaces, agricultural fields and forests. This not only impacts utility infrastructure in the surrounding communities, but also wildlife habitat. Wildlife conservation educational efforts are targeted to a wide range of audience beliefs and knowledge levels. The Wildlife and Conservation Plant Demonstration Nursery at the Georgetown Research & Education Facility, is a “classroom” for people to observe plant materials they are considering establishing on their properties. Newly established native trees, shrubs and grasses were added to the site this year.

Farmers and landowners face an increasingly complex array of public regulations and programs that influence their management decisions regarding issues like conservation and environmental quality. How can farmers and landowners make informed decisions with conflicting information? Economists must devise coherent approaches to optimally integrate both conservation and agricultural federal, state and local programs. By identifying the conflicts among these programs and sharing this information, policy makers can enhance the performance of these programs. A booklet entitled, “Linkages Between Agricultural and Conservation Policies,” was developed and made available through the Northeast Regional Center for Rural Development.

UD programs aimed at ecosystem balance focus on the maintenance of biodiversity in natural ecosystems in ways that are compatible with agriculture and with urban/suburban population growth and development. Program components include developing and delivering integrated pest management programs—a systems approach using chemical, cultural, mechanical, and biological control to increase net profits to producers while protecting the environment. The expansion of integrated pest management into processing vegetables, melons, potatoes and ornamentals has led to the refinement of disease and mite management programs in watermelons and other crops.

Human activity affects migratory shore birds, bat activity patterns, and horseshoe crab ecology in Delaware. DSU scientists are looking at horseshoe crab conservation, and a method for determining their reproductive condition. Results from these studies will yield recommendations for the management of horseshoe crabs. Also being studied are the habitat preferences of bats so management strategies can be established to maintain populations of these beneficial animals, particularly in wetlands. Feral horses on Assateague are being examined for their role in seed dispersal to determine if grazing fauna has a beneficial or detrimental effect on barrier island flora.

The declining abundance of songbirds that migrate from Central and South America to breed in temperate North America (so-called Neotropical migrants) has made them frequent subjects of intensive ecological and behavioral study by wildlife

biologists. The scientist's concern is whether these methods disturb an individual bird enough to reduce its normal tendency to return to the same place to breed in future years. During a 28-year study of a Wood Thrush *(Hylocichla mustelina)* population in a 35-acre woods, UD researchers have used banding and intensive monitoring of the population to see whether birds return the next year. This study provides support to ecologists and biologists who need to gain data for conservation decisions, demonstrating that current research techniques, detailed above, cause minimal potentially confounding effects on their subjects.

Roadside rights-of-way are notorious for allowing the rapid spread of invasive exotic plant species that threaten native vegetation. UD's ongoing collaborative research project with DelDOT and the Delaware Center for Horticulture has planted 34 pilot sites along Delaware roadsides to study methods of establishment, species evaluation, maintenance strategies and economics. The pilot plots have provided information for a design and concept manual to be used by DelDOT that will stipulate roadside vegetation in any new or renovation road project.

The total expenditures by source of funds and FTE's for goal 4 are:

Hatch Act Funds	$341,655
Smith-Lever Act Funds	$202,309
State Matching Funds	$1,583,223
Full-Time Equivalents	16.5

NATIONAL GOAL 5. ENHANCED ECONOMIC OPPORTUNITY AND QUALITY OF LIFE FOR AMERICANS

EXECUTIVE SUMMARY. Agriculture represents an important economic base for Delaware; however, communities and families are a key target for work under this goal. We have offered a variety of programs to children, youth, and families in low or limited-resource communities, including programs designed to improve academic skills. Service learning has become an important component of 4-H and of academic offerings at our universities. Many of the activities reported under this goal are joint efforts between the University of Delaware and Delaware State University.

ANNUAL REPORT ON GOAL. If at-risk children and youth in limited-resource communities are to become productive adult citizens, they need to encounter more resilience factors than risk factors. UD Extension has been working with community residents in three low-resource communities throughout Delaware to assess needs and strengths, develop resources and implement customized programs to reduce developmental risks.

