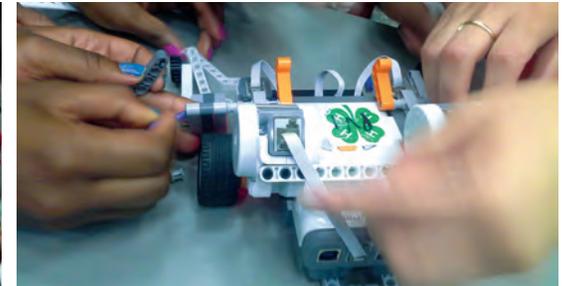


RUTGERS

New Jersey Agricultural
Experiment Station

New Jersey Agricultural Experiment Station



njaes.rutgers.edu

OUR MISSION

To enhance the vitality, health, sustainability, and overall quality of life in New Jersey by developing and delivering practical, effective solutions to current and emerging challenges relating to agriculture; fisheries; food; natural resources; the environment; public health; as well as economic, community, and youth development.



Robert M. Goodman
Executive Dean of Agriculture and Natural Resources
Rutgers, The State University of New Jersey
Executive Director
848-932-3600
execdean@aesop.rutgers.edu

Bradley I. Hillman
Senior Associate Director
Director, Research
848-932-3777
hillman@aesop.rutgers.edu

Larry S. Katz
Senior Associate Director
Director, Cooperative Extension
848-932-3591
katz@aesop.rutgers.edu

Margaret Brennan-Tonetta
Associate Director
Director for Economic Development
848-932-3776
brennan@aesop.rutgers.edu

Jack Rabin
Associate Director, Farm Programs
848-932-3610
rabin@aesop.rutgers.edu

Joseph Cronin
Grants Facilitator Supervisor
848-932-3751
cronin@aesop.rutgers.edu

Michael Christian
Business Specialist
848-932-3773
christian@aesop.rutgers.edu

Gail Alexander
Senior Associate for External Affairs

Mary Jane Willis
Associate Director, Cooperative Extension

RUTGERS

New Jersey Agricultural Experiment Station

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The Office of Grants Facilitation is dedicated to providing support to faculty to help them pursue competitive funding initiatives. The office serves both the School of Environmental and Biological Sciences (SEBS) and the New Jersey Agricultural Experiment Station (NJAES).

In fiscal year 2015, SEBS- and NJAES affiliated faculty and staff submitted 659 endorsement packages for new proposals, competing continuations, non competing continuations, sub awards, increments, and supplements. Sponsors have included federal, state, municipal, and non profit funding agencies, as well as corporations.

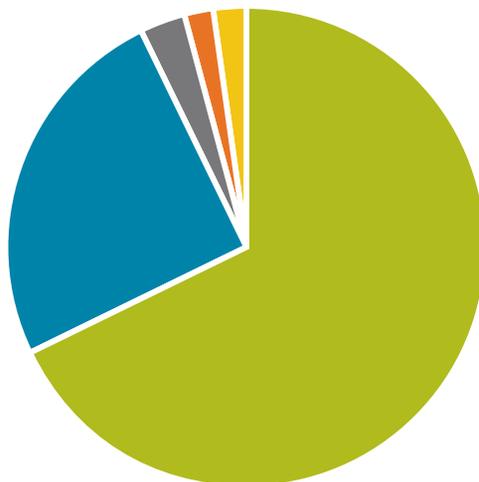
Most popular agencies for submissions include:

- National Science Foundation
95 Submissions
- United States Department of Agriculture
92 Submissions
- State of New Jersey
64 Submissions
(this includes submissions to the NJ Department of Environmental Protection, the NJ Department of Labor, and the NJ Sea Grant program)
- National Institutes of Health
51 Submissions
- Corporate Funders
50 Submissions
- Foundations and Non-Profit Funders
41 Submissions
- United States Department of Commerce - NOAA
26 Submissions

RESEARCH AND SPONSORED PROGRAMS

Of the awards issued in FY15, federal grants constituted the largest percentage (68%) of grants and contracts obtained.

Research Grants and Contracts by Funding Type



- Federal **68%**
- State **25%**
- Foundation and Non-Profit **3%**
- Corporate Contracts **2%**
- Other* **2%**

*Other funding sources include higher education and municipal institutions.

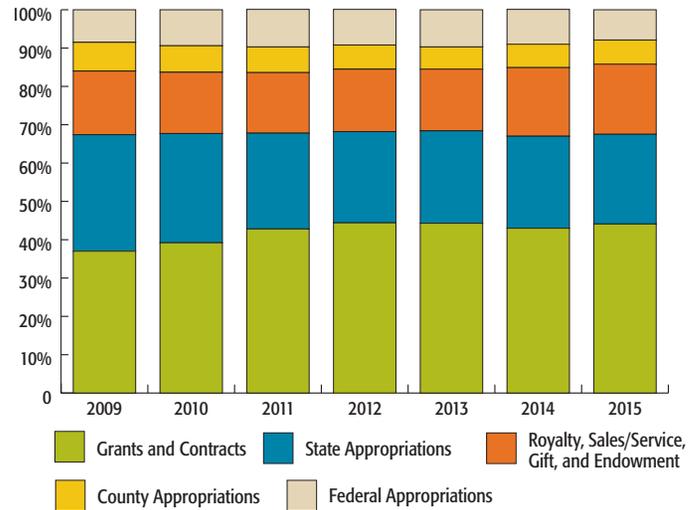
Top Research Grants and Contracts by Sponsor

- National Science Foundation
\$10,789,270
- New Jersey Department of Human Services
\$7,477,032
(SNAP-Ed Program as a Federal Pass-through)
- National Institutes of Health
\$5,066,390
- United States Department of Commerce - National Oceanic and Atmospheric Administration
\$4,521,031
- United States Department of Agriculture – National Institute of Food and Agriculture
\$3,898,147
- Selected Foundations and Non-Profit Organizations
\$1,564,772
- United States Department of Defense
\$1,505,695
- New Jersey Department of Environmental Protection
\$983,821
- United States Department of Commerce - Economic Development Administration
\$498,540
- United States Environmental Protection Agency
\$420,018
- United States Department of Agriculture - Animal and Plant Health Inspection Service
\$259,836



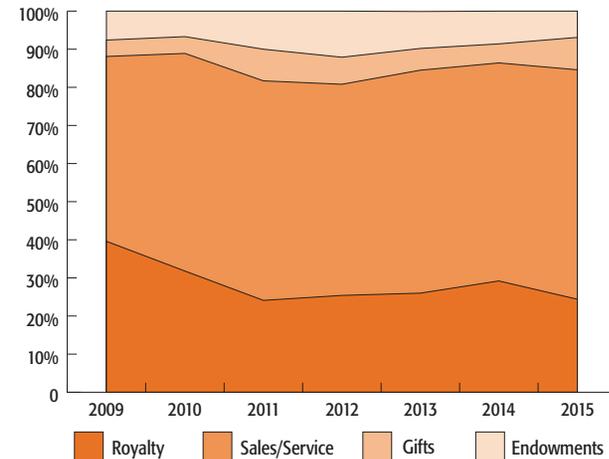
NJAES FINANCIAL OVERVIEW

Funding Source Trends



ROYALTY, SALES/SERVICE, GIFT, AND ENDOWMENT

Royalty/Service Income and Gift/Endowment by Year



In fiscal year 2015, NJAES maintained level funding of \$92.9 million to support its research and extension activities. The State of New Jersey and the U.S. Department of Agriculture (USDA) continue to provide the main sources of funding to NJAES through appropriations and sponsored research. As appropriations steadily decrease and sponsored research funding flattens (due to increased competition), NJAES relies more on generating an income stream through its various service and royalty programs as well as through the growth of endowment and gift donations. In fiscal year 2015, NJAES saw increased service income sales mainly within Cooperative Extension's 4-H Camp, as well as pest management and continuing professional education certificate and short course programs. This combined service, royalty, gift, and endowment funding stream accounted for 18.3% of the total funding in comparison to 17.9% in fiscal year 2014. Current year gifts in support of operations increased about \$600,000 due to a few sizable one-time donations as well as recurring ones.

Sponsored research support represented 44% of the experiment station's total funding. The largest research sponsor, USDA, provided funding of \$7.9 million in fiscal year 2015 compared to \$8.4 million in the previous year. The State of New Jersey provided \$11.2 million, up 19% from FY 2014. In comparison to fiscal year 2014, total sponsored research support funding saw a slight increase of nearly \$1 million or 2.4% mainly due to increased program support in the Supplemental Nutrition Assistance Program Education (SNAP-Ed) and the Lower Passaic River Study Area Site Cooperating Parties Group (CPG), which works with New Jersey veterans primarily in Essex and surrounding counties. Remaining sponsored research funding continues to support plant biology and pathology research, IR-4's national program, continuing professional education programs, environmental sciences, and the new transformational initiatives across many disciplines related to food, nutrition, and health.



Commercial Agriculture



Robert M. Goodman
Executive Director of NJAES

The celebration of Rutgers' 250th anniversary year underscores our deep commitment and long record of achievements, primarily in the role we play as an enduring and meaningful presence in the lives of the residents of New Jersey. We have increased our focus on philanthropy and innovative ways of supporting our outstanding research and transformative service that will ensure Rutgers remains relevant to the wellbeing of the people it serves for the next 250 years and beyond.

Valuable Pollination Services of Bees to N.J. Agriculture



The lab of Rachael Winfree, associate professor in the Department of Ecology, Evolution, and Natural Resources, focuses its research on bees and pollination, including the pollination of crops, and in communicating those scientific results to the agricultural community.

Her lab has focused its outreach efforts on two areas related to sustainable crop pollination. First is developing science-based protocols for pollinator restoration on private lands, an effort funded through several federal Farm Bill programs. Winfree and colleagues are testing the efficacy of different pollinator restoration protocols, in collaboration with New Jersey Natural Resource Conservation Service and the Xerces Society for Invertebrate Conservation.

