EASTERN REGION

RESEARCH GOALS AND IMPACTS

Texas A&M AgriLife Research and Extension Center at Beaumont
Texas A&M AgriLife Research and Extension Center at Corpus Christi
Texas A&M AgriLife Research and Extension Center at Dallas
Texas A&M AgriLife Research and Extension Center at Overton
Texas A&M AgriLife Research and Extension Center at Temple
College of Agriculture and Life Sciences, Texas A&M University
College of Veterinary Medicine and Biomedical Sciences, Texas A&M University
Norman Borlaug Institute for International Agriculture
Texas A&M AgriLife Genomics and Bioinformatics Service Facility
Institute for Infectious Animal Diseases
Office of the Texas State Chemist

2015
GOAL
Protect water quality and increase the amount of water available for urban and rural use through new technologies and approaches.

PROGRESS
Testing, improving, and protecting water quality

• The Dallas Center, in collaboration with the Temple Center and the Spatial Sciences Laboratory in the College of Agriculture and Life Sciences (Department of Ecosystem Science and Management), conducted a basinwide assessment for 12 major reservoirs in the Trinity River Basin for sediment and nutrient delivery.
  - This resulted in a calibrated model for the Dallas–Fort Worth Metroplex that allows governments, municipalities, water districts, agencies, planners, and developers to make better decisions on how to manage land resources to protect and improve water quality.

• Soil and Crop Sciences Department research in 2015 determined that the alluvial aquifer below the city of Austin was not contaminated by fecal matter and other pathogens following the release of water from the Colorado River dam.

• The Soil and Water Assessment Tool (SWAT) hydrologic model, developed at the Temple Center and in the Department of Ecosystem Science and Management in cooperation with the USDA Agricultural Research Service, is the standard across all federal agencies to evaluate the hydrologic and nutrient impacts of growing crops for biofuels.

Developing irrigation strategies to save water

• Overton Center researchers are estimating the water requirements of landscape plants and evaluating management of lawn sprinkler systems with equipment controllers that account for potential evapotranspiration conditions.
  - They initiated a study with Kilgore College to estimate irrigation water requirements of Coastal and Tifton 85 Bermuda grass and of selected vegetable crops.
  - Researchers demonstrated the potential for developing salt-tolerant ryegrass cultivars for lawns and golf courses that can be irrigated with marginal water.

• Collaborating with researchers in several southern states, Overton Center scientists screened plant pathogens commonly found in recycled irrigation water for fungicide resistance.
Conserving water on farms and in urban environments

- The nation’s first EPA-certified WaterSense retrofit home, at the Dallas Center, serves as an urban water education center. It promotes residential water conservation by providing hands-on learning opportunities in such areas as on-demand hot water systems, water-efficient faucets, water-efficient landscaping and irrigation systems, rainwater harvesting, and rain garden design. A WaterSense home saves 50,000 gallons of water and $600 in utility costs each year.

- During 2014, the Dallas Center’s Urban Water Team trained 3,700 individuals and constructed 4,800 rain barrels, which collect 7.6 million gallons of water annually, eliminate 7,000 pounds of non-point source pollution, and save their owners $60,000 a year on water bills.
  
  - The team also serves on government and private boards, including the Texas Water Development Board’s Water Conservation Advisory Council and the Fort Worth Water Department’s Water Conservation Advisory Council. In 2014 the team was recognized with numerous awards, including the WaterSense Award from the U.S. Environmental Protection Agency.

- Capping eroded urban landscapes having marginal permeability with a thin layer of more permeable material such as sand can help capture more rainwater, reducing the need for supplemental irrigation. Soil and Crop Sciences researchers are developing fundamental data to show the appropriate hydraulic properties and depth of capping materials for particular landscapes.

- Wildlife and Fisheries scientists conducted research on the Brazos and Trinity Rivers that provided information for state agencies and regional stakeholder groups to evaluate current environmental flow standards. These standards have been established by the Texas Commission on Environmental Quality and are used to evaluate applications for new water rights.
  
  - Surface water is a limiting factor for residential, industrial, and agricultural growth in many regions of Texas, and balancing direct human water needs with ecosystem services of the state’s rivers, streams, and estuaries requires scientific studies to determine ecological responses to flow variation.

- Beaumont Center researchers have developed the Rice Water Conservation Analyzer to estimate the effects of on-farm water conservation methods such as laser leveling, on-site reservoirs, buried laterals, and water-conserving rice varieties.
  
  - It also leads development of water- and fertilizer-efficient rice production systems and promotes optimization of cutting heights to increase ratoon crop production.

  - New proposals are being developed with scientists from Texas, Mississippi, and California addressing the optimization of rice water management using both field experimentation and crop modeling to analyze how regional differences in soil, rainfall, climate, and cropping practices affect the degree with which different on-farm conservation measures can reduce rice water use.
GOAL

Sustain and support efficient use of land resources and ensure air quality in the production of food and non-food crops.

PROGRESS

Developing best practices for remediating soil contamination and conserving land and water

- The Conservation Effects Assessment Program (CEAP) Modeling Team at the Blackland (Temple) Center plays a pivotal role in the development of national resources conservation policy leading to the development and application of federal farm programs. The team helps state, federal, and nonprofit environmental organizations address high-priority concerns, including water quality, agricultural runoff, and soil erosion.
  - The team completed priority assessments of water quality for Chesapeake Bay, Delaware River, Lake Erie, Des Moines River, St. Francis River, and the California–San Francisco Bay tributaries for the USDA Natural Resources Conservation Service chief’s congressional testimony on efforts to improve water quality in critical areas.
  - The team completed and published 12 reports for the 2003–2006 CEAP Cropland Assessment. The research showed that the nation has made significant strides overall in reducing the loss of sediment, nutrients, and pesticides from cropland by adopting conservation practices. There is still a need for comprehensive conservation planning related to high fertilizer losses in many areas.