DSU Extension offers a program for low-income, largely minority, at-risk youth who lack the necessary educational skills to pass state mandatory academic testing. Students who do not pass the test cannot go on to the next grade, and often are

identified as exhibiting negative social and academic behaviors. The DSU program—called Ladies and Gentleman's Club—addresses these issues (with the input of school officials, team leaders, guidance counselors, and concerned adults) and helps youngster learn confidence in and out of the classroom.

The Woodbridge School District in Sussex County, Del., serves a population in which more than half of the families with school-age children are below the poverty line. Woodbridge students consistently score at the lowest level in comparison with other Delaware school districts. An after-school program was created in a joint effort with Woodbridge School District, UD Cooperative Extension/4-H Youth Development and the YMCA Resource Center in Sussex County to address academic and cultural enrichment. Extension provides educational programming/curricula, office space, leadership staff and support staff. Using the skills of experienced Extension personnel, the after-school program provides instruction in areas ranging from archery and anti-tobacco education to teamwork and bike safety. Preliminary evidence suggests that after-school participants have improved academically.

Service learning has been shown to have a positive impact on the academic skills of youth who participate as well as instilling a lasting benefit by teaching youth the importance of volunteering. Delaware 4-H engaged at-risk youth in the 4-H Summer of Service Program, the purpose of which was to introduce youth in grades 6 and up to the idea of community service in a concentrated series of volunteer projects. Upon completion of the six-week program, the young people had performed more than 1,200 hours of community service.

UD Extension workshops in financial management, which target low-resource adults, help foster greater financial literacy in topics such as basic money management, debt reduction, educated consuming, and saving for the future.

Youth tobacco and alcohol use has been on the rise in Delaware. It is estimated that 19,500 Delaware youth will die prematurely from smoking or in alcohol-related vehicle crashes. The Health Rocks program in Delaware has been taught at statewide 75 schools and other locations to 1,900 youths. Post-test evaluations show that participants have improved their decision-making skills and the ability to resist peer pressure.

Some Delawareans are financially over-extended because of job loss, easy access to credit, divorce, or the loss of an earning family member. UD Extension offers a financial management education program called *Doing More With Less* geared to social workers, clergy, teachers and others who work with clientele mired in perpetual money problems. *Doing More With Less* is an intensive approach to basic financial management and counseling techniques. Topics covered include goal-setting, spending plans, credit use and debt management, basics of saving, and fraud. UD Extension educators worked with 40 professionals employed in the Delaware Health and Social Services Division of State Service Centers. If every one

of these social worker helps just one family, an additional 40 families will be served by Extension educational outreach.

High school students who are behind academically need positive experiences in the work world to prepare them to be productive adult citizens. Through the Workforce Preparation Program, overseen by Delaware 4-H, youths are placed in part-time jobs at non-profit organizations during vacation from school. Students also participate in enrichment classes to ensure academic continuity over the summer months. The program provides students with real-work experience on a daily basis, reinforcing the importance of reporting to work as scheduled and the teamwork involved in doing a good job.

Delaware's Office of Child Care Licensing requires child care providers to attend 30 hours of in-service training yearly. UD Extension provides up-to-date, affordable training for childcare providers with monthly programs for family- and center-based childcare providers in each county. Topics include Behavior is Contagious, Car Seat Safety, Nutrition, Let's Talk Discipline, Food Safety, Ups & Downs of Outdoor Play, and How to Work with Problem Parents. In Sussex County, especially, a wide range of people were reached, including African Americans, Latinos and Asians.

The McRae Foundation's Community Services Program at *A Place for You* meets the needs of more than 100 low-income families with at-risk teens. This program emphasizes nutrition, parenting, budgeting, life skills, and family survival skills. Program representatives also collaborate with other community agencies on projects, such as the Police Athletic League and the joint venture with Community Bridges program that included four children from *A Place For You* in a neighborhood clean up and beautification project.