In addition, her lab is helping to facilitate the integration of native pollinators into crop pollination programs. Native bees can contribute significantly to crop pollination—an important benefit to agriculture given ongoing health problems with managed honey bees (*Apis mellifera*). The goal is to identify the landscape- and farm-scale factors that determine the crop pollination services provided by native pollinators and to communicate these results to agricultural growers.

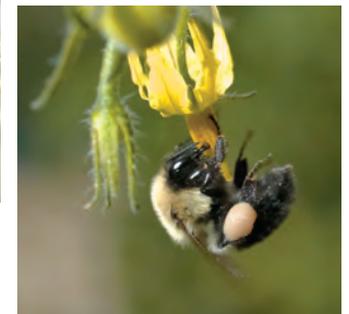
Recent high-profile publications of research conducted by the Winfree lab include a 2015 study published in *Ecology Letters*, the top-ranked journal in the field of ecology. The results of the study showed that the wild, native bees that pollinate watermelon,

cranberry, and blueberry crops in New Jersey are dominated by a small number of highly effective species, despite the fact that almost 100 different native bee species have been found pollinating these crops in our region.

A second prominent paper, published in *Nature Communications*, reported a similar finding using data from over 40 studies representing all continents, except Antarctica. The results from this study also showed that crop pollination by wild bees (non-honey bees) is worth \$3,251 per hectare, per year on average, which is on par with the economic value of pollination provided by honey bees (\$2,913).

Data on habitat use by pollinators, plant-pollinator relationships, and the functional importance of particular pollinator species have also been used by Winfree to develop recommendations for state and federal agencies that implement pollinator conservation and restoration projects. A current project is determining whether both rare bee species and species that provide ecosystem services to crops can be restored via the same habitat restoration protocols.

Another current project of the Winfree lab is collaborating with the New Jersey Department of Environmental Protection to develop what will be the first comprehensive statewide list of rare bee species for any state in the U.S. This work is funded by a \$75,000 grant from the U.S. Fish and Wildlife Service.



New Jersey Agricultural Experiment Station

Tree Fruit and Strawberry Releases Bred for New Jersey



The tree fruit breeding program at the Rutgers New Jersey Agricultural Experiment Station began in 1907, introducing varieties of peaches, nectarines, apples, and apricots that have become standards in the fruit industry and bred for their excellent eating quality, winter-hardiness, and disease resistance. Joseph Goffreda, associate professor of plant biology and pathology and director of the Rutgers Fruit and Ornamental Research Extension Center in Cream Ridge, New Jersey, has led the Rutgers tree fruit breeding program since 1989.

Goffreda has developed 12 patented peaches, and his cultivars have proved to be highly suitable for production in the Northeast and mid-Atlantic regions. The commercial success of these peach varieties contributes to New Jersey being ranked among the leading U.S. states in peach production.

In October, Goffreda was honored with an “Inventor of the Year Award” by the New Jersey Inventors Hall of Fame for breeding a hybrid peach (NJF16). This peach variety, marketed under the name TangOs®, has a combination of attributes attractive to commercial producers and consumers, yet is resistant to major diseases, particularly bacterial spot.



Goffreda’s co-inventor of NJF16 is Anna Voordeckers, who retired in August as a lab technician with the Rutgers tree fruit breeding program for more than 50 years. In developing this unique peach, Voordeckers and Goffreda decided to combine the genes for a flat peach shape, heirloom cling-peach flavor, and the complete lack of any red over-color, so that the fruit would be visually striking and readily identified by the consumer. Rutgers has received more than \$100,000 in royalties from this single peach variety, attesting to its attractiveness to both growers and consumers.

TangOs® is licensed to Adams County Nursery, a long-established commercial grower in Pennsylvania that partners with Rutgers on testing and propagation of this and other Rutgers tree fruit cultivars. A prolific tree fruit breeder, Goffreda also has 14 patents for apples, apricots, and nectarines.



While New Jersey tree fruit growers have had access to a wide selection of Rutgers cultivars, local strawberry growers have been limited to growing mainly California varieties, as no new strawberry selections bred for New Jersey conditions have been available for decades. After many years of testing hundreds of selections to develop a better-tasting strawberry, the first variety release from the strawberry breeding program of retired plant biology professor Gojko Jelenkovic was launched in 2015. The ‘Rutgers Scarlet’ strawberry underwent several years of testing on commercial farms by agricultural agents Bill Hlubik and Pete Nitzsche, and will be followed by more of Jelenkovic’s selections in the coming years.

Commercial Agriculture

Tapping into the Ethnic Vegetables Market

The latest census data of the East Coast—16 states and the District of Columbia—show that there are 1.3 million Asian Indians, 1.2 million Chinese, about 3 million Mexicans, and 3.6 million Puerto Ricans. Hispanics and Asians, a subset of this population, were shown to have a combined purchasing power of almost \$2.3 trillion in 2015, representing a major market opportunity for farmers on the East Coast.

For New Jersey, approximately one-third of its population today has a foreign-born background and actively seeks food crops not found commonly or plentifully in U.S. grocery stores. While a potentially lucrative market, there are multiple questions on how farmers along the East Coast can serve this sizable ethnic population by growing ethnic greens and herbs.

Rutgers NJAES researches and colleagues from the universities of Pennsylvania, Massachusetts, and Florida undertook an in-depth study to document and quantify the ethnic produce market to identify new opportunities for farmers to grow crops that cater to specific demographic groups. The motivation for studying demand for ethnic greens and herbs was based on the size of the Asian and Hispanic immigrant population in this region as well as a 2006 consumer survey that valued the total ethnic produce market on the East Coast at more than \$1 billion.

The study, "Ethnic Produce Marketing," was funded by a Specialty Crop Research Initiative grant from USDA's National Institute of Food and Agriculture. It was led by marketing specialist Ramu Govindasamy, professor and chair of the Department of Agricultural, Food, and Resource Economics, and included Rutgers faculty James Simon, director of the New Use Agriculture and Natural Plant Products Program; Brian Schilling, specialist in agricultural policy; and Albert Ayeni, plant science instructor; as well as agricultural and resource management agents William Sciarappa (Monmouth County); Richard Van Vranken (Atlantic County); Peter Nitzsche (Morris County); and Stephen Komar (Sussex County).

The study analyzed consumers' demand for ethnic greens and herbs and their willingness to pay a premium for fresh leafy greens and herbs, and documented ethnic consumers' preferences for local produce to gain a better understanding of the demographic characteristics of likely buyers.

A telephone sampling of 1,117 households was randomly collected from the target audience between May and October 2010, and participants were asked to indicate what ethnic greens and herbs they purchased. Gaining this type of invaluable data would prove overwhelming to the individual farmer and pose a significant barrier to entering this market, so the funded study will bring vast benefits to the agricultural community. Results of the study will be developed into fact sheets for farmers so that they can explore niche crop opportunities in New Jersey and along the East Coast.



Innovative Crop Production System Aids Apple Growers

New Jersey fruit growers are rapidly adopting the “tall spindle” production system for apples, with more than 300 acres planted in New Jersey in the last six years. This tall spindle system relies on dwarf well-feathered or branched apple nursery trees planted in high densities of over 1,200 trees per acre.

To enable the transition from large, unwieldy apple trees to compact rows of small, high-yielding trees, the Multistate NC-140 Regional Research Project has evaluated and recommended dwarfing apple rootstocks to nurseries and growers worldwide. Research on the NC-140 project at Rutgers NJAES is led by professor and area fruit agent Win Cowgill. In recognition of the multistate group’s exceptional collaboration and research impacts, NC-140 received the United States Department of Agriculture’s 2015 Experiment Station Section Excellence in Multistate Research Award.

Research on dwarfing apple rootstocks and systems by NC-140 has enabled the adoption of the tall spindle system by U.S. orchards. The work at NJAES on NC-140 in New Jersey has enabled national and international partnerships between the university and New Jersey’s apple growers.

Once the best rootstocks were identified, sourcing high-quality nursery trees was the next challenge for the industry. Cowgill went right to the nursery source to conduct applied research and demonstrate how to grow and produce highly feathered apple nursery trees. Working with researchers from Cornell University and the staff at Adams County Nursery (ACN), Cowgill established trials at ACN, the largest supplier of fruit trees to commercial growers in New Jersey. Cowgill conducted nine research trials during the past four growing seasons at ACN’s location in Delaware and at Rutgers’ Snyder Farm, in Pittstown, NJ.

By developing nursery management techniques to stimulate lateral branch development, apple trees can be produced with the 10–12 “feathers” needed for the high-quality tree demanded by the orchardists. The successful research results have been fully implemented as an apple nursery tree production practice by Adams County Nursery and high-quality trees for New Jersey growers are now a reality.

As a result of research under the NC-140 project and the availability of these high-quality nursery trees, New Jersey growers have increased yields and reduced both the cost and amount of pesticides needed. On a “tall spindle” apple acreage, pruning and harvest labor has declined by 50%, fruit quality and size increased by 20%, and net profit increased by 50%. In addition, chemical and pesticide cost and application are down by nearly 40% among apple orchards using these dwarfing rootstocks.





Robert L. Barchi
Rutgers University President

As Rutgers marks its 250th anniversary in 2016, we recognize a significant milestone in our history: the establishment of NJAES, which has touched the lives of countless New Jerseyans in every county. Its people and programs make Garden State life better in so many ways—in our waterways, on our farms, in our communities, on our dinner tables, and among our youth. I applaud everyone who has contributed to another fruitful year for NJAES.

Anticipating the Emerald Ash Borer

The Emerald Ash Borer (EAB) attacks all species of true ash trees (genus *Fraxinus*). Once symptoms are visible, the trees die very quickly. EAB has killed hundreds of millions of ash trees since the pest arrived in the U.S. in 2002, costing billions of dollars in removals, replacement plantings, and chemical treatments. It is estimated that 80% of the costs related to EAB will be borne by municipal governments and homeowners.