- A Soil and Crop Sciences professor developed a team to provide leadership in reducing soil contamination problems associated with oil leaks internationally. This work has expanded to offering workshops and advanced training on soil remediation.

- A Soil and Crop Sciences researcher developed methods resulting in a reclamation strategy that has successfully revegetated the largest U.S. EPA Superfund site, a 150-year-old mining and copper ore–smelting site near Butte, Montana. The reclamation reduces further risks of heavy-metals pollution at the site.

Identifying cropping strategies for better land use and air quality

- Overton Center researchers have completed three years of a trial using legumes as nitrogen source crops in rotation with grain sorghum. Results indicate warm-season legumes contribute at least 100 pounds of nitrogen per acre per year to cropping systems.

- Overton researchers are in year 2 of trials designed to develop cropping systems using rotations of cowpea and forage rye to reduce nitrogen fertilizer inputs in forage and cowpea seed production systems for East Texas.
The Overton Center has identified optimum stocking rates and strategies to maximize land-use efficiency in producing beef cattle weight gains on pasture.

- Overton researchers are developing stocking strategies and pasture systems for grass-fed natural beef.

Soil and Crop scientists have selected an extensive collection of drought-tolerant, cold-tolerant, resource-use-efficient forage crops that can also be used for biofuels, developed through the Perennial Grass Breeding Program. The researchers recommend using these crops on abandoned, degraded, and underutilized grassland resources throughout Texas.

Research at the Corpus Christi Center into the use of warm-season legumes adapted to South Texas has discovered the potential for their use as pulse/grain, hay, grazing, and bioenergy crops.

- Legumes increase resource-use efficiency by providing nitrogen and soil stabilization to perennial warm-season grasses grown for bioenergy or livestock grazing.
- A project evaluating germplasm of black-eyed peas, which are less susceptible to iron chlorosis, is in its fourth year. This crop will produce pulse for domestic and international markets and provide fodder for livestock production or crop residue, which is nitrogen rich.

Designing tools for production and conservation

After 15 years, the Crop-Weather Program for South Texas (CWP), launched at the Corpus Christi Center, continues to be a robust, reliable, and expandable Web-based tool for researchers and crop managers, due to its innovative and efficient architecture.

- As of 2015, the network of 32 weather stations extends from Fort Bend County to the Rio Grande Valley, with approximately 2,050 registered users.

The pilot of the Temple Center’s index-based insurance grazingland risk management product for the USDA’s Risk Management Agency has been well received, with livestock producers enrolling more than 52 million acres across 29 states. Research is underway to extend its capabilities to include national drought monitor information so producers can receive daily actionable information for adaptive drought management and livestock optimization.

- An outgrowth of the PHYGROW and Livestock Early Warning System developed by AgriLife Research and USAID in East Africa, this product has become an important safety net for U.S. livestock producers.
• Soil and Crop Sciences developed methods for applying poultry litter to prevent problems associated with *E. coli* runoff following land application. They are adding a new poultry bacterial source tracking model (with greater than 99% effectiveness against tested isolates) to the Texas Bacterial Source Tracking Toolbox to monitor sources of water contamination.

• The demand for the Soil and Water Assessment Tool (SWAT), Agricultural Policy/Environmental eXtender (APEX), and Environmental Policy Integrated Climate (EPIC) models, developed at the Temple Center, continues to grow in the United States and around the world. In 2014, 435 people participated in training for these models at workshops held in the United States, Brazil, Italy, Ethiopia, Uzbekistan, Kazakhstan, Poland, India, Vietnam, Jordan, and Tunisia.

The USDA Natural Resources Conservation Service established regional modeling centers for APEX at Temple and in Alabama, Massachusetts, and California. Researchers will address regional conservation and water quality concerns. The AgriLife Research APEX modeling team is supporting these efforts by developing regional databases and adjusting model parameters to better serve the needs of landowners and managers in each region.

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o Interest in the application of these models is very strong in Africa, with 120 students and scientists trained in Ethiopia alone.

GOAL

Conduct basic and translational research to minimize the unfavorable effects of agricultural production and urban communities on the environment.

PROGRESS

Minimizing the impacts of industry on the environment

• A novel Hybrid Zero Valent Iron treatment for wastewater was developed in the Department of Biological and Agricultural Engineering. This treatment can remove more than 95% of heavy metal contaminants generated by electric power plants, mining, and other industries.

  o Evoqua Water Technology and Texas A&M AgriLife Research have an exclusive license agreement and a research and development agreement to continue to develop and commercialize this technology.

Reducing greenhouse gas emissions in animal agriculture through nutrition models

• An *in vitro* gas-production technique has been developed by Animal Science faculty to assess biological values of feeds based on their pattern of accumulated gas (including methane, a potent greenhouse gas) during incubation with rumen fluid under anaerobic conditions. This information is used to formulate and balance rations for ruminants to reduce greenhouse gas emissions in animal-feeding operations.
Identifying best practices for Texas landscapes

- Research on pest-resistant rose varieties at the Overton Center aims to minimize the use of pesticides by rose producers and by consumers planting roses in home and commercial landscapes.
  - Annual bedding plant varieties are being tested for adaptation, which will allow producers and consumers to make ornamental plant selections that will increase the sustainability of commercial and home landscapes, reducing costs from shrinkage, pesticides, and water use.

- Overton Center research has contributed to the growth of horticulture in East Texas to an over $1.2 billion industry.
  - Bedding plant trials, plant management research, and disease studies continue to provide technology to aid producers and homeowners.

- Soil and Crop Sciences researchers studied the effects of fertilization timing and source on resulting runoff losses of nitrogen and phosphorus during establishment of St. Augustine grass sod. They found that regardless of nitrogen source or timing, only 0.6%–4% of the total applied nitrogen fertilizer was lost to runoff and that nearly 33% of the nitrogen was dissolved organic nitrogen, suggesting that it was from natural sources rather than fertilizer. The data suggests that in healthy, properly irrigated and fertilized sod, environmental losses of nitrogen and phosphorus should be minimal.