Volunteerism is a core value of 4-H, and Delaware 4-Hers serve a critical need volunteering in their communities. In summer 2004, Delaware 4-H conducted three two-week-long day camps that focused on structured service learning for campers in 6^{th} through 8^{th} grades. Community service activities included work at the Food Bank, Read Aloud Delaware, renovation of a barn in a state park, Earth Day promotion, Make A Difference Day, Coastal Clean-up, food drives, Adopt A Highway, planting trees, Meals on Wheels, Toys for Tots, beach grass planting, Relay for Life, pet therapy and clothing drives. The average number of volunteer hours provided by 4-Hers at a rate of $8/hour would mean that they contributed more than $165,600 worth of services in the past year.

The total expenditures by source of funds and FTE for goal 5 are:

Hatch Act Funds	---
Smith-Lever Act Funds	$639,359
State Matching Funds	$710,687
Full-Time Equivalents	21.2

B. STAKEHOLDER INPUT PROCESS

In the State of Delaware, the University of Delaware and Delaware State University used a multi-faceted approach to securing stakeholder input for the original Plan of Work. We believe in direct contact with people and attempt to solicit input from a wide variety of clientele, users, and stakeholders. Opportunities for input 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, agri-businesses, 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 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: Delaware Herb Growers Association (DHGA), American Herbal Products Association (AHPA) and American Botanical Council (ABC), 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.

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.

C. PROGRAM REVIEW PROCESS

Peer Review of Research Programs

We adopt by reference the National Standards for Peer Review.

Merit Review of Extension Programs

Merit review for Delaware Cooperative Extension consists of five levels of peer and stakeholder review. Extension professionals submit county plans that have been reviewed by their peers within the county and by county stakeholder advisory

groups. These stakeholder groups 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 five-year 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, state and local funders, etc. 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 the states advise each other on opportunities to strengthen individual state plans and ways that we can collaborate across state lines.

D. EVALUATION OF THE SUCCESS OF MULTI AND JOINT ACTIVITIES

Delaware State University and the University of Delaware have participated in numerous programs and projects that are multi-state, multi-institutional, multi-disciplinary, and joint research and extension programs. Sections E, F, and G highlight a few of the successful programs. All twelve program areas in the Delaware Plan of Work involve some multi-state and joint activities.

The planned programs were identified through the stakeholder input process as described in section B. Program evaluations and surveys are being used annually to ensure that the planned programs are still on track and relevant to the needs of the state and region.

We provide many services to underserved and underrepresented populations. Many of our programs in youth development are targeted to at-risk populations. Our programs in nutrition are targeted to populations that most need help, including

those for which English is not the primary language. We have recruitment committees that are charged with recruiting a diverse student body. We have provided interesting forums and lectures on diversity and we continually emphasize the importance of diversity in our faculty and professional search processes.

In sections E, F, and G the outcomes and impacts of joint and multi programs are described. These outcomes and impacts are consistent with the description in the Plan of Work.

Delaware State University and the University of Delaware have a tradition of multi-state, multi-institutional, and joint activities. These programs have been effective and efficient in the past and continue to accomplish their goals. We share faculty with the University of Maryland, combined the dairy herds of Rutgers and Delaware, and participate in region-wide crisis management programs for beekeepers and stone fruit growers.

We are combining programs with Delaware State University more effectively than in the past. In fact, during the Fall of 2004, a joint retreat was held for Cooperative Extension at both Delaware State University and the University of Delaware.

Further evaluation of planned programs including outcomes and impacts are presented in Sections E, F. and G.

E. INTEGRATED EXTENSION AND RESEARCH

At UD, research and Extension are closely aligned in efforts to provide Delaware producers with information they can put to use. The following examples are highlights of this collaboration, which also can be found in other goal sections of this report.

For Delaware's billion-dollar poultry industry, the economic damage caused by infectious poultry diseases could be devastating. Using biotechnology techniques and animal genomics research to unravel the fundamental mechanisms of poultry diseases, UD researchers develop recombinant vaccines that combat current and emerging infectious diseases in poultry, thus preventing catastrophic losses. In an outreach effort, UD Poultry Diagnostic Laboratory monitors for diseases in poultry and assesses the effectiveness of vaccination programs.

In 2004, our efforts to combat AI received national acclaim. We are following up with multi-state and integrated extension and research activities aimed at controlling AI in the future and reducing the risk to our poultry industry.