EAB, which spread from the Midwest to the East Coast, was confirmed in New Jersey in 2014. In response, representatives from the New Jersey Department of Agriculture, the New Jersey State Forestry Services, the USDA Animal & Plant Health Inspection Service, and Rutgers formed the NJ EAB Task Force to address this problem, and to help consolidate and disperse information and resources relevant to EAB. Jason Grabosky, director of the Rutgers Urban Forestry Program, serves as the chairman of this task force. He has initiated or supported several programs in partnership with the other agencies to address EAB in New Jersey. As the state's land-grant university, Rutgers' role on the task force and as it relates to emerald ash borer more generally, includes leadership and facilitation, research, outreach, and teaching.

Rutgers NJAES outreach to alert New Jersey residents and professionals on the emerald ash borer has been conducted via articles, presentations, and workshops for landscape and forestry professionals and gardeners, as well as assisting communities in preparing for EAB infestations.

EAB research has focused on assessing ash tree inventories and enabling community response initiatives. One such



initiative was the Rapid Ash Survey, which was conducted in order to determine the extent of the ash tree population owned by municipalities in New Jersey. A team of Rutgers student interns conducted the rapid survey in 43 municipalities across the state. The survey locations were selected to quickly fill gaps in the existing data of street tree inventories that 53 municipalities have shared with Rutgers over the past 15 years. Altogether, data now exists for a combined ash tree inventory of almost 100 municipalities, which will be used to better understand the financial and environmental impact of the emerald ash borer on New Jersey. Findings and estimated management costs are complete and have been shared with the surveyed municipalities and posted on the NJEAB Task Force website, emeraldashborer.nj.gov.

EAB impacts and management have been incorporated in lecture and student discussions in a Rutgers urban forestry course since 2007, building awareness with young professional alumni in the tree care and environmental management industry.



Unmanned Aerial Systems in Mosquito Control

In 1930, Rutgers University made the world's first aerial application for mosquito control. These early experiments were ridiculed as 'pie-in-the-sky', but by 1947, a million acres of mosquito habitat were being treated annually by air. Today we stand at the edge of another technological revolution with transformational promise for mosquito control: unmanned aerial systems (UAS), that is, robotic aircraft or 'drones' controlled by computers. As we are increasingly challenged to diminish pesticide use for mosquito control, UAS offer potential for precision mosquito control. Local mosquito control agencies will use this emerging technology to target narrowly-defined areas, applying insecticides precisely where needed, thereby reducing time, money, and environmental impact.

Rutgers has constructed several experimental drones for mosquito control, including a heavy-lift hexacopter built on a carbon-fiber airframe for less than \$5,000. The aircraft are lifted and propelled by multiple electric motors and are virtually maintenance free. These 'skeetercopters' are equipped with an array of equipment, including sonar, barometer, magnetometer, gyros, camera, accelerometers, GPS, telemetry, and more. A mission planner permits setting point-and-click GPS waypoints so missions are executed entirely autonomously including takeoff and 'return to launch' landing.

Research is focused on developing UAS capability to contribute to multiple precision mosquito control functions, including spraying, surveillance, and mapping. Prototype modules are fabricated in the "Fab Lab" to support each of these essential mosquito control functions aided by a cutting-edge 3D printer. For example, the most obvious application for UAS is using a camera for a bird's-eye view of larval habitats. This has been taken a giant step forward with a waterproof drone for use in difficult to access areas (e.g., salt marshes) where the drone can land on mosquito pools to capture real-time video images and determine whether an insecticide application is necessary. The larvicide sprayer module is regulated by a motor controller integrated into the flight controller so that flow rates are automatically adjusted to flight speed. The flight controller permits sprayer actuation to be triggered by GPS waypoints for accurate targeting. A net module offers a fast and efficient means of monitoring adult mosquito populations, permitting surveys of otherwise inaccessible or obstructed areas.

Rutgers, designated one of six national FAA test sites to help integrate unmanned aircraft into the national airspace, recently established a UAS center and is poised to take a leadership role in the state. Its efforts are led by Randy Gaugler, director of the Rutgers Center for Vector Biology (CVB). Greg Williams, superintendent of the Hudson Regional Health Commission and a CVB member, is the chief engineer responsible for drone design and construction. Scott Crans (CVB) and Isik Unlu (Mercer County Mosquito Control and CVB), direct field experimentation. Additional partners include Shaun Kenny (Department of Mechanical and Aerospace Engineering), and Yi Wang and Devi Suman (CVB).



Environment and Natural Resources

Ecological and Social Impacts of Fertilizer Nitrogen in Barnegat Bay

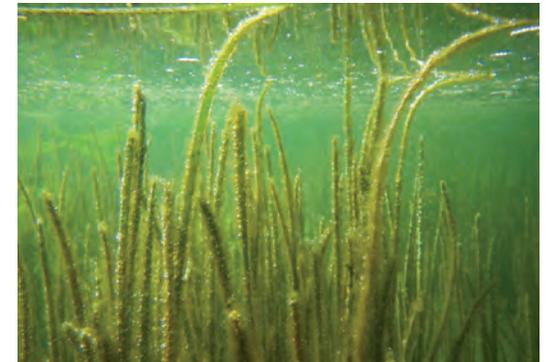
Eutrophication poses a threat to the long-term health of the Barnegat Bay-Little Egg Harbor Estuary. Nonpoint source inputs of fertilizer nitrogen from the adjoining coastal watershed make their way into the estuary, but the linkages between estuarine condition and fertilizers have not been unequivocally made.

To measure ecological and social impacts of fertilizer nitrogen inputs in the estuary, a three-year research project, funded by New Jersey Sea Grant, was recently completed by research professor Michael Kennish (principal investigator) and Benjamin Fertig (co-principal investigator), Department of Marine and Coastal Sciences, and field researcher Gregg Sakowicz, Rutgers University Marine Field Station. The scientists used stable nitrogen isotope tracking to detect the link between man-made nitrogen inputs from fertilizers in the watershed and seagrass uptake in the estuary. They also assessed whether the New Jersey Fertilizer Law, enacted in January 2012, led to improvements in the condition of seagrass beds and ecosystem eutrophication.

To assess ecological effects, they compared characteristics of eelgrass (*Zostera marina*), used as the bioindicator to monitor estuarine health, and tracked eelgrass biomass and areal cover in the period before and after enactment of the fertilizer law. Their findings indicate that there was a generally declining trend of reduced biomass and areal cover of eelgrass both prior to and since the law, alongside generally increasing nitrogen loading from the watershed. The generally low $\delta^{15}\text{N}$ values recorded in the eelgrass indicate that the estuarine system overall is influenced by synthetic fertilizers.

To measure the social impacts, the scientists considered if the state fertilizer law would result in increased public awareness of the connection between fertilizer application in the watershed and water quality in the estuary, and if this awareness would be an important step leading to changes in fertilizer application practices and improvement in water quality. To this end, they conducted a telephone survey of residents in Ocean County in 2013, which showed that more than 90% of the residents surveyed owned a lawn or garden, with fertilizer being applied to more than half. The scientists also found very little variability in the behaviors and attitudes of residents across the county regarding fertilizer use, although in general, residents were cognizant of the link between fertilizer use and potential water quality problems in the estuary.

Based on this study, the implementation of the fertilizer law—and the related public awareness, attitudes, and behavioral change with respect to fertilizer application—did not result in reduced nutrient impacts on seagrass habitat in the estuary in 2012 and 2013. Moreover, more seagrass monitoring is necessary in coming years to determine if the fertilizer law will have a longer-term, positive effect on *Z. marina* in the estuarine system.



Creating a Green Infrastructure Initiative in Newark

The Rutgers Cooperative Extension (RCE) Water Resources Program, RCE of Essex County, and an extension specialist in landscape architecture have collaborated to secure a \$312,518 grant from the New Jersey Department of Environmental Protection to support a green infrastructure initiative in the City of Newark. An approach to wet-weather management that is cost-effective, sustainable, and environmentally friendly, green infrastructure technologies infiltrate, evapotranspire, capture, and reuse stormwater to maintain or restore the natural movement of water in relation to land. By capturing stormwater runoff through green infrastructure practices, nonpoint source pollution such as litter, fertilizers, and oil and grease from cars, can be reduced in our waterways.

In September 2013, a partnership was created to lead a green infrastructure initiative called Newark DIG (Doing Infrastructure Green). Newark DIG is a partnership among Rutgers Cooperative Extension, the City of Newark, local nonprofit groups, and regional and state stakeholders in an effort to establish sustainable green infrastructure as the first line of defense to better manage stormwater runoff, improve water quality and resiliency to flooding, and reduce combined sewer overflows (CSOs), with a focus on the Passaic River and its tributaries.

Newark DIG is coordinated by the Rutgers Water Resources Program, led by extension specialist Christopher Obropta, with support from Amy Rowe, environmental and resource management agent for RCE at Essex and Passaic counties, and Tobiah Horton, extension specialist in landscape architecture.

By December 2014, Newark DIG had leveraged funding and local partnerships to implement 10 green infrastructure projects that include rainwater harvesting systems, rain gardens, and permeable pavements, installation of more than 400 street trees, and distribution of over 75 rain barrels to residents. With additional projects undertaken for 2015, these demonstration green infrastructure projects are managing an estimated 1.2 million gallons of Newark's stormwater annually. So far, the workshops and seminars associated with this initiative have reached more than 400 local residents.

In addition to addressing stormwater runoff, demonstration green infrastructure projects in Newark are being implemented to improve communities by providing a space for residents to socialize, work, play, reflect, and enjoy the outdoors. One such project is the Ujima Garden, a vacant lot that has become a site for collection, infiltration, and reuse of stormwater; reuse of repurposed building materials; and processing of neighborhood organic material for composting. This project, led by Tobiah Horton and his Landscape Architecture Praxis Design/Build Studio, and garden manager It Takes a Village (ITV, Inc.) non-profit organization, is an example of community-driven designing for multiple uses.



Fisheries and Aquaculture



Douglas H. Fisher
New Jersey Secretary of Agriculture

Rutgers, The State University of New Jersey, which is observing the significant milestone of 250 years, has a long history of providing our farmers with valuable research and vital technical assistance. The agriculturalists of our state recognize the importance of collaborative endeavors, and strive to find common ground and develop opportunities for the benefit of all constituencies.