- Research by a Recreation, Park and Tourism Sciences professor and graduate students have helped College Station, Texas, reduce water use by nearly 200 million gallons over a four-year period by providing 5,500 homeowners with targeted landscape water budgets. Based on these budgets, homeowners adjusted their outdoor water use and reduced lawn overwatering. The Brazos Valley WaterSmart website (bwatersmart.tamu.edu) helps homeowners reduce further overwatering.

- The Texas Coastal Watershed Program (TCWP), working with researchers in the Department of Recreation, Park and Tourism Sciences, has taken a lead role in developing Green Stormwater Infrastructure (GSI), also known as low-impact development, for the greater Houston region. Using the WaterSmart landscape program, they collaborated on development of the Ghirardi WaterSmart Park, a first-of-its-kind park in Texas and one of few in the United States demonstrating a number of GSI techniques. These demonstrations are also used for water quality monitoring.

- Consulting with professionals in Recreation, Park and Tourism Sciences, the Texas Coastal Watershed Program has installed several high-profile stormwater wetlands in the Houston region, including two in the Texas Medical Center.
The TCWP laid the groundwork for one of the very first stakeholder-based watershed protection plans in Texas, the Armand Bayou Watershed Protection Plan, and is currently concentrating on watershed protection plans in Galveston County.

**Researching forage and soils for optimum use of nutrients**

- Forage and soils data from long-term experiments at the Overton Center document the impact of stocking rates and fertility regimens on soil nutrient status at multiple depths.
  - Nutrient cycling returns key nutrients to pastures via excreta and plant decomposition, providing a way to grow forage without nitrogen fertilizer.

- Overton researchers developed recommendations for nitrogen supplementation to poultry litter applications to maximize the efficient use of nutrients for plant growth.

**Designing cost-effective, sustainable, pest- and disease-management solutions**

- Scientists at Beaumont developed a web-based postharvest grain management program for insects in on-farm storage bins and in rice mills. Included is a feature that evaluates the effects of organic pesticides on postharvest insect control.
  - The Beaumont Center is a leader in the development of cost-effective and sustainable rice integrated pest management (IPM) production systems. Development of IPM programs for rice water weevil, rice stinkbug, and stem borers have reduced yield loss to rice by about 5% annually, resulting in a savings of $8.1 million per year for producers.
    - Revised treatment thresholds for rice stinkbug and registration of new residual insecticides have decreased the number of insecticide applications from 4 to 2, saving $2.8 million per year in application costs alone.
    - Development of an IPM program for the red-banded stinkbug in soybeans is expected to save growers $2.5 million per year.
    - The center’s entomology research program led to the development of a microbial seed treatment, BioEnsure, for use in rice and other field crops. This treatment represents a new type of research that enables growers to manage plant disease, drought, salt, and temperature stresses.
The Beaumont Center’s plant pathology research program is a national leader in developing innovative blight-management options that use beneficial growth-promoting bacteria, bio-fumigation cover crops, and rate-reduced fungicides. Development of a resistant rice cultivar–based sheath blight management program has reduced damage and reduced the use of fungicide by 50%, with an estimated economic advantage of $4.1 million per year.

- Beaumont research has led to an emergency exemption for a product to control a newly invasive sugarcane aphid; supported the registration of a product to manage sheath blight, which threatens rice production; and supported the registration of fungicides for rice seedling disease control, now used to treat more than 60% of rice seed in the United States.

- A researcher in the Department of Plant Pathology and Microbiology demonstrated that mutants deleted in each of four genes encoding a particular type of protein in the fungal biocontrol agent *Trichoderma virens* enhanced induced systemic resistance in maize and tomato, reducing the defense levels in the plant. *T. virens* produced volatile compounds to stimulate the growth of cotton seedlings and had a negative effect on growth of the cotton pathogen *Fusarium oxysporium*.

- A Plant Pathology scientist developed next-generation plant virus–based gene expression vectors to modulate gene expression in plants. These can be used to isolate high levels of proteins of interest in plants grown for biofuel and pharmaceutical purposes.

- A scientist in Plant Pathology and Microbiology was recognized for her contributions to the field of plant-microbe interactions and plant immune signaling. Another distinguished researcher won recognition for his paradigm-breaking research on the role of programmed cell death in plant pathogen interactions.

- A plant pathologist published the first analyses of innate immune responses of the model species *Brachypodium distachyon* (C3 grass) and *Setaria viridis* (C4 grass) to infection by seven plant viruses that are known to cause significant economic damage to small grains and forage grasses.

- A scientist in Plant Pathology showed that the genes involved in mating of maize and sorghum isolates of the head smut pathogen are compatible and developed DNA markers that will allow them to determine whether crosses will occur in nature or the laboratory. The ability to cross would allow new combinations of virulence alleles and perhaps account for the ability to overcome host resistance.
• A Plant Pathology researcher developed a computation algorithm to define key genetic elements involved in mycotoxin biosynthesis in corn toxigenic fungi. This researcher is also developing a device to improve functional genomics research in plant pathogenic fungi; it could innovate and streamline fungal genomics with much greater efficiency and cost savings. A third project involves a research collaboration to better understand cellulolysis and amylolysis at the molecular level in fungi, which would provide a conceptual blueprint for microbial metabolic engineering via synthetic biology.

• A plant pathologist has conducted experimental trials to control cotton root rot in wine grapes with the fungicide flutriafol and found it to be successful in suppressing disease development and saving vines. This information will be used to obtain emergency registration for a commercial product to help Texas grape growers control the disease.

• A Plant Pathology scientist has confirmed that silver nanoparticles are effective for managing plant-parasitic nematodes in golf courses.