Plant health is critical to soybean growers, and two new potentially yield-reducing plant diseases have been identified in Delaware: sudden death syndrome in soybeans and wheat streak mosaic virus. Knowing that these diseases are present allows UD scientists and Extension to mount research and educational efforts to

prevent these plant diseases from becoming serious problems for Delaware growers.

Current pickling-cucumber harvesting methods fail to remove much dirt and cause excessive product damage so an innovative farming technique was needed. UD researchers, working closely with Extension, have constructed a pickling-cucumber harvester that reduces dirt on the final product by 12 percent, while the innovative redesign of the conveyer decreases product abrasion by 5 percent, thus economically benefiting both grower and vegetable processor.

UD researchers have evaluated the effect of chemical treatment of poultry litter with alum (aluminum sulfate) on phosphorus mobility. Their findings supply critical information for this important broiler-growing region concerning fate, transport, and bioavailability of toxic metals and contaminants, enabling Extension to offer growers scientifically sound and cost-effective strategies.

UD researchers conducted field trials on farms throughout Delaware to demonstrate the value of “starter” fertilizer on corn across soils with a wide range of initial soil test phosphorus levels, to show the value of poultry litter applied at various rates, and to demonstrate the value of diagnostic tools for better nutrient management during crop production. UD Extension’s long-term goal is to increase Delaware farmers’ awareness of the economic value of poultry litter as a source of nutrients in crop production, thus minimizing the environmental problems associated with over-application of poultry litter to cropland.

F. MULTI-STATE EXTENSION ACTIVITIES

UD Extension often reaches across state lines to Extension staff at other universities for a wider distribution of information. These states include all those on Delmarva (DE, MD, VA) as well as PA and NJ. The following examples of multi-state Extension activities touch on some of these programs, which also may be contained in other goal sections of this report.

Farm business management skills are taught 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.

MAAREC (Mid-Atlantic Apiculture Research & Extension Consortium) is a five-state consortium (DE, MD, NJ, PA, and WV) of university research/Extension, state regulatory and beekeeper associations, charged with keeping bee colonies healthy, thus meeting regional pollination demands, and ensuring agricultural profitability.

Coordinated research and data gathering by the Southeast Pennsylvania IPM group (which UD Extension participates in) has allowed Extension specialists to pinpoint proper monitoring windows for a number of ornamental insect pests.

To reduce loss from crop insects, weeds and diseases, Extension and researchers from the University of Delaware, the University of Maryland/College Park, Rutgers University, and Virginia Tech collaborate on compiling comprehensive Pest Management Recommendation Guides for regional field crops and for vegetable crops. The information is specific to local climate, soils and conditions, comparing the effectiveness of treatments for specific weed, insect, and crop diseases based on data derived from university trials.

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 that provides new educational information. Designed to provide continuing educational opportunities for Certified Crop Advisers, Nutrient Management Consultants, agency personnel (NRCS, Conservation Districts, and Cooperative Extension), independent consultants, and growers, the school provides valuable, applied information to improve incomes in farm and rural communities.

UD Extension and Rutgers University share a herd of 300 cows: 200 heifers and 100 milking cows. UD maintains a milking herd and heifers are raised at Rutgers until just before first calving. The reason for combining the herds is better and more efficient use for teaching, Extension outreach and ruminant nutrition studies.

G. MULTI-STATE RESEARCH

Researchers at the University of Delaware are participating in the nationwide effort to study and control AI via their participation in the USDA Coordinated Agricultural Project on AI.

DSU and the University of Delaware participate in numerous multi-state research projects in support of our State Plan of Work. We will highlight the impact of two of these projects: the Claude E. Phillips Herbarium and NC228, Avian Respiratory Diseases: Pathogenesis, Surveillance, Diagnosis and Control.

The Claude E. Phillips Herbarium consists of a 110,000 specimen vascular plant collection from around the world that dates back to 1799, 2500 volumes dating back to 1737, and numerous periodicals and photographic slides. The herbarium cooperates with many federal, state, and private institutions, including the Natural Resource Conservation Service, the Delaware Department of Natural Resources and Environmental Control, the Delaware Nature Society, the Herb Society of America, and The International Herb Association. This resource is available to students, farmers, public service agents, members of the scientific community, and the public.

