

GOAL 1

AN AGRICULTURAL SYSTEM THAT IS HIGHLY COMPETITIVE IN THE GLOBAL ECONOMY

The economic damage caused by infectious organisms on animal health for Delaware's billion-dollar poultry industry has devastating potential. 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 addition, UD Poultry Diagnostic Laboratory yearly examines 700 disease cases and tests 20,000 blood samples for antibodies in order to monitor for diseases and to assess the effectiveness of vaccination programs.

The Integrated Pest Management (IPM) team developed a multi-state approach to watermelon IPM, focusing on a total crop management system with innovations that included the development of alternative mite management, which resulted in a savings of \$20 per acre in reduced miticide use. Fly management on dairy farms if not controlled can contribute to a five to 25 percent loss in milk production. Whole farm surveys to determine possible breeding areas were conducted, resulting in the use of citric acid as an edge treatment and use of alternative beddings, for a reported reduction in use of insecticides by as much as 60 percent.

Agricultural profitability in today's environment means livestock producers must improve forage production and extend the grazing season through irrigation, one aspect of an ongoing UD study on Delaware pasture management.

Soybean variety selection has an impact on the agricultural profitability so cultivar performance trials are conducted yearly by UD researchers and the results are widely disseminated to growers. These trials are an important factor in estimating the potential impact of choosing a cultivar based on its performance.

The management of mushroom flies in commercial mushroom crops has become increasingly difficult, so researchers at UD are investigating a number of alternatives for use in mushroom crops, including pesticides with novel chemistries and new modes of action: a growth regulator, nematode parasites, a botanical pesticide, and a bacterium producing proteins toxic to fly larvae.

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, caused by a soilborne fungus, and wheat streak mosaic virus. Knowing that these diseases are present allows UD scientists and Extension to mount educational efforts and research to prevent these plant diseases from becoming serious problems for Delaware growers. Also, a major effort was made in lima bean fields to control downy mildew, which caused major losses in areas where control measures were implemented too late

Pond research at Delaware State University has been exploiting farm diversification through an array of low-technology aquaculture crops that can provide local farming operations with niche-markets. Alternative aquaculture crops and management techniques that minimize disruption of current farming and maximize available resources. DSU focused on developing management

practices for the culture of two species of bait minnows, both of which are native to the region and highly prized as bait in local waters. From preliminary production data, rarity of and current retail price, these bait minnows are a viable alternative agricultural crop in the mid-Atlantic region.

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 in the following areas: 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 foods products.

DSU held an international conference devoted to sedges, an ecologically and economically important plants that support wildlife in wetland habitats around the world. Topics discussed included the impact of sedges as weeds, gardening with sedges, the importance of sedges in wetlands restoration, and the systematics of several genera of sedges.

Processors for vegetable crops were leaving the state, which grows more than 40,000 acres of vegetables for processing, creating a loss of millions of dollars in farm income. Working through trade organizations and personal contacts, UD's Extension specialist for vegetable crops proactively sought new processors. In 2002, two new companies began operations in Delaware--Kenny Produce LLC began a pickling cucumber grading operation that generates \$3.5 million in annual cash farm income for 15 producers, and PictSweet Frozen Foods, which plans to use 10,000 acres of production in peas, sweet corn, and lima beans.

Current pickling-cucumber harvesting methods fail to remove dirt and cause excessive product damage so an innovative farming technique was needed. UD researchers constructed a pickling-cucumber harvester that reduces dirt on the final product by 8.5 percent, while the innovative redesign of the conveyer decreases product abrasion by 5 percent, saving growers \$60 per acre over 6,000 acres in Delaware, thus increasing plant production efficiency.

To assist the small farmer DSU initiated the Small Farmer Technical Assistance and Outreach Program to assist farmers with workshops, seminars, and short courses, which often are critical for successful operation. Courses have been offered in basics of operating a farm, innovation and farm entrepreneurship. Farm management specialists work extensively with farmers on a one-on-one basis to custom tailor the assistance to their individual needs.