• A Plant Pathology and Microbiology researcher has developed and licensed to a pharmaceutical company a bacteriophage-based treatment for Pierce’s disease of grapes. Phage therapy is an attractive disease-control method because it is pathogen-specific and has no negative effects on beneficial bacteria.
  - This work is gaining interest by the olive tree community because olive scorch disease, which has affected millions of olive trees in Italy, is also caused by the bacterium that causes Pierce’s disease (Xylella fastidiosa). The process will also be useful for treating Xylella-caused diseases in coffee and citrus.

• By implementing the School Integrated Pest Management (IPM) System, developed by researchers in the Department of Entomology, the Spring (Texas) Independent School District (serving 36,000 students) now uses 100% “Green” category pesticides, the lowest-risk pesticides.
  - No sprays are applied to the interior of buildings.
  - The amount of chemicals used has been reduced by 70%.
  - Before the adoption of IPM, 55% of pesticides used in Spring ISD were classified by the EPA as highly toxic.
GOAL

Conduct basic and translational research into the factors affecting biological diversity and ecosystem structure and functioning, including the role of human activity.

PROGRESS

Finding solutions when human activity might affect endangered species

- Researchers at the Temple Center and in the Department of Ecosystem Science and Management have provided unbiased data on habitat requirements and ecological interactions of endangered species, such as the golden-cheeked warbler and the black-capped vireo. Wildlife and Fisheries Sciences researchers have substantially advanced the understanding of the status of these and many other endangered species in Texas. Using advanced methods and study designs, Wildlife and Fisheries has provided management agencies with the information they need to alter existing guidance for conserving these species.
  - This data has helped government leaders, agricultural producers, and the U.S. Department of Defense arrive at workable solutions to human-wildlife interactions in the Fort Hood region of Central Texas.

- Researchers in Wildlife and Fisheries Sciences are studying the impacts of persistent organic pollutants on migrant birds, the impacts of harmful algal blooms on aquatic birds, and the impacts of neonicotinoid insecticides on bobwhite quail in Texas. They are also evaluating the impacts of the red imported fire ant on northern bobwhite populations.

- Wildlife and Fisheries researchers are collaborating with Texan Exotic Wildlife Ranchers and the International Conservation community to determine the social behavior and habitat requirements of dama gazelles. They hope to help repopulate these animals in their native African lands, where they are highly endangered.

- A Recreation, Park and Tourism Sciences researcher is studying the attitudes and behaviors regarding the natural environment that U.S. citizens bring to developing nations through amenity migration. Some improve local ecosystems, whereas others are questioned or rejected by local populations. Rural areas rich in natural resources seem to be benefiting from a large pool of environmental attitudes and behaviors that are emerging in countries experiencing amenity migration, brought both by larger macro-societal movements and U.S. citizens.

- Recreation, Park and Tourism Sciences is also studying changing rural communities that are encroaching into natural ecosystems or protected areas. While most people wish to protect these environments, many are unwittingly causing damage by building homes and consuming natural resources in the areas.
The direct economic contribution from Lower Rio Grande Valley nature tourism led to a total county-level economic output of $463 million and more than 6,600 full- and part-time jobs annually. This total contribution includes a $266.6 million contribution to gross regional product and a $163 million contribution to labor income across the region. This information was provided to local destination-marketing organizations to help them plan for sustainable tourism throughout the region.

- A Recreation, Park and Tourism Sciences professor led the development of a national Socioeconomic Monitoring Program for the National Park Service to inventory the social, cultural, and behavioral stressors affecting the ecological and social systems that parks occupy. He conducted a yearlong national needs assessment to identify vital social indicators whose long-term monitoring would improve the planning and management of parks. The report is guiding the development and pilot testing of a national monitoring program in 20 National Park System units, with the long-term goal of expanding the program to represent all 407 units of the park system.

**Studying the economic impacts of sustainable nature tourism and Texas state parks**

- A team of researchers from the Departments of Recreation, Park and Tourism Sciences and Agricultural Economics assessed the economic impact of nature tourism throughout the four-county region of the Lower Rio Grande Valley, estimating the direct, indirect, and induced effects of spending among nature tourists. The results of the study showed that the direct economic contribution from Lower Rio Grande Valley nature tourism led to a total county-level economic output of $463 million and more than 6,600 full- and part-time jobs annually. This total contribution includes a $266.6 million contribution to gross regional product and a $163 million contribution to labor income across the region. This information was provided to local destination-marketing organizations to help them plan for sustainable tourism throughout the region.

- A Recreation, Park and Tourism Sciences professor was commissioned by the Texas Parks and Wildlife Foundation in a study that collected data from over 51,000 park visitors in 2014. The sample was used to estimate the economic impact of each of the 89 state parks on its host community. In fall 2015, these results were cited in major media and were used by leaders of conservation organizations to inform individual legislators of the economic impact of Texas state parks. As a result, the 2015 legislature increased the state parks’ budget by about $100 million for 2016–17. In addition, a sporting goods sales tax will now be a designated fund that can be allocated only to state parks, guaranteeing that 94% of the $130 million from the tax will go to state parks in future years.

**Providing resources for biodiversity research**

- The Texas A&M University Insect Collection (TAMUIC), in the Department of Entomology, currently holds nearly 3 million total curated specimens. This is the largest insect collection in Texas, and it provides a resource for scientists and others who conduct systematic research.
  - The TAMUIC also participates in the Global Biodiversity Information Facility in Copenhagen, Denmark, which provides the largest biodiversity database on the Internet, collected from dozens of participating countries. Its basic collection data may be accessed electronically.
A researcher in Recreation, Park and Tourism Sciences is helping to protect the biodiversity of Texas’s inland and coastal fisheries by studying the human dimensions of fisheries, with the Texas Parks and Wildlife Department as part of its long-term monitoring program. A 2015 survey of licensed Texas anglers will provide information concerning the public’s attitude toward existing resource management plans, current angling behavior, and the angling public’s awareness of threats to fishing, such as introduced and invasive species.