The goals of NC228 are to determine the pathogenesis and interactions of specific avian respiratory disease agents, determine the occurrence and consequences of agent and host variation on disease susceptibility, and develop new and improved methods for the diagnosis, prevention, and control of avian respiratory agents. Delaware scientists are sequencing the *Mycoplasma synoviae* genome and studying the relationship between attenuation and intracellular invasiveness for mycoplasma species. In addition, Delaware scientists have examined differences among infectious bronchitis isolates and have been able to better understand the derivation of emerging isolates of this important and costly pathogen.

Participants in NC228 are located in Alabama, Connecticut, Delaware, Georgia, Illinois, Indiana, Iowa, Maryland, Minnesota, North Carolina, and Ohio.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Multi-state Extension Activities and Integrated Activities

Institution: University of Delaware
State: Delaware

Check one: __x_ Multi-state Extension Activities
_____ Integrated Activities (Hatch Act Funds)
_____ Integrated Activities (Smith-Lever Act Funds)

Title of Planned Program/Activity	Actual Expenditures				Projected Budget
	FY 2001	FY 2002	FY2003	FY2004	FY 2005
Goal 1: An agricultural system that is highly competitive in a global environment	**149,977**	**238,720**	**168,383**	**175,270**	**170,000**
Goal 2: A safe and secure food and fiber system	**11,044**	**17,578**	**12,399**	**13,999**	**13,000**
Goal 3: A healthy, well-nourished population					
Goal 4: Greater harmony between agriculture and the environment	**85,605**	**136,258**	**96,111**	**101,000**	**97,000**
Goal 5: Enhance economic opportunity and quality of life for Americans	**68,465**	**108,977**	**76,868**	**77,149**	**77,000**
Total	**315,091**	**501,533**	**353,761**	**367,418**	**357,000**

Robin W. Morgan **April 30, 2005**
Director **Date**

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U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
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Multi-state Extension Activities and Integrated Activities

Institution: University of Delaware
State: Delaware

Check one: ____ Multi-state Extension Activities
__x_ Integrated Activities (Hatch Act Funds)
____ Integrated Activities (Smith-Lever Act Funds)

Title of Planned Program/Activity	Actual Expenditures				Projected Budget
	FY 2001	FY 2002	FY2003	FY2004	FY 2005
Goal 1: An agricultural system that is highly competitive in a global environment	**305,551**	**219,476**		**379,770**	**309,870**
Goal 2: A safe and secure food and fiber system					
Goal 3: A healthy, well-nourished population					
Goal 4: Greater harmony between agriculture and the environment	**19,162**	**13,763**	**465,264**	**20,143**	**19,433**
Goal 5: Enhance economic opportunity and quality of life for Americans					
Total	**324,713**	**233,239**	**465,264**	**399,913**	**329,303**

Robin W. Morgan **April 30, 2005**
Director **Date**

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Multi-state Extension Activities and Integrated Activities

Institution: University of Delaware
State: Delaware

Check one: ____ Multi-state Extension Activities
____ Integrated Activities (Hatch Act Funds)
__x__ Integrated Activities (Smith-Lever Act Funds)

Title of Planned Program/Activity	Actual Expenditures				Projected Budget
	FY 2001	FY 2002	FY2003	FY2004	FY 2005
Goal 1: An agricultural system that is highly competitive in a global environment	**141,684**	**215,065**	**218,520**	**250,479**	**150,479**
Goal 2: A safe and secure food and fiber system	**10,321**	**15,665**	**83,548**	**70,002**	**10,962**
Goal 3: A healthy, well-nourished population					
Goal 4: Greater harmony between agriculture and the environment	**80,002**	**121,434**	**68,020**	**79,168**	**84,968**
Goal 5: Enhance economic opportunity and quality of life for Americans	**72,417**	**109,924**	**150,074**	**146,913**	**76,913**
Total	**304,424**	**462,088**	**520,162**	**546,562**	**323,322**

Robin W. Morgan **April 30, 2005**
Director **Date**

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