A survey conducted by DSU Extension poultry specialist to determine consumer attitudes in relation to food irradiation and hormones found that most supermarket shoppers mistakenly believe that hormones are used in the production of broiler chickens. In an effort to educate the public, fact sheets and videos were produced with emphasis that hormones are not used in poultry production.

Many herbaceous perennials both native to the temperate United States and garden-worthy are wild-dug (which endangers wild gene pools) due to lack of quick, convenient propagation methods. UD developed micro propagation protocols, making quick propagation possible, thus increasing availability. In vitro-generated "plugs" and/or plants of native varieties are now available for ornamental agriculture growers and for the home gardening market.

Seedless watermelons have become the choice of consumers, making the seedless varieties more commercially profitable for melon growers than the seeded ones. UD studies have demonstrated the advantages of commercial seedless watermelon production, which has grown from zero to 1,300 acres and a \$3.2 million-dollar increase in profit for Delaware seedless watermelon growers over the past three years.

In the UD corn breeding project, two inbred maize lines were released as plant germplasm. Developed at UD, these lines promise drought tolerance, European corn borer resistance, and desirable agronomic performance.

For the plant-disease-causing nematodes that each inflict 100 billion in damage to crops worldwide, UD molecular biologist are using biotechnology to explore ways to build in genetic resistance in the plant.

DSU is involved in a long-term program to control the gypsy moth, a devastating pest of northeastern forest and shade trees. DSU is trying to adapt virus strains and formulations, with or without enhancing agents, for use by arborist, nurserymen and people living in urban communities. Improving biological control methods for controlling gypsy moth will protect the environment from chemical sprays and introduce long-term biological control into gypsy moth populations.

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 new product that improves the aerobic stability of silage was developed based on , research conducted at UD helped in the development of a new silage inoculant containing the bacteria *Lactobacillus buchneri*.

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

Taking advantage of natural disease resistance in plants has proven to be a promising avenue for plant research at UD. Engineered crop plants that can resist disease will save tens of millions of dollars.

Since the 2002 Farm Bill's Direct and Counter-Cyclical program could have an huge impact on the profitability of 6,000 Delaware grain farmers eligible to participate, decisions they make now will be binding for the next six years. To help farmers understand their options, UD Extension farm risk specialist created an Excel spreadsheet called "Farm Bill Calculator" to help farmers nationwide determine their commodities payments based on acreage and yields.

GOAL 2

A SAFE AND SECURE FOOD AND FIBER SYSTEM

UD researchers using a high hydrostatic pressure processing for foods is ongoing in the pursuit for methods of food processing that offer foodborne pathogen protection, yet preserve food quality, ensure a greater variety of wholesome foods with intact nutrient content, and retain taste while minimizing changes to the product from the raw or fresh state.

UD Extension food safety training of teachers and volunteers who work with youth in 4-H and other youth development groups has significantly increased the youngster's knowledge. Since many of the youngsters are responsible for preparing food for themselves and their families, their knowing how to handle food safely, about the risk associated with microbial contamination of foods and how to prevent this has resulted in fewer instances of foodborne illness.

A DSU project in sustainable agriculture was designed to address the needs of farmers and Extension agents interested in developing an environmentally friendly nutrient use system and growing free-range broilers in a sustainable system. Four methods of poultry manure, fertilizer and manure/fertilizer blends were imposed on corn, soybeans, and winter wheat in a three-year rotation. The only significant difference is commercial fertilizer, which produces significantly more corn. In two separate broiler growth trials using alfalfa, orchard grass and conventional methods of rearing, no significant differences in growth rate, feed consumed and feed efficiency were found between the broilers grown on forages compared to the conventionally reared birds.

UD Extension has offered the ServSafe certification course for food service managers throughout Delaware. The risk associated with microbial contamination of foods can be reduced if food handlers use the recommended food handling procedures, thus giving managers of food service facilities the tools for preventing the wide spread of foodborne illness.

GOAL 3

A HEALTHY, WELL-NOURISHED POPULATION

Individuals with limited funds must get the most nutrition for their food dollars. UD Extension's Lifeskills, a new program conducted in cooperation with the Food Bank of Delaware, Inc. and its member agencies, teaches low-income individuals how to plan and prepare nutritious meals on a limited budget.