- A researcher is studying the use of artificial reefs in Texas for fishing and boating and informing the public about the Texas Parks and Wildlife Department’s Artificial Reef Program in the Gulf of Mexico. The results of the study have implications for ecosystem restoration, water quality, fisheries production, recreation, and placement of future reefs.

- Students in the Department of Agricultural Leadership, Education, and Communications developed presentation materials to support the application of the Namib Sand Sea as a UNESCO World Heritage site. They also compiled a photo repository for the Gobabeb Research and Training Centre, located in the Namib Desert, which conducts research and educational training to serve as a catalyst for understanding arid environments.

- The Sand Sea is a coastal fog desert that is home to a large number of endemic plants and animals that are globally important examples of evolution and life in extreme environments.

Reseaching wetlands and preserving ecosystems

- The Texas Coastal Watershed Program (TCWP), developed in coordination with the Department of Recreation, Park and Tourism Sciences, researches the ecohydrology of headwater wetlands in the greater Houston area and maps ecosystem resources and services on the Upper Gulf Coast. The program has developed new information on the loss of so-called isolated wetlands, the relationship of the wetlands to the quality of receiving water bodies, and the documentation of mitigation for wetland loss. This research influenced the direction of the recently adopted Clean Water Act Section 404 wetland rule.

- The TCWP recently collaborated with the Houston Advanced Research Center (HARC) to evaluate wetland mitigation in the Houston Metro region. This research is just beginning to influence policy discussions on long-term wetland mitigation issues.

- The TCWP developed an “ecologic map” for the eight-county Houston Metro region, documenting significant natural habitats of 100 acres or more. The map has been a major factor in the emerging Regional Conservation Plan facilitated by Houston Wilderness and is recognized across the region as the “go-to” map.
The TCWP, working with the Texas Parks and Wildlife Department, has pioneered a simple but extremely effective method for restoring coastal prairie pothole wetlands. Known as the Sheldon-Sipocz Method, this tool enables first-class restoration to successfully take place in record time, because the original wetland topsoil is re-exposed using the same tools that leveled these wetlands for rice from the 1960s through the 1990s.

The method is coming into wider use across the area (for example, by the Katy Prairie Conservancy), and more than 100 acres received high-quality restoration at Sheldon State Park in Houston.

### Studying the impacts of livestock grazing and animal domestication

A 30-year project at Overton revealed the impact of grazing management on Bermuda grass ecotype composition. Current and long-term pasture and plant sampling documented extensive Bermuda grass ecotype diversity in response to beef cattle stocking rate, fertility regimens, and other factors.

Department of Ecosystem Science and Management researchers demonstrated that soil nematode communities are much more diverse in native grasslands than in invasive woody plant communities, altering the flow of energy and nutrients in belowground food chains.

Because nematodes help regulate ecosystem function, their distribution in grasslands rather than woody clusters could affect the bioavailability of nutrients and limit plant-microbe and plant-plant interactions, altering the future of ecological processes in their ecosystem.

### Mitigating the effects of invasive species

The Overton Center initiated a collaborative project with the Noble Foundation to define habitat-use patterns of feral hogs to aid in developing control protocols.

Agricultural economists estimated that a biological control program for giant reed along the Rio Grande would contribute $9 million to $18 million per year to the South Texas economy by 2025 and create an additional 197 to 351 jobs.

This has resulted in the implementation of a biological control program for giant reed in the Rio Grande Valley.
GOAL

Improve agricultural production and efficiency through advances in animal and plant breeding, management, and health.

The Texas A&M AgriLife vegetable breeding program, coordinated in the Department of Horticultural Sciences, generated more than 700 new lines and hybrids of pepper, tomato, onion, and melon and is evaluating them for commercial potential. Seven pepper, three melon, and eight tomato hybrids were chosen by private industry collaborators for advanced trials. Disclosures for four onion lines and two tomato lines were submitted to the Office of Technology Commercialization for licensing to two private companies, and for a utility patent.

PROGRESS

Using genetics and genomics to develop drought- and disease-resistant, herbicide-tolerant, high-yielding plants

• Studies on crop drought tolerance began at the Corpus Christi Center in 2010 on construction of the Drought Tolerance Laboratory. Cotton drought tolerance studies were conducted in collaboration with AgriLife Research cotton breeders. Other studies included sugarcane transgenic genotypes, which helped identify drought-tolerant genotypes. For example, two cotton genotypes showed higher water-use efficiency as a result of higher biomass partition into seed cotton. Two transgenic sugarcane varieties also showed higher water-use efficiency while maintaining biomass production. Studies conducted in 2015 with sugarcane are still in progress; those with cotton are being analyzed.

• Corpus Christi Center scientists and AgriLife Research peanut breeders have developed new peanut varieties that have a greater potential yield and make better use of irrigation water. Research on newer herbicides, which provide more effective control of problem weeds, has led to a reduction in overall herbicide usage. The use of more effective fungicides, along with varieties with tolerance to foliar and soil-borne diseases, has led to increased control of disease and higher yields.

  o These developments have resulted in increased net profits for growers. With a yield increase from 3,500–4,000 pounds per acre about 20 years ago to 5,500–6,000 pounds per acre today, the added gain for peanut producers can be $100–$150 per acre at today’s prices.

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• Over the past four years, the AgriLife Research Prunus Breeding and Genetics Program in the Department of Horticultural Sciences has released 20 new peach or nectarine cultivars for the low- to medium-chill zones with improved flesh colors, flavors, shapes, and nutritional content.

  o These releases represent a major advancement in the types of stone fruit available to growers in the southern regions of the country, advancing the commercial harvest by 2–3 weeks and potentially adding 10% in production capacity. This could have a potential value of up to $50 million annually in the United States.
Analyses of a collection of corn mutant lines that are nearly genetically identical except for the LOX family of genes revealed new functions for this gene family, which can produce plants with the ability to grow in zinc- and iron-deficient soils, drought tolerance, resistance to insects and pathogens, and resistance to aflatoxin contamination of seed.