Community Supported Fishery Best Management Practices

Community Supported Agriculture farms are well established in New Jersey with over 50 operating in 2015. Gef Flimlin, marine extension agent in Ocean County, worked with a new clam farmers' cooperative that he helped form, Heritage Shellfish Cooperative, to start a Community Supported Fishery or CSF.

This concept brought locally, responsibly harvested fish or farmed shellfish to three new sites for 2015: Beach View CSA in Manahawkin, Heirloom Kitchen in Old Bridge, and the Rutgers Gardens Farmers Market on the Cook Campus in New Brunswick. Shareholders purchase shares before the season starts and then pick up their seafood products every two weeks during the season, with 10 shares in all. Shareholders have expressed their satisfaction with the quality, value, and variety of the seafood they receive. These include Eventide Littleneck clams (the main product of Heritage Shellfish Coop), tilefish, shark, albacore tuna, wild harvested oysters from the Mullica River, and the ever-popular lobsters.

The seafood is sourced from a number of docks and growers, as no individual dock in New Jersey could handle the variety of species offered through this CSF. Working with the various fishermen and shellfish farmers helps to return more money to the industry for their hard work in producing Jersey Seafood. At a time when 91% of the seafood consumed in the U.S. is imported, supporting local fishermen and shellfish farmers helps the food producers of New Jersey and their families.

With grants from the USDA Northeast Regional Aquaculture Center and the NOAA Office of Aquaculture, Flimlin worked with colleagues to produce a Code of Practice and Best Management Practices (BMPs) for the East Coast Shellfish Growers Association. Over the course of two years and two road trips, from Maine to Florida, their efforts brought together about 350

shellfish growers, resource managers, academics, extension specialists, and environmentalists to produce this document.

Working with the New Jersey Aquaculture Advisory Council, of which he is a member, Flimlin suggested that the New Jersey Department of Agriculture adopt these BMPs, which will serve as agricultural management practices for New Jersey shellfish farmers. This will help protect the shellfish farmers under the Right to Farm Act and provide guidelines that they can convert into individual farm plans to be used with lenders, insurers, their customers, and consumers to show that they conduct business in an environmentally sound way.



Shellfish Research Targets Oysters and Scallops



The Pacific oyster, which is native to Asia but transplanted to all continents except Antarctica, is the number one oyster species cultured globally. A close sister species of the native eastern oyster, Pacific oysters are cultured on the West Coast of the U.S., as well as France, and Australia. Since the early 1990s, they have been suffering from mass summer mortalities associated with an oyster herpesvirus that infects a variety of marine molluscs but not humans.

Just how the herpesvirus infects oysters and how oysters defend themselves against the disease are not well understood. Haskin Shellfish Research Laboratory (HSRL) scientists Ximing Guo and Susan Ford led an international team consisting of their French and Chinese counterparts to study these issues. The collaborative team used advanced DNA sequencing technologies to identify oyster genes expressed in response to virus infections. Their results indicate that although oysters do not have adaptive immunity or produce antibodies, they can mount a strong and complex antiviral response by activating a large and often novel set of genes, leading to the suppression of infections in some oysters. Variations in these genes that are linked to improved survival can likely be used to select for disease-resistant oysters. This will potentially boost oyster farming, considered one of the most important aquaculture industries in the U.S. and around the world.

The Atlantic sea scallop (*Placopecten magellanicus*), severely overfished in the early 1990s, has rebounded to become the most valuable fishery in the U.S. One possible contributor to the recent recovery is the system of rotational fishery closures that have enhanced scallop biomass within closed areas, possibly leading to elevated recruitment in other areas. HSRL scientist Daphne Munroe is leading current research that estimates and examines the links between increased scallop abundance and potential for young scallops being supplied to other areas using coupled larval biology and physical circulation models. Results of this research will provide better understanding of how rotating stock closures function and how they may directly impact sea scallop management.



Scallops are harvested using a dredge, which hauls only the large scallops up from the bottom to the surface to be sorted and cleaned on deck. Sometimes smaller scallops are damaged due to interaction with the dredge but because this all happens deep on the ocean bottom, accounting for this unseen component of fishing mortality—called incidental mortality—can prove difficult. The most recent surveys on incidental mortality are 25 years old and were conducted using now-outdated fishing gear. Recognizing the importance of getting updated estimates of incidental mortality for stock assessment and sustainable management of the scallop population, HSRL scientists Eleanor Bochenek and Jason Morson are working with local scallop-fishing crews to conduct surveys using modern equipment.

Fisheries and Aquaculture

Oyster Farms and Migratory Shorebirds

Aquaculture is a burgeoning industry along the Delaware Bayshore, infusing millions of dollars and jobs into local economies each year. A particular area of growth over the last decade has been intertidal rack and bag oyster production of eastern oysters (*Crassostrea virginica*).

The majority of existing oyster farms in New Jersey are located along the Cape Shore region of Delaware Bay where oyster cultivation developed more than a century ago. The region is also an important stopover site for the federally listed red knot (*Calidris canutus rufa*), a shorebird that migrates from southern Argentina to breeding grounds in the Canadian Arctic.

Red knots rely heavily on the lipid-rich eggs deposited by spawning horseshoe crabs in order to gain enough weight to complete their migration and begin their breeding season in the Arctic. Horseshoe crabs deposit eggs over a three- to seven-week window each spring, and red knots have evolved over millennia to time their migration and stopover to take advantage of this energetically rewarding food source during the brief period it is available.

Overexploitation of horseshoe crabs and loss of spawning habitat have combined to reduce this critical food supply and is associated with recent declines in the red knot population. Intertidal oyster aquaculture occurs within portions of these same tidal flats. However, the potential impacts of oyster aquaculture activities on red knot foraging have not been quantified, severely challenging the development of oyster tending guidelines that would minimize negative impacts to red knots without compromising farm viability.

A team of Rutgers scientists comprising Brooke Maslo, specialist in wildlife ecology; Joanna Burger, Rutgers Division of Life Sciences behavioral ecologist, affiliated with the Department of Ecology, Evolution, and Natural Resources (DEENR); Julie Lockwood, conservation biologist and professor in DEENR; and David Bushek, director of the Haskin Shellfish Research Laboratory, initiated an in-depth study to provide a baseline understanding of how intertidal rack and bag oyster aquaculture, as it is currently practiced, is affecting red knot foraging. Their research was funded in 2015 by the New Jersey Department of Environmental Protection and the National Fish and Wildlife Foundation.

The team, which completed its first field season in 2015, is currently analyzing the data and has received two additional years of funding from New Jersey Sea Grant to continue the study. Their understanding will lead to the development of appropriate and effective protective measures for red knots and facilitate the exchange of information between the oyster aquaculture industry and governing agencies. This would promote modifications to current practices that will ensure the persistence and growth of a key industry in the region.



Advancing Shellfish Aquaculture in New Jersey

Many coastal states have developed multi-million dollar shellfish aquaculture industries and sell their shellfish products in markets close to New Jersey. A key to their success has been a top-down mandate from state government to grow the industry. States such as Maryland, Virginia, and Rhode Island have experienced tremendous growth in shellfish production stemming from strong state leadership.

These mandates have established shellfish aquaculture as a priority activity with significant economic value and created a single, lead authority for shellfish aquaculture. In addition, they have expanded acreage that is suitable for shellfish aquaculture and have led to the implementation of science-based regulatory frameworks.

New Jersey has an opportunity to enable the shellfish aquaculture industry to flourish as it does in other coastal states. However, a number of regulatory impediments constrain the growth of the industry. These include laws designed to govern wild fisheries that are applied to aquaculture, conflicting policies among the nine state and federal agencies that oversee aquaculture, a complex series of requirements for aquaculturists to obtain permits and leases, and the lack of a blueprint for aquaculture expansion that reduces conflicts with other users of the coastal zone.

In New Jersey, the state government must make shellfish aquaculture a priority economic activity and take near-term steps to enact regulatory reform, promote industry innovation and growth, and identify suitable areas for expansion. Rutgers researchers are working in partnership with a diverse group of stakeholders to make this happen.

Mike De Luca, director of the New Jersey Aquaculture Innovation Center in Cape May, and Lisa Calvo, NJAES aquaculture extension program coordinator, have been working with state and local officials, relevant state agency managers, and shellfish growers to develop a management system tailored specifically to the needs of the shellfish aquaculture industry. Key measures under consideration include consolidation of management authority into a single agency, identification of suitable areas for industry expansion, restoration of water quality in suitable growing areas, and establishment of a state ombudsperson to develop and advance pathways for growth of the industry.

With these proposed changes, New Jersey has an excellent opportunity to expand the shellfish aquaculture industry, profit from a renaissance of market opportunities, and create new jobs and economic opportunities in what is an eco-friendly industry.



Food, Nutrition, and Health



Bradley I. Hillman

Director, Research

NJAES supports strong and diverse research programs whose effects are seen globally, regionally, and especially within the state. The 250th anniversary celebration at Rutgers offers the opportunity to highlight our exceptional plant breeding programs. New introductions include varieties of dogwood, tomato, strawberry, cranberry, peach, basil, and turfgrass. Currently undergoing field tests, the first disease-resistant hazelnut varieties ideal for the eastern U.S. could create an industry by allowing for large-scale production in eastern North America.

Making New Jersey the “Healthy State”

The New Jersey Institute for Food, Nutrition, and Health (IFNH), which had its official dedication on October 27, is a special and unique place. It is where food, nutrition, and health come alive at Rutgers. Following the National Institute of Health’s model of how institutes operate, IFNH oversees multiple centers of excellence and several cross-cutting thematic programs.

While one of the IFNH centers is well established, i.e., the Center for Lipid Research under the leadership of George Carman of the Department of Food Science, the other centers are more nascent and just now building their creative and innovative new programs.

The Center for Digestive Health, under the leadership of Michael Chikindas of the Department of Food Science, is exploring the role of gastro-intestinal processes and microbiota in the promotion of human health. The Center for Health and Human Performance, under the leadership of Shawn Arent of the Department of Exercise Science and Sports Studies, is a high-energy, state-of-the-art facility filled with graduate students and elite university athletes investigating the interplay of physical activity and nutrition. The Center for Childhood Nutrition Education and Research, under the leadership of Daniel Hoffman of the Department of Nutritional Sciences, is taking nutrition, cooking, and physical activity into the community to instill healthy lifestyle skills in young children.