DSU Extension's Intelligent Eaters Club instructs women between the ages of 17 years and 65 who are overweight, obese and interested in improving their health by changing their diets, as well as engaging in various forms of regular exercise. Another dietary concern—preventing obesity in children—was met by DSU Extension programs to train childcare providers on their role in preventing obesity in preschoolers. Creating a positive foodservice atmosphere was also addressed to ensure children develop healthy attitudes towards food.

Low-resource families with young children must get the maximum nutrition for the food dollar. The UD EFNEP program instructs low-income homemakers with children on how to improve their diets, encourage good lifelong eating habits, and employ smart shopping and budgeting practices so that monthly food allotments last all month.

“Dining with Diabetes” is a successful three-part educational series on food intake and preparation designed for people with diabetes, their family members or their caregivers, thus increasing knowledge about healthy foods and presenting healthy versions of familiar foods.

UD Extension provided to childcare providers throughout Delaware classes that addressed the prevention of osteoporosis through human nutrition and exercise.

GOAL 4

AN AGRICULTURAL SYSTEM WHICH PROTECTS NATURAL RESOURCES AND THE ENVIRONMENT

Soils contaminated by hazardous materials or industrial wastes can result in levels of metals, such as nickel, lead, arsenic, and chromium that could contaminate groundwater. UD researchers have discovered that metals form stable precipitates on the surface of soil minerals, greatly reducing their leachability into groundwater. By understanding how metals interact in soils, models are being developed to predict the process to improve scientists' ability to evaluate the potential risk of metal migration, which is vital in protecting soil and water quality.

Delaware's Nutrient Management Act requires that agricultural waste management practices in poultry-producing areas be developed for soils 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 P to be of environmental concern.

The curbside yard and garden waste-reduction program was assisted by DSU Extension staff who work directly with homeowners and gardeners to learn how best to composting yard and

vegetable food waste into organic matter for the garden, thus reducing landfill trash and improving the soil.

Nutrient management is an important issue on the sandy soils of the state, especially since the regulation of Total Maximum Daily Load and the realization that many of Delaware's waterways are environmentally degraded. Because poor nitrogen efficiency increases production costs and decreases profitability, farmers are concerned about nitrogen loss. Based on the acreage involved in the recommendations (about 6,000 acres), the farmers estimate that they have reduced nitrogen applications by 18,000 pounds and increased their net income by \$45,000.

UD soil scientists are studying the inactivation and transport mechanisms of viruses in porous media under relevant environmental conditions, which provides an important scientific basis for developing regulations to protect water resources from contamination by microbial pollutants.

UD Extension has developed and is carrying out an education/certification program on water quality issues in Delaware, so that livestock producers will know how to comply with the new stricter Nutrient Management regulations. An anticipated long-term impact will be an increase in the knowledge base of affected producers and a corresponding improvement in both the economic efficiency of nutrient management and in water quality conditions in Delaware.

The UD Agroforestry/Tree Planting for Poultry Houses project resulted in a publication and effort on wind break establishment around poultry houses that landowners can implement to reduce soil erosion by wind, reduce snow velocity, maintain energy efficiency for heating in winter months and cooling in summer months, and improve water and air quality. Forestry resource management is the main concern of a UD educational outreach effort that connects with forest landowners (rural and urban) to assist them with proper management of forestry crops so they can reap the environmental benefits of proper management.

Wetlands restoration and protection will be enhanced by a current UD project to identify and delineate freshwater wetlands on the Atlantic Coastal Plain even when wetland hydrology is not present because of the season. Three UD research projects on seasonally saturated wetlands will help to identify indicators of historic hydric soils and wildlife species important to determining wetlands. These projects have the potential to improve our ability to identify and delineate seasonally saturated wetlands.

UD programs aimed at ecosystem balance focus on 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 in other crops, the use of alternative controls including fly tapes, insecticidal baits and biological control.

As Delaware's physical landscape changes from open-space agricultural land and large forest parcels to urban and suburban development, children get less exposure to exploring natural habitats in their neighborhoods or through school classes. UD Extension continues to provide environmental outreach education through Delaware ENVIROTHON™ --a high school environmental knowledge challenge with partners from agencies throughout the state covering water quality, wetlands, urban forestry, pests, and tree planting.