- The AgriLife Research wheat-breeding team, including a wheat breeder in the Department of Soil and Crop Sciences, has been recognized for its varieties, which continue to dominate wheat production in the Great Plains and are estimated to add more than $200 million annually to the U.S. economy. The recently released TAM 204 is a grazing-type wheat, and TAM 114 is a new drought-tolerant wheat that makes a stronger dough. In 2015, Texas A&M wheat varieties topped the Republic of Georgia trials, and they average three times the yield of previously grown cultivars.

- The AgriLife Research potato-breeding program has developed 15 potato varieties, and several of these are licensed to seed producers nationwide. The latest addition is the recently patented variety ‘Sierra Rose’. Our potato breeder is a member of the USDA Zebra Chip Team, which was recognized by the USDA as a recipient of the 2014 Partnership Award for service to the national and international potato industry.

- Plant Pathology and Microbiology researchers have identified five genes that either positively or negatively affect drought tolerance in maize. Analyses of the genomes of 60 diverse maize lines identified four lines in which the genes required for drought tolerance are duplicated. Efforts are underway to breed these beneficial duplicated alleles into AgriLife Research maize elite germplasm.

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- The sorghum-breeding program in Soil and Crop Sciences has developed the lines that are the bases for most bioenergy sorghum work, but breeders have also developed parental lines for food and forage. Significant among those are lines that produce photoperiod-sensitive forage hybrids. This system of impacting maturity, and thus forage quality, was developed and released by the Texas A&M AgriLife sorghum team and is now used worldwide for forage hybrid production. The long-term program in breeding grain sorghum has led to hybrids that are noted for their healthy characteristics and are currently being evaluated for the food industry.

- A researcher in Soil and Crop Sciences has developed advanced lines of corn for improved resistance to biotic and abiotic stresses; improved quality and processing properties for food, feed, and industrial products; and improved agronomics for Texas production. Trials indicated that this is one of best germplasms across the southern United States, and multiple agreements are underway to investigate potential market opportunities.
Dallas Center scientists developed the first sequence-tagged high-density genetic maps of two commercial, warm-season turfgrasses, Zoysia japonica and Zoysia matrella. The zoysiagrass map, which was accepted for publication in Plant Journal, provides an essential genomic tool for gene tagging and marker-assisted selection for accelerated development of significantly improved varieties. It is also the foundation for sequencing the zoysiagrass genome and for conducting comparative genomics analyses among grasses. This research will speed the development of more water-efficient, heat- and cold-tolerant, and disease-resistant turfgrass varieties. The grasses will also be more tolerant to the use of effluent or brackish water for irrigation, preserving freshwater for human consumption and food crop production.

- Corpus Christi Center research on the fungus that causes sorghum downy mildew in wild Johnson grass across the upper and lower Coastal Bend of Texas has led to discovery of the best resistance genes for hybrid grain sorghum grown in the region. The research also indicates that seed treatment fungicides once thought lost may again be effective in sorghum grown here.

- A new drought- and cold-tolerant St. Augustine grass developed at the Dallas Center and released in 2013 (DALSA 0605) is being licensed to more than a dozen turfgrass producers in Texas and is currently in pre-licensing evaluation by producers in Georgia and Australia. A new hybrid bluegrass for southern climates (DALBG 1201) is in pre-licensing evaluation by a major turf producer in Georgia. New cold-tolerant zoysiagrass lines co-developed by the Dallas Center and Kansas State University (KSUZ 1201, KSUZ 0802) underwent pre-licensing evaluation by 11 companies in 7 different states during 2015. KSUZ 1201 has already been released, and KSUZ 0802 was scheduled for release in 2015.

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  - Using genotyping by sequencing for diversity analysis of zoysiagrass varieties, the scientists also discovered that several current commercial zoysiagrasses, thought to be different varieties, are actually identical genotypes. This new approach demonstrates a novel scheme for protecting intellectual property of new plant varieties.

- Soil and Crop Sciences researchers co-developed Palisades zoysiagrass, a staple in the product line of turfgrass sod producers in Texas and throughout the southern United States. Palisades greatly contributes to the sustainability of urban-suburban agroecosystems. Researchers also developed more efficient irrigation strategies for landscapes and reduced potable water consumption by 25% or more for consumers adopting these strategies.

- The Overton Center initiated cooperative research to develop roses broadly adapted for heat tolerance and disease resistance.
  - These roses would increase the sales of the national flower and provide landscape plants that would reduce the need for pesticides and have reliable ornamental value for home and commercial landscapes.
Cotton-breeding programs in the Department of Soil and Crop Sciences have several new elite strains that exhibit high-yield potential, high-fiber quality, or both. AgriLife Research has developed and released germplasm lines with extraordinary fiber length and strength, with length equaling that of pima cotton and fiber bundle strength that is 25% stronger than current upland cultivars grown in Texas. The material is under testing agreements with various companies to identify market opportunities.

The Basye Endowed Rose Breeding Program in the Department of Horticultural Sciences is working to develop disease-resistant and heat-tolerant rose varieties to expand the market for roses and reduce the amount of chemicals needed to maintain the plants in the landscape. This work is complemented by genome-mapping studies that will lead to a better understanding of the rose genome and better methods to create disease-resistant varieties.

Developing a hybrid rice-breeding program is a top priority for the Beaumont Center. Scientists integrate model-assisted selection to allow rapid identification of sets of primary phenotypic traits having the greatest likelihood of producing superior performing hybrids. They also initiate advanced marker development for key phenotypic traits to allow rapid incorporation into breeding lines. A primary goal is to develop locally adapted, high-yielding, superior grain quality, and disease-resistant hybrids.