Enabling external partnerships complement the institute’s activities. For example, the institute works with *ChopChop Kids* to make its award-winning magazine available throughout the state. The mission of *ChopChop Kids* is to inspire and teach kids to cook and eat real food with their families, a mission that is clearly aligned with the IFNH mission of making

New Jersey the “healthy state” and a model for the nation. The institute’s technical collaboration with Metabolon, Inc. of Research Triangle Park in North Carolina, allows Rutgers researchers access to an analytical and bioinformatics platform at the cutting edge of nutritional metabolomics.

The institute is more than a research facility; it is also a unique “real-world” environment where students, staff, and faculty from across the university come together to work in modern, open-configuration laboratory and office space. With high-tech conference rooms, huddle-space, state-of-the-art teaching facilities, and engaging common areas like Harvest IFNH, a healthy eating courtyard, the institute offers its residents the best of what can be found in the food or pharmaceutical sectors.



New Jersey Agricultural Experiment Station



African Horticulture Project Enhances Nutrition

Rutgers NJAES faculty in the fields of agriculture and human nutrition are working together on a new international development project that combines these disciplines to strengthen the linkage between increased production and consumption of fresh vegetables with improved human health and nutrition. Principal investigator Jim Simon, distinguished professor of plant biology, with co-principal investigators Dan Hoffman, associate professor, Department of Nutritional Sciences, and Ramu Govindasamy, professor, Department of Agricultural, Food, and Resource Economics, along with other Rutgers colleagues and in concert with Purdue University, were recently awarded a competitive five-year award valued at \$2 million from the USAID-funded Horticulture Innovation Lab.

The initiative will address major barriers to nutritional and economic growth of at-risk populations in Sub-Saharan Africa (SSA) that face poverty, hunger, and under-nutrition. The project's approach is to develop nutritional measures for at-risk individuals and the general public to incorporate improved intake of highly nutritious African Indigenous Vegetables (AIVs) and at the same time strengthen the value chain for production and marketing of these vegetables by smallholder farmers.

One of the major obstacles in adequate nutrition is the availability of sufficient micronutrients from a diversified diet. The indigenous vegetables to be studied potentially include amaranth, moringa, African eggplant, Ethiopian mustard, African nightshade, and spider plant, which contain ample levels of these nutritional components. The project will focus on access, affordability, availability, and adoption of these AIVs in Kenya and Zambia while working with the World Vegetable Center in Tanzania.

The objectives are to increase indigenous horticulture in Africa, especially engaging the value chain for smallholder farmers in production, which will drive improvements in health and nutrition while also serving as a prime income generator to deliver adequate nutrition for at-risk populations of SSA. The project team will monitor access, availability, price, adoption, and consumption in producer households to increase consumption of nutritious foods using AIVs. The research will also address nutritional aspects of AIVs in human diets, validate how health is improved when AIV consumption is increased, and how, through appropriate interventions in the value chain and education, smallholder farmers can reduce poverty while improving food security, nutrition, and health for these at-risk populations.

The project team will also work toward identifying the most effective communication and outreach strategies. Plans are to communicate nutritional information based upon scientific research to the populace via digital filmmaking and visual images, as well as more conventional radio; agricultural fairs; school demonstrations; school gardens; seed packs; and developing user manuals for food production, harvesting, storage, packaging, preparation, and nutrient compositions of the various AIVs while collecting data on effects of the programs and their impacts.



Food, Nutrition, and Health

Building Healthier Generations Through Nutrition

This past spring, 43 Girl Scouts from Roosevelt and McKinley, two elementary schools in New Brunswick, participated in seven sessions focused on healthy cooking and physical activity. Rutgers Cooperative Extension's Supplemental Nutrition Assistance Program (SNAP-Ed) provided the nutrition educator, the Robert Wood Johnson Wellness Center provided the kitchen, and the Girl Scouts of Central and Southern New Jersey provided transportation, and most importantly, the girls! With research linking healthy eating and physical activity to higher self-esteem among children and a greater ability to learn, these collaborative sessions likely benefited the girls far beyond the kitchen table.

The girls' moms were welcome to join them to learn about MyPlate, a program developed by the USDA as a mechanism to improve the nutrition and well-being of Americans using the five food groups that are the building blocks for a healthy diet using a familiar image—a place setting for a meal. Participants also learned about food safety, physical activity (swimming and Zumba®), and healthy cooking. Since most of the girls were Latina, the SNAP-Ed educator provided information in both English and Spanish for any of the moms who needed translation. The program helped the Junior Girl Scouts earn their "Simple Meals" legacy badge and the Cadets Girl Scouts earn their "Eating for Beauty" badge. The girls took what they learned home, and in fact, one girl spoke of making one of the recipes as a welcome-home greeting for her father when he returned from a stay in the hospital.

Working with the Girl Scouts organization is just one way in which New Jersey SNAP-Ed and the Expanded Food and Nutrition Education Program (EFNEP) help low-income youth learn more about nutrition and how to improve their health. These programs also work in schools, after-school settings, Boys and Girls Clubs, libraries, and 4-H groups to promote the benefits of healthier food and lifestyle choices.

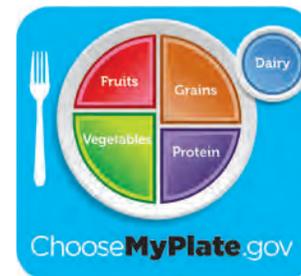
The programs have also taken advantage of opportunities to work with teens in places like an early college high school, a Planned Parenthood program, and a youth advocacy program. During this year alone, 28,186 youth, encompassing kids from ages 5 to 18, were reached in lessons and activities that ran the gamut from touching and tasting the vegetables growing in a school garden to making healthy choices at fast food restaurants.

New Jersey SNAP-Ed and EFNEP educators also work with schools and community agencies to support food and physical activity improvements for the children, including a breakfast program, use of bike paths, and making healthy choices at corner stores. Plans are underway to form additional community partnerships to produce lasting changes aimed at making healthy choices an easier option in low-income areas throughout New Jersey.



Eating for Beauty

Simple Meals



Teaching Children Healthy Eating Through Cooking

Healthy eating habits ideally begin early in life, and one approach that has proved successful in sparking children's interest in healthy eating is through cooking programs. Cooking can benefit kids by encouraging them to try healthy foods, helping them take part in family routines, and even increasing the odds that they will sit down to a family meal after helping to prepare it.

The Rutgers Department of Family and Community Health Sciences (FCHS) is helping children develop healthy eating habits through a variety of cooking programs. In 2015, more than 250 children participated in cooking programs led by FCHS educators. Key themes included basic cooking skills, food safety, new food tastings, and incorporating USDA's MyPlate healthy eating guidelines into meal planning.

In the "TOPS" summer cooking camp offered by Somerset County FCHS and 4-H, campers in grades one through five enjoyed preparing and sampling different varieties of hummus, flavored waters, and homemade fruit ice pops.

The "Smart Chefs" four-week, afterschool enrichment program in Hunterdon County helped third and fourth graders prepare healthier "make-over" versions of their favorite foods, such as breakfast sandwiches, and macaroni and cheese. Students reported a greater interest in helping to prepare meals at home. In Mercer County, a weekly afterschool cooking club for middle school students stressed basic cooking skills, following a recipe, and MyPlate guidelines. One student's feedback: "Before the class I thought I didn't like vegetables. Now I changed my mind about them because we made them in so many good ways."

Afterschool and summer cooking clubs in Monmouth County reached students from pre-K through high school, covering topics like food safety, MyPlate guidelines, and making healthier versions of fast food favorites. In Gloucester County, fifth graders took part in the "Healthy Me" afterschool enrichment program. As a result, more students in this program reported adding fruit and vegetables to snacks, washing their hands properly, and cooking at home.

The middle school "Junior Chefs" cooking camps in Cape May County engaged students in one-week, half-day cooking classes held each summer. Students reported that they planned to eat more fruits, vegetables, and whole grains; share information with parents; and prepare class recipes at home.

To date, more than 500 students of all ages have participated in FCHS cooking programs, which are making a difference in the healthy eating habits of youth and families across New Jersey.



Home, Lawn, and Garden



Larry S. Katz

Director, Cooperative Extension

This past year has been an exciting one with several new extension specialists, county agents, and educators joining our ranks. This growth, addressing pressing needs in agriculture, family and community health sciences, and youth development, was made possible by the generous support of key stakeholder groups and philanthropic foundations. We are grateful for this ongoing support, which enables us to remain steadfast in our commitment to innovation and sustained excellence in our mission areas.

Stress-Tolerant Turfgrass Research for China's Growing Industry

As China's economy is growing and the population is increasing, China's turfgrass industry is rapidly expanding due to the increasing needs for general landscaping and sports fields. The GDP of the turf-related industry in China is over 3 billion yuan and is expected to increase by 30–50 percent each year.

One of the major issues facing China's turfgrass industry is limited water resources for irrigation. Restricted use of fresh water and increased use of recycled water present challenges to the rapidly growing turfgrass industry in China with respect to maintaining quality turf on general landscape and sports fields due to drought and salinity stress.

Bingru Huang, distinguished professor and Ralph Geiger endowed chair in turfgrass science, is known for her expertise in turfgrass stress physiology with a focus on improving turfgrass tolerance to abiotic stresses, such as heat, drought, and salinity through understanding mechanisms of stress tolerance in different turfgrass species. Huang has been collaborating with Chinese scientists exploring mechanisms and strategies of improving turfgrass tolerance to drought and salinity, and developing water conservation strategies that can be adopted by the Chinese turfgrass industry and worldwide.

One of the current collaborative projects Huang is working on is the collection of grass species from dry grasslands in Inner Mongolia, where annual rainfall is less than 300 mm (11.8 inches). Analysis of these species enables understanding mechanisms of water-saving strategies in those drought-tolerant grass species. This will contribute to developing stress-tolerant turfgrass through genetic modification by using candidate genes from the drought-tolerant germplasm from the dry grassland.