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 the Delaware Center for Horticulture and the DelDOT 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 for including roadside vegetation in any new or renovation road project.

GOAL 5

ENHANCED ECONOMIC OPPORTUNITY AND QUALITY OF LIFE FOR AMERICANS

If children and youth at risk in limited-resource communities are to grow up to become productive citizens, they need to experience and accumulate 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 and enhance resiliency factors for children and youth.

Primeros Pasos, or First Steps, is a licensed bi-lingual early childcare center that provides safe, affordable and comprehensive childcare to Sussex County's growing Hispanic population. More than a child care facility, *Primeros Pasos* is a concerted outreach effort involving UD Extension that engages parents as partners in the education of their children. The targeted families have two working parents and household incomes that fall below the poverty level. Language, cultural, and financial barriers overwhelm many in this community, making seeking outside help difficult. *Primeros Pasos* is also a vital resource for members of the community with programs that connect Hispanic residents to the social services they may need.

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.

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.

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 teens had performed more than 1,100 hours of community service.

Because keeping teens in youth programs is difficult, UD 4-H has addressed this problem in part with its Counselor-in-Training Program. Teens remain active in the 4-H camping program by serving as camp counselors, which allows staff to provide quality programs for this difficult-to-reach audience.

Impressing on youngsters at a teachable age the importance of protecting the environment engenders life-long interest in and commitment to safeguarding our precious resources of soil and water. Basic soil and environmental information was the focus of a three-day summer 4-H camp co-sponsored by Delaware's Institute of Soil and Environmental Quality and Delaware 4-H. Students learn about fertilizers and water contamination, leaching and soil, soil profiles, rainfall, runoff, and ecosystem diversity.

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

Teens need opportunities to hone their leadership skills, so Delaware 4-H provides numerous youth development programs in which teens serve as volunteers, including teaching roles at the club and community level, and in county and state programs. They also plan and conduct programs and training at all levels. The skills learned in 4-H activities carry over into other parts of their lives. For example, most of these teens also serve in leadership roles at church and school, and half the delegates to National 4-H Congress from Delaware were either class president or student government president.

GOAL 6

SOCIETY READY GRADUATES

With over-development into natural habitats, land use changes, and protection of natural resources reaching a serious stage, there is a need for college graduates with interdisciplinary environmental studies backgrounds to solve current and future environmental problems. Three departments—entomology and applied ecology, food and resource economics and plant and soil sciences—joined forces to offer a major in Natural Resources Management (NRM) that focuses on the physical sciences coupled with an understanding of economics, ethics and public policy. This major produces graduates who have the skills to solve “real world” problems; a sound knowledge of the world’s biodiversity; a broad interdisciplinary education in the arts, humanities, and social sciences; and an awareness of the ethical issues in natural resource use and management.

A severe shortage of agricultural science teachers in high schools today is reaching critical levels. Just to meet local demand in Delaware, the University of Delaware College of Agriculture and Natural Resources must recruit 20 new students a year for the ag education program. Regionally, the demand for agricultural science teachers has risen to 50 to 65 per year, and this at a time when fewer universities offer ag education courses. UD’s Agriculture and Technology Education program provides an opportunity for students to get the technical and educational training need to teach. Also, there is a marked increase in the number of students with degrees returning to school to complete requirements for certification.

INTEGRATED EXTENSION AND RESEARCH

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

The economic damage caused by infecting organisms on animal health for Delaware’s billion-dollar poultry industry 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.

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, caused by a soilborne fungus, 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 disease from becoming serious problems for Delaware growers.

Current pickling-cucumber harvesting methods fail to remove much dirt and cause a 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 (P) 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.

MULTI-STATE EXTENSION ACTIVITIES

UD Extension often reaches over 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 through educational outreach are available through programs of the Northeast Center for Risk Management Education (serving New England states, New York, New Jersey, Pennsylvania, Maryland, West Virginia, and Delaware), which 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.

Southeast Pennsylvania IPM group coordinated research and data gathering 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 heard 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.