Beaumont Center researchers developed Texas A&M AgriLife Research’s first rice cultivars, ‘Colorado’ and ‘Antonio’, released in 2012. They are available for large-scale commercial production for 2015. If a 15% adoption rate is achieved over the next five years, the 5% yield advantage over currently grown inbred rice varieties will increase statewide rice production revenue by $1.22 million per year.

- This program will be enhanced by the recent awarding of a U.S. Department of Agriculture Specialty Crop Research Initiative grant of almost $4.6 million to a team of researchers led by AgriLife Research scientists to study the rose rosette disease.

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- ‘Antonio’ provides a 9% increase in yield over existing inbred rice genotypes, while ‘Colorado’ averages a 7% increase in yield and has extremely high milling quality.
In a multi-year collaboration with AgroFresh, Beaumont Center scientists have identified antioxidants that can mitigate the effects of reactive oxidative species by preventing damage to cell membranes, thereby reducing crop sensitivity to heat stress, maintaining foliage health. Experiments have shown a 5.7% increase in yield, which if applied to the entire Texas rice production area would have a value of $9.26 million per year at an expected cost of less than $1.45 million per year.

- An added benefit of this research has been the development of methods for screening large numbers of rice cultivars as a means of identifying sections of DNA corresponding to heat tolerance in rice.

**Boosting state income from forage, pasture, livestock, and forestry industries**

- Overton Center research has a current annual economic impact of $150 million on the $1.5 billion forage, pasture, and livestock industries of East Texas.
  - Technologies developed by Overton researchers such as use of fine lime, sod seeding of winter annuals, grazing management, and new forage varieties continue to contribute to increased productivity.

- The Overton Center released five new cultivars: ‘Neches’ white clover, ‘Blackhawk’ arrowleaf clover, ‘Sabine’ crimson clover, and ‘TAM TBO’ and ‘Nelson’ ryegrass.
  - The early and profuse flowering traits of ‘Neches’ clover will save stakeholders approximately $1 million each reseeding year, assuming ‘Neches’ is only 5% of total white clover use.
  - ‘Blackhawk’ arrowleaf clover was developed with multiple disease resistance to improve reliability of annual clovers in forage-animal systems.
  - ‘Sabine’ clover was developed to improve the reliability of long-season forage production as a component of ryegrass-clover mixtures.
  - The two new tetraploid ryegrass varieties have improved vigor and productivity over previous varieties.

- Clovers affect the forage production system by (1) capturing nitrogen from the atmosphere to yield forage for grazing and (2) increasing soil nitrogen for future plant growth through animal waste recycling and the decay of residual forage material. Nutrient cycling research at Overton provides a protocol for growing forage and producing beef weight gains on pasture without applying nitrogen fertilizer.
  - Management and grazing strategies have been developed to maximize efficiency of nutrient use on pastures maintained with no applied nitrogen fertilizer as well as with conventional production practices.
• Overton research has provided management guidelines for Tifton 85 bermudagrass to ensure that producers realize best returns from this excellent cultivar released from Tifton, Georgia.

Grazing stocker cattle in East Texas

• Overton Center research has shown that cool-season annual pastures (sod-seeded rye and ryegrass) and warm-season perennial grass pastures (Tifton 85 bermudagrass) are complementary and could support increased post-weaning grazing of stocker cattle in East Texas.
  
  o Research has determined potential individual animal gains of 2.5 to 3.0 pounds per day, or 1,000 pounds per acre, on cool-season pastures and 2.25 pounds per day, or 1,500 pounds per acre, on Tifton 85 for the respective grazing seasons.
  
  o Gains can be increased significantly by providing low levels of supplemental feed to the grazing animals if feed costs and cattle values warrant this practice.

Breeding better beef cattle

• Overton Center research has increased understanding of the effects of early puberty, temperament, and stress on the growth, reproduction, and health of tropically adapted beef cattle.
  
  o Research on stress response shows that cattle temperament affects production efficiency, immune response, and product quality.
  
  o The center has developed an early-calving line of tropically adapted Brahman cattle to increase beef production efficiency in Texas and in tropical regions throughout the world.

• Residual feed intake (RFI) research on cattle at the Overton Center indicates there is low correlation between RFI of a weaned calf and RFI of the same animal as an adult. This implies that selection for RFI post weaning will not impair adult performance.

• Concerns currently exist about the use of antimicrobial products in cattle production. Overton scientists are researching systems to measure cellular immune response and antibody-mediated immune response in beef cattle. Selection of cattle with high immune responses would result in a reduced need for antimicrobials as well as improved performance due to reduced disease and treatment costs.
**Epigenetic effects in beef cattle**

- Overton researchers have discovered that transportation — a common management practice — produces stress in pregnant cows, which alters the performance of their subsequent calves. Offspring from cows that are stressed are more temperamental, have decreased immune function, and have an increased response to insulin, with implications for growth and fat deposition. These results imply that common management practices applied differentially can alter the effectiveness of genetic evaluation programs.

**Protecting and improving livestock**

- Investigators in the Department of Large Animal Clinical Sciences in the College of Veterinary Medicine and Biomedical Sciences have discovered a cure for Trichomonas in bulls. This will greatly affect the disease-control program that currently calls for the slaughter of approximately 1,000 bulls that test positively each year in Texas. Successful treatment of infected bulls can also prevent the millions of dollars of lost production due to herd infertility.

- Investigators in the Department of Large Animal Clinical Sciences have demonstrated that a metal-based drug (gallium maltolate) can replace traditional antibiotics. This has reduced the use of standard antimicrobials at farms in central Kentucky, thereby reducing pressure for antimicrobial resistance, which is a major problem for livestock industries, including horse production. Although quantifying lives saved or number of doses of antimicrobials reduced is difficult, this finding will likely be influential in coming years as use grows.