One of the typical concerns in turfgrass management is leaf chlorosis, or senescence, of cool-season turfgrass species that lose aesthetic appearance and physiological functions during summer months, particularly in areas with limited irrigation or fertility. To address leaf-senescence issues, Huang collaborates with Chinese scientists to understand mechanisms controlling stay-green traits and generating stay-green turfgrass that is managed with limited water and fertilizer inputs through genetic engineering.

Through her collaboration, Huang has co-authored more than 60 refereed publications and obtained over \$3 million in grant funds and support from the Chinese government and funding agencies. She has trained more than 20 graduate students and scholars from China. The Chinese scholars trained at Rutgers, who have returned to China, have now developed flourishing careers there and have become great assets for developing further collaborations to enhance Rutgers' global visibility and reputation in turfgrass science.



Turf That Withstands Treated Wastewater Irrigation

Clean water is a valuable limited resource and water conservation is a priority in arid and drought-stricken regions. While people require clean water for survival, some plants are able to grow without perfectly clean water, leaving more potable water for drinking. One water conservation strategy is to use treated wastewater, which contains salt left over from the cleaning process, to irrigate large areas of turfgrass, which include athletic fields and golf courses. In arid regions, golf courses alone use approximately 750 billion gallons of water annually.

As most plants cannot tolerate high levels of salt, plant breeders are trying to breed plants that are more salt-tolerant. This would conserve clean water while maintaining healthy turf.

Associate professor Stacy Bonos in the Department of Plant Biology and Pathology and members of her lab are conducting a series of experiments to study salt tolerance in perennial ryegrass (*Lolium perenne* L.). Perennial ryegrass is a popular wear-tolerant turfgrass used in mixtures and as a popular seed to repair disturbed and weak turf areas. Bonos' team has found that tolerance is strongly controlled by additive genetic effects rather than environmental effects. This knowledge is good news for breeders, making it easier to breed for salt tolerance.

Further experiments conducted by the team determined how genetic factors pass to the plant's offspring. For example, two plants may combine to pass on tolerance, but one of those parents may not pass on that same strong influence in a different cross. This gives breeders an estimate of which parents are better to use in crosses and confirms what type of gene effects are influencing salinity tolerance. The results show that when it comes to salt tolerance, additive gene effects are more important.

Bonos and her team are working to concentrate these genes for salt tolerance so turfgrass can use more wastewater and less fresh water. They hope to eventually breed a marketable grass with high tolerance. This has the biggest implication for golf courses, because there are some courses now that are required to water their grasses with wastewater instead of potable water.

Bonos' study, "Inheritance of Salinity Tolerance in Perennial Ryegrass," was published in *Crop Science*, a publication of the Crop Science Society of America. The research was funded by the United States Golf Association, the OJ Noer Turfgrass Research Foundation, the International Turf Producers Foundation, the New Jersey Turfgrass Foundation, the Rutgers Center for Turfgrass Science, and the New Jersey Agricultural Experiment Station.



Home, Lawn, and Garden

Gardens Teach About Personal Health and Stormwater Management

The Shiloh Community Garden in downtown New Brunswick has been the focal point of a unique health project that seeks to foster positive physical, emotional, and social health outcomes for an underserved city population: uninsured clients of Elijah's Promise Soup Kitchen. These clients, who receive free primary care through the Promise Clinic, a volunteer clinic run by medical students associated with Robert Wood Johnson Medical School, obtain gardening skills while they learn about healthy food and improving personal health.

Through the efforts of Richard Alomar, assistant professor, and Megan Pilla, graduate student, in the Department of Landscape Architecture, sketching at the Shiloh Community Garden has been integrated into the community-based project. Pre-and post-health assessments will evaluate whether the experience leads to positive health outcomes, and sketching journals will document the work recollections and attitudes of the participants. The results will inform future Elijah's Promise programming, community gardening expansions, further scholarship in community-based health, and an expanded study. The project, a collaboration of Elijah's Promise, the Robert Wood Johnson Medical School, and Rutgers, is funded by a Community-University Partnership grant.

Another innovative garden project involves the creation of a rain garden in the Township of Springfield as an educational tool to be used by teachers to tell the story of stormwater and biophysical systems. The 3,000-square-foot front garden at the Jonathan Dayton High School is a functional and educational arrangement of landform, stone, concrete, plants, and water as expressions of New Jersey's unique physiography. The "Jersey Rain Garden" represents geology and plant communities across the state, from the landscapes of the Valley and Ridge, Highlands, and Piedmont to the Coastal Plain.

"Anthropogenic" or human-made stone is not ignored either. In the Piedmont garden, an area of broken concrete from the town's transfer station forms one of the weirs that control the flow of stormwater across the garden. This construction in reused concrete demonstrates the "green infrastructure" concept of pavement removal or modification to reduce stormwater runoff and encourage infiltration. Signage and educational materials will help tell the story of the systems model, explaining how rain gardens work 'biomimetically' with natural principles to improve water quality, create habitat, and integrate distinctive landscapes into town properties.

Tobiah Horton, extension specialist in the Department of Landscape Architecture, worked with the Board of Education and Department of Public Works of the Township of Springfield on this project, which was funded by the two township entities and a Sustainable Jersey Grant.



Rutgers Master Gardeners Sowing It Forward

Rutgers Master Gardeners are trained volunteers who assist Rutgers Cooperative Extension in its mission to deliver horticulture programs and information to the general public. In addition to the training they receive through their county Cooperative Extension program, master gardeners gain hands-on skills and give back to their communities through volunteering. Throughout the state, master gardener volunteers are helping “green” New Jersey communities in diverse ways.

Middlesex County Rutgers Master Gardeners worked on the Milltown Public Schools Project to establish a sustainable education program which included solid waste reduction, water conservation, composting and gardening. The project involved students from kindergarten through 8th grade from two schools. “Green Clubs” were created at each school and master gardeners along with parents attended weekly club meetings. Educational programs included composting, recycling, an interactive game “Messy Town” which shows how everyday activities affect water quality, and a rain barrel demonstration. The master gardeners also worked with the two schools to build vegetable gardens. Thirteen master gardeners were involved in the project along with teachers, Board of Education members, parents, Home Depot employees, and councilmen. The team of master gardeners coordinated all their work with the students, parents, and community and school officials, and have been recognized for the successful completion of their comprehensive project.

Rutgers Master Gardeners of Morris County planted and maintained demonstration plots at the Morris County Park Commission Community Garden and the Madison Community Garden. These vegetable gardening demonstrations had three objectives: to teach community garden members about succession planting and crop rotation; to demonstrate the growth habits of different varieties of lettuce, beans, kale, and garlic; and to provide fresh produce to needy clients of the Interfaith Food Pantry. Educational signage and reference materials were developed and made available at the site. Community gardeners were able to view the plot during the growing season, as well as interact with master gardeners while they tended the plot.

Rutgers Master Gardeners of Passaic County worked with the County Parks Department to spruce up the landscaping around the entrance signs at each county park. These areas have high deer populations, so the design and plants were chosen based on their maintenance requirements. This project brought some consistency to the landscaping across the county. The new plantings were installed in time to showcase the volunteers’ efforts for the first true county fair and the plantings were minded, watered, and weeded throughout the growing season.



Youth and Community Development

Serving the Learning Needs of New Jersey's Workforce

Rutgers has a long tradition of providing training to New Jersey's workforce. The NJAES Office of Continuing Professional Education (OCPE) was established in 1906 and served 22 New Jersey farmers that year by providing technical information through two- and three-day "short courses."

Today, OCPE successfully supports the learning needs of thousands of people in the state of New Jersey and beyond. With over 10,000 enrollments in more than 250 individual courses last year, the careers of public health professionals were launched, the horticultural knowledge of landscapers was improved, and residents from across the state learned the importance of beekeeping. From drinking water operators to recycling professionals and environmental consultants, continuing education training is delivered to keep them up-to-date in their disciplines and to assist them in maintaining their professional certifications.

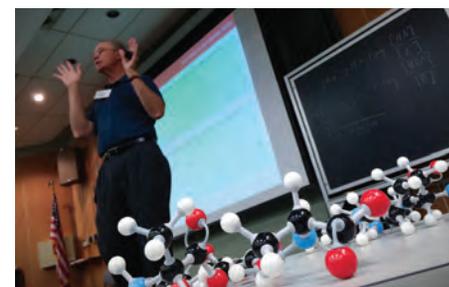
Since 1997, OCPE's Workforce Development/Customized Training Unit has delivered training to over 150,000 employees, and more than 200 "employer clients" have been awarded close to \$17 million in grants from the New Jersey Department of Labor. The training—in such diverse areas as food safety, computer applications, foreign languages, multiculturalism, team building, communications, business writing, and managing conflict—is designed to upgrade employee skills in order to ensure that New Jersey's workforce is strong, productive, and globally competitive.

Through a long-standing partnership with the New Jersey Department of Health, OCPE staff develops courses, manages statewide conferences, and creates online tools to support and improve continuing education and licensing procedures for New Jersey's Health Officers and Registered Environmental Health Specialists.

In addition, OCPE hosts, supports, and maintains an online training, examination, and certification platform used by emergency response personnel from across the state.

OCPE's Conference Unit boasts decades of event management experience. It offers *a la carte* options to a full suite of event support services to clients that include the New Jersey Department of Children and Families and the New Jersey Pest Management Association, and hosts conferences on myriad topics, from obesity prevention to duckweed management.

The CPE Media team provides high-quality multimedia and production assistance services to enhance the communication, education, and marketing goals of organizations and businesses across the state. Learn more at cpe.rutgers.edu.



Veterans Trained in Aquaponics Raise Fish for Exchange

The historic chemical contamination of the Lower Passaic River in northeastern New Jersey has been documented in great length and the strategy for remediation of the contaminated sediment is still being determined. Despite the extent of industrial contamination of dioxin, PCBs, mercury, and other industrial pollutants, recreational fishing continues to take place on the river. The EPA has identified the consumption of contaminated fish as the greatest health risk to the general public from the river.

The concept of a fish exchange, in which a clean fish is provided after the return of a contaminated one, has been explored in many watersheds, but there have been no fish exchange trials in the U.S. A fish exchange program was recently undertaken in the Lower Passaic River in Newark, NJ. Previously collected data was reviewed, interviews of current fishermen were conducted, and a trial aquaponics system was implemented for fish production based on the need and community acceptance of swapping a contaminated fish for a healthy one. All of the fishermen encountered who consume their catches responded that they were willing to participate in the fish exchange. A trial aquaponics system was installed in a greenhouse for fish production of tilapia and the facility is able to produce 600 pounds of tilapia each year. Aquaponics is a way to grow fish and plants in an integrated system. The fish are raised in tanks connected to water trays used for growing vegetables or herbs. The fish waste is converted by bacteria into nutrients the plants can use as fertilizer. The plants uptake the nutrients and water they need and the effluent is returned to the fish tanks.

The greenhouse and aquaponics system was maintained by the Rutgers Veterans Environmental and Technology Solutions (Rutgers VETS) class. The class provides green job skills training to unemployed U.S. military veterans so that they can re-enter the workforce. The program exposed the veterans to a variety of topics, but the main subject areas were sustainable agriculture, landscaping, stormwater management, and entrepreneurship. The veterans not only managed the aquaponics system, but also provided the education and outreach needed to implement the fish exchange in the communities along the Lower Passaic River. The nation's first-ever fish exchange was undertaken and implemented in June and the exchange occurs weekly on Saturday mornings. Seasonal tallies continue, but so far more than 100 river-caught fish were turned in for clean tilapia in a pound-for-pound exchange. The collected fish were frozen and stored for later tissue analysis to determine contaminant concentrations.



Youth and Community Development

Feeding Communities with Foods from New Jersey Farms

In 2010, as the desire for locally grown and produced foods was resonating with consumers, the Rutgers Food Innovation Center, in collaboration with the New Jersey Department of Agriculture and the New Jersey Farm to School Network, explored the potential of bringing locally grown, value-added products year-round to school cafeterias throughout the state.

Five years later, with the concept discussed with school food service directors, farm visits made, and farmers committed, healthful breakfast and lunch menu items were developed utilizing Jersey Fresh sweet blueberries and cranberries, tender eggplants, zucchini, and yellow squash; and juicy Jersey peaches and tomatoes. After hundreds of sensory taste tests of these menu items were performed with students across the state, the Rutgers Food Innovation Center team is now transforming a great idea into reality. Based on student acceptability, food service director feedback, and production and economic feasibility, two products have been scaled at the facilities of local manufacturers and test marketed with students on cafeteria lines. The menu items include BBerry Yogurt Parfait (layers of creamy Kefir yogurt and crimson cranberry/beet compote with Jersey Fresh blueberries topped with crunchy low-fat granola—perfect for breakfast and lunch) and Very Veggie Pasta Sauce (a vegetable-tomato sauce secretly loaded with a bounty of Jersey Fresh vegetables and herbs, including zucchini, red and green peppers, onion, fennel, and basil—great on pasta or as a nutritious convenient base for soups, chilis, casseroles, pizza and hearty sandwiches). Thanks to funding provided by the USDA Federal-State Marketing Improvement Program and USDA Rural Development, the team is now in the final stages of bringing these delicious, nutritious local products to the school food service marketplace and beyond.

The Rutgers Snyder Research and Extension Farm in Pittstown, NJ, hosts numerous research trials by NJAES faculty on the farm's 390 acres. The farm trials span an array of fruit and vegetable research that includes breeding, variety trials, insect and disease control, and cultural propagation. Unlike commercial farms, the research farm harvests are not destined for wholesale or retail sale. For 20 years Snyder Farm, working with Rutgers Against Hunger and more recently with community organizations, has been harvesting and distributing tons of high-quality farm-fresh fruits and vegetables to New Jersey food banks and soup kitchens. This massive effort has been orchestrated by farm supervisor Ed Dager. In 2014, the farm achieved its highest total food bank annual donations of 104,120 pounds, bringing the cumulative total to well over a million pounds of donated produce. For 2015, the farm harvested another 73,744 pounds. Dager has coordinated various groups of volunteers to harvest the produce, including Rutgers Master Gardeners, Rutgers students, local schools, and even corporate sponsor volunteers such as Johnson & Johnson. The farm-fresh produce is a welcome contribution to food bank recipients who often have limited access to fresh fruits and vegetables.



4-H Science Pathways Building Youth Skills

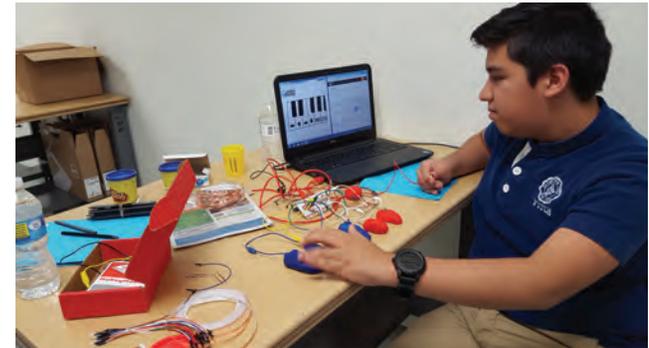
4-H Science Pathways is a high-context leadership development program that makes use of a “makerspace” as a conduit to learning. A makerspace is a location where people come together to create, invent, and learn with technology. These spaces often are equipped with software, electronics, craft and hardware supplies, and tools. The Science Pathways program is currently funded by the Children, Youth, and Families At Risk (CYFAR) grant through USDA and the services are delivered by Rutgers 4-H Youth Development. The grant provides funding for five years to implement a sustainable program that will positively affect the lives of youth at risk. Maker projects combine multiple fields of science and technology and engage youth through hands-on activities and workshops. By focusing on accomplishing Science, Engineering, and Technology (SET) goals and challenges, youth will develop a strong skill set for their future. The guiding principal of the Science Pathways program is as follows:

If we give teens the opportunity to learn skills that prepare them for leadership in a digital future, expose them to the opportunities and resources in their community, and give them the support they need to plan for success, teens will be more able to transition from high school to a successful future.

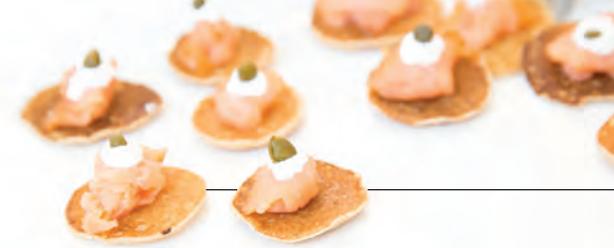
With this understanding, twenty teen participants in Trenton and Paterson enter the program each year as freshman in high school (ten teens at each site) and remain with the program throughout high school. Each week, the teens are engaged in 3–6 hours of makerspace activities that inspire tinkering, inventing, problem solving, and creativity. As participants progress through each year of the program, hands-on activities are combined with opportunities to provide peer-teaching to incoming students, give back to the community, and plan for the transition to college or career.

In addition to the weekly activities, youth also participate in the Science Pathways Summit at the end of the year. The summit is an opportunity for youth to come together to showcase the year’s accomplishments and learn from professional scientists and researchers at Rutgers. It is an opportunity for career exploration and personal recognition.

Currently in its infancy, the 4-H Science Pathways program has completed the first year of the grant. Twenty students entered the program and have completed their first set of activities in computer programming.



Economic Development



Margaret Brennan-Tonetta
Director, Economic Development

NJAES is a vital economic engine for the state and its programs impact many sectors—from food to bioenergy to aquaculture. It is committed to building and supporting viable businesses, developing vibrant communities, and improving the skills of New Jersey workers. NJAES is supported in its mission by a broad range of research and extension expertise within Rutgers, as well as a strong network of resources across New Jersey and the U.S.

FIC “Soft Landings” Focus Attracts International Business

A core component of the Rutgers Food Innovation Center (FIC) is its ‘Soft Landings’ program that focuses on international business attraction, which has been recognized by the International Business Innovation Association as the only such program in the world that specializes in the food industry.

FIC works very closely with New Jersey’s Partnership for Action, and the state’s Choose New Jersey and Business Action Center organizations to target international food businesses seeking to enter the U.S. marketplace. The center supports international companies in a range of services, including market research, consumer testing, competitive assessment, product development, government regulations, food safety systems, organizational support, and sales and distribution strategy. They also have the opportunity to incubate at the center’s 23,000-sq.-ft. USDA- and FDA-inspected processing facility to initially produce and validate their products in the U.S. market, which minimizes capital costs and reduces their risk.

One of these incubated companies was the Italian company Schär USA, one of the largest gluten-free businesses in the world. The FIC supported its U.S. operations for several years, in areas like market research, research and development, engineering, quality assurance, organizational hiring, and training. Schär USA ultimately “graduated” and built a 60,000-sq.-ft. facility in Logan Township, NJ, that initially created over 50 jobs. The FIC team continues to work with the company today on new concepts.

FIC consistently meets with international companies and was the host organization for a U.S. Department of State tour of companies from Brazil, Chile, Colombia, Mexico, and Peru in December 2015. The center has also supported the office of Lieutenant Governor Kim Guadagno with a reception honoring

the many international visitors to the Fancy Food Show in New York City.

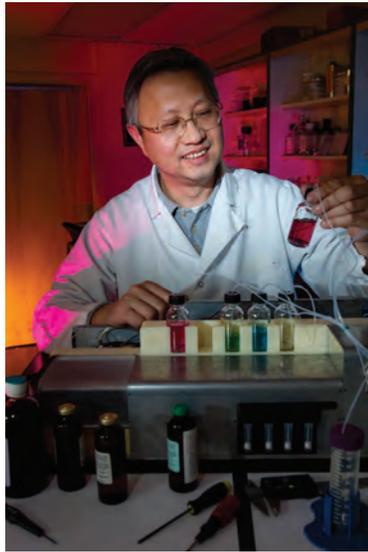
In addition, FIC director Lou Cooperhouse visited with numerous food companies, universities, and economic development agencies in Israel during June 2015. This resulted shortly thereafter in the development of a business alliance among Rutgers University, Tel-Hai College, and a member of the Israeli Knesset (parliament), and a formal announcement that resulted in significant international publicity. This business alliance will be assessing the market opportunities that exist at the intersection of the food and life sciences industries, and will focus on academic cooperation, scientific research, technology commercialization, and business incubation. The goal is a business cluster for the development of the healthy, functional, and medical foods industry in both Israel and New Jersey.





Building the Bioenergy Industry of New Jersey

The Rutgers EcoComplex is a nationally recognized center for sustainable biomass energy business incubation and clean energy cluster development. Designated a Clean Energy Innovation Center, it focuses on innovative bioenergy processes and was one of the first in the nation to serve as a university-based clean energy business incubator. It was recognized by the State of New Jersey with the “Governor’s Environmental Excellence Award” for setting a benchmark for top performance for the clean energy sector.



In keeping with the mission of NJAES, the EcoComplex takes a multi-pronged approach to building a sustainable bioenergy industry through applied research and demonstration, outreach and education, and business development. This facility proves that it “walks-the-talk” when it comes to bioenergy by conducting demonstration projects and helping start-up businesses further develop their technologies. Through these demonstrations, improvements can be made and the technologies verified to optimize their technical and economic performance. By offering these services and resources to entrepreneurs, the center helps to reduce barriers in the commercialization process.



A key component to fostering a vibrant bioenergy industry is information on availability of biomass resources. To help fill that void, the EcoComplex recently released its updated report, “Assessment of Biomass Energy Potential in New Jersey 2.0,” which provides detailed data on 41 biomass feedstocks for every county in the state. It may come as no surprise that solid waste is the most plentiful biomass resource in New Jersey, given the state’s high population density. It’s logical that any company with the technology to produce bioenergy from waste should be developing projects in New Jersey.

The EcoComplex leads the New Jersey Clean Energy Resource Network (NJCERN), a comprehensive business development strategy for clean energy and energy efficiency companies in the state and those considering relocation to New Jersey. The EcoComplex has updated the NJCERN website (njcern.rutgers.edu), an online portal through which project developers can quickly filter hundreds of resources specific to New Jersey for information on financing, permitting, green job training, and other essential business development functions.



Appropriately, this Clean Energy Innovation Center also leads the New Jersey Clean Energy Innovation Council, which is a unique group of stakeholders representing government agencies and academia that support bioenergy-based economic development in New Jersey.

As the EcoComplex continues to build on its mission to serve as a regional hub of expertise and resources for the bioenergy industry, New Jersey is well positioned to benefit economically and environmentally from its activities.

Supporting NJAES



Noah Ginter
Director of Development



Rachel Karl
Development Manager

Individual donors and industry are helping to build our endowment. Gifts of insurance, charitable annuities, and bequests are just some of the ways donors helped us raise the bar in 2015, setting new records for private philanthropy at NJAES. Industries also made more robust contributions, coming together to make significant investments in research. Sincere thanks to our generous donors for helping us enhance the vitality, health, sustainability, and overall quality of life in New Jersey.

Partnering with Industry for the Tree Fruit Breeding Program

In the early 1900s, Adams County in Pennsylvania was rapidly becoming an important fruit-growing region. Mr. H. G. Baugher anticipated the need for high-quality nursery stock to sustain this growing industry and founded family-owned Adams County Nursery (ACN). Generations of Baughers have partnered with plant breeders across the globe, including scientists at the Rutgers Fruit and Ornamental Research Extension Center in Cream Ridge, NJ.

This past summer, ACN invested in Rutgers by presenting a \$25,000 gift during the nursery's 110th anniversary celebration. In partnership, ACN and Rutgers have released many new peach, nectarine, and apple varieties. The anniversary showcase featured six new peach and nectarine selections developed at Rutgers. These have been through evaluation and the patent process will begin this year. These selections have expressed high levels of resistance to bacterial leaf spot, a pathogen that causes spotting of the fruit and is difficult to control in the eastern United States.

The showcase was led by retired RCE county agricultural agent Jerry Frecon and director of the tree fruit breeding program at Cream Ridge Joseph Goffreda, who recently won an "Inventor of the Year" award from the New Jersey Inventors Hall of Fame for breeding a hybrid peach (NJF16), marketed by ACN as TangOs®.

Another highlight at the anniversary event was the presentation of a new ACN apple variety, Premier™ Honeycrisp (DAS 10 cltv.), which was developed in 2010 at Mt. Ridge Farms in Pennsylvania. It ripens three weeks sooner, but tastes like a traditional 'Honeycrisp'. ACN's development of the variety will have a major economic

impact on growers, extending the season and increasing profitability for the industry.

The ACN donation created the Tree Fruit Breeding Program Fund to support the germplasm collection and trials at NJAES. The fund will help maintain and expand the center's breeding research, with particular focus on the testing and evaluation of disease-resistant, novel, and commercially appealing tree fruit varieties. Special attention will also be given to potential new releases that offer unique characteristics, including new flavor profiles, increased durability, and ability to thrive in adverse conditions.

ACN's donation reflects industry commitment to sustain the programs whose innovations, in turn, help to ensure the sustainability of the industry. The nursery is working with other industry partners to secure additional support for the new Tree Fruit Breeding Program Fund at Rutgers.





Gerwig Gift Supports Extension Professionals

There are few individuals who represent the essence of Rutgers Cooperative Extension (RCE) like John and Anne Gerwig. John has a 75-year history with extension. He holds the title of the longest-serving director of extension at Rutgers, perhaps nationwide, and was a 4-H member from age 5. During his term as director, RCE underwent tremendous changes. Throughout his 30 years as RCE director, he remained perceptive of the state's needs, the philosophy of Cooperative Extension, and the land-grant system. He maintained that agriculture made a positive contribution in an urban state. His innovative and visionary leadership catapulted New Jersey into a national model for techniques used to reach urban communities in such areas as urban gardening, 4-H for at-risk youth, and family and community nutrition.

Anne broke new ground for Cooperative Extension as well during her more than 30-year tenure at Rutgers, achieving the rank of associate director of RCE. She led the university's Expanded Food and Nutrition Education Program to reach limited-resource families and showcased extension's work with these families to the greater university community. She was also instrumental in obtaining critical employee benefits for paraprofessionals in extension. Both John and Anne have long understood the importance of communicating the significance of extension programs and securing funding.

In 2014, in celebration of the 100th anniversary of the Smith-Lever Act that officially created the national Cooperative Extension system, John and Anne jointly established the John and Anne Gerwig Director's Endowment for Rutgers Cooperative Extension with a gift of \$200,000. The goal of this fund is to empower Cooperative Extension professionals so that they can make a bigger impact on our communities. A portion of the fund will be reserved to award through a formal "request for proposal" process set up and managed by the director's office. Any remaining funds will be used to support emerging issues, internships, awarding additional proposals, and other needs that arise. The fund is intended to provide resources to extension professionals in perpetuity.

Current RCE director Larry Katz envisions the fund empowering extension professionals to break new ground. For example, New Jersey veterans have the second highest unemployment rate in the nation. Some funding has been designated to help solve the problem but mini-grants through the Gerwig fund would make it possible for us to do more. Another potential area in need of funding is in disaster preparedness and emergency response, a deficit that was recognized in the wake of Superstorm Sandy, which helped us recognize the value of "boots-on-the-ground", the quintessential extension model exemplified by RCE.

The Gerwigs firmly believe that "a strong workforce will support a strong community." The Office of Development welcomes matching donations to the fund to help sustain the Gerwigs' legacy.



We Have the State Covered

BOARD OF MANAGERS

The New Jersey Agricultural Experiment Station Board of Managers, appointed by the Rutgers Board of Governors, is an advisory group to the Executive Dean of Agriculture and Natural Resources and Executive Director of NJAES. The board consists of a representative from each county nominated by the County Board of Agriculture or Board of Chosen Freeholders, and a six-member statewide advisory committee. The President of Rutgers, the Executive Director of NJAES, and the State Secretary of Agriculture serve as *ex officio* members.

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Our Commitment to Sustainability



2 trees **preserved**
for the future



69 lbs. of solid waste
not generated



9 lbs. of waterborne
waste **not** created



1,020 gal. of wastewater
flow **saved**

OFF-CAMPUS STATIONS

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snyderfarm.rutgers.edu

Haskin Shellfish Research Laboratory, Bivalve
hsrl.rutgers.edu

Lindley G. Cook 4-H Youth Center for Outdoor Education, Branchville
nj4hcamp.rutgers.edu

New Jersey Aquaculture Innovation Center, Cape May
aic.rutgers.edu

New Jersey Center for Wine Research and Education, Upper Deerfield
njvines.rutgers.edu

Philip E. Marucci Center for Blueberry and Cranberry Research and Extension, Chatsworth
pemaruccicenter.rutgers.edu

Rutgers Agricultural Research and Extension Center, Upper Deerfield
njaes.rutgers.edu/rarec

Rutgers EcoComplex (Clean Energy Innovation Center), Bordentown
ecocomplex.rutgers.edu

Rutgers Food Innovation Center–North, Piscataway
njaes.rutgers.edu/ficn

Rutgers Food Innovation Center–South, Bridgeton
foodinnovation.rutgers.edu

Rutgers Fruit and Ornamental Research Extension Center, Cream Ridge
njaes.rutgers.edu/creamridge

Rutgers Plant Science Research and Extension Farm, Adelphia
njaes.rutgers.edu/plantscience

Rutgers University Marine Field Station, Tuckerton
marine.rutgers.edu/rumfs

YE²S Center–Camden
teemgateway.rutgers.edu/yescenter-camden.html

YE²S Center–Newark
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esc.rutgers.edu

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188 lbs. of net greenhouse gases (GHG) saved



10% power reduction due to co generation

The savings above are achieved when post-consumer recycled fiber is used in place of virgin fiber. This project, based on a production run of 3,500 pieces, used 3,700 lbs. of paper, which has a post-consumer recycled percentage of 10%.

Acknowledgments:

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