- Investigators in the Department of Large Animal Clinical Sciences Comparative Orthopedics and Regenerative Medicine Laboratory investigate musculoskeletal disease and healing in the horse and regenerative medicine techniques to enhance musculoskeletal healing. They have demonstrated that the joint flare seen after stem cell injection is due to laboratory preparation technique. The result of this project had a major impact to the veterinary regenerative medicine world.
  - They continue to work on concepts that have the potential to shift the paradigm in regenerative medicine, including the development of methods to determine the mechanism of action of stem cell therapies, including methods to longitudinally track stem cells in vivo.

- Researchers in the Department of Animal Science have discovered that gestating, growing, and lactating swine require arginine and glutamine — previously classified as “dispensable” amino acids — to achieve maximum production performance.
  - They found evidence that led to the recognition by the American Society of Animal Science of arginine and glutamine as conditionally essential amino acids for both pregnant sows and neonatal pigs.
They played a role in the commercial development of feed-grade glutamine as a nutritional supplement to prevent intestinal atrophy, improve feed efficiency, and enhance growth in pigs worldwide.

They also identified arginine deficiency in piglets and demonstrated that dietary supplement with arginine improved skeletal muscle growth in pigs.

They led the commercial development of feed-grade arginine as a nutritional supplement to increase litter size and neonatal survival in pigs.

Improving nutrition and milk production reduces piglet mortality from about 13% to less than 6%, which has an economic value of over $2 billion to the swine industry.

Innovative research on metabolism and physiological functions of amino acids led to a paradigm shift in understanding of protein nutrition that changed the course of research in this discipline, to help improve human and animal health worldwide.

Animal Science researchers following the One Health Initiative Systems Biology Approach to Foods for Health and Prevention of Disease integrate scholarship between disciplines in human and veterinary medicine, agriculture and life sciences, biomedical engineering, computational sciences, genomics, and environmental sciences to ensure a safe, abundant, and affordable supply of high-quality animal protein.

Improving calf crops from 63% to 85% in beef and dairy cows, and piglets weaned per sow from 17.5 to 22, will increase animal protein to help feed our world and add values of $4.5 billion and $2.7 billion to the beef and swine industries, respectively.

Current One Health Initiative projects in Animal Science also focus on bacteriophages (viruses that infect bacteria) as antimicrobials against several common human and animal pathogens, including Salmonella, methicillin-resistant Staphylococcus aureus (MRSA), Klebsiella pneumonia, and E. coli. The use of phages in animal agriculture may be able to reduce the use of chemical antibiotics, increasing agricultural efficiency and reducing the burden of antibiotic resistance in both humans and animals. Reducing pathogenic bacteria in animal agriculture can also protect human health by reducing the risk of foodborne illness and zoonosis.
• The impacts of translational research in Animal Science highlight links between nutrition and reproduction and metabolic diseases such as obesity and type 2 diabetes.
  o Interferon tau, the pregnancy-recognition hormone for ruminants, has been used in studies that show it can reduce accretion of white fat, increase accretion of brown fat, reduce oxidative stress, and prolong insulin sensitivity in a mouse model of diabetes. This research could reduce the more than $100 billion spent on healthcare to treat adult-onset metabolic syndrome and inflammatory diseases.

• Investigators in the Department of Large Animal Clinical Sciences have helped to improve the productivity of goat farms by recommending targeted culling to reduce losses from intestinal parasitism. Resistance of intestinal parasites to anthelmintic agents (i.e., dewormers) is a global problem that is widely recognized in the United States.
  o The investigators plan to extend this work by using genome-wide approaches available through Texas A&M AgriLife resources to identify genetic (and eventually epigenetic) markers of susceptibility to endoparasitism in goats. This approach could lead to selective breeding programs and also might help identify biological pathways and processes that drive susceptibility and are possible targets for novel therapeutics and/or preventatives to control endoparasites.

• Animal Science faculty focusing on animal nutrition have designed and developed the Large Ruminant Nutrition System and the Small Ruminant Nutrition System to help producers, consultants, researchers, and students learn about issues related to animal nutrition; help feedlot managers achieve maximum profit; provide advanced modeling techniques; and deliver a complete system for assessing the quality of feeds for ruminants.
  o The nutrition models website (nutritionmodels.tamu.edu) and the department’s computer models are accessed and used by universities in Australia, Italy, and Brazil and by many commercial users.

• At the Animal Reproduction Laboratory in Beeville (part of the Corpus Christi Center), researchers study the reproductive biology of beef cattle, meat goats, and horses to develop procedures that enhance reproductive efficiency. Their protocol Bee Synch I was named in 2014 and 2015 in the National Beef Sire Directory as the method of choice for synchronization of ovulation in fixed-time artificial insemination of Bos indicus (Brahman) influenced cattle.
  o Bee Synch I enables breeders to use the top artificial insemination sires, which can increase individual beef carcass values of progeny by more than $400.

• Beeville researchers have now developed Bee Synch II, which in early trials appears to produce results similar to Bee Synch I but with fewer injections and a $5 reduction in drug costs per head. With the cost of developing replacement heifers approaching $1,500 per heifer, being able to time puberty and first pregnancy is one of the most critical components of efficient beef production.
• A forage scientist at Beeville has developed systems for sustainable use of natural resources and has defined ways to improve seasonal forage production for livestock and wildlife. Research includes the following:
  o Discovery of novel brain mechanisms that affect sexual maturation in beef heifers as influenced by early calfhood nutrition. This research also has implications in human diet as it relates to female puberty.
  o Development of a pharmacological method for controlling seasonal breeding in mares that accelerates time of pregnancy by up to 60 days. The center has collaborated with industry to develop a subcutaneous treatment that could have a $20 million to $30 million impact on the industry with a 15% market penetration.
  o Identification of forage crops with potential in South Texas and a fibrolytic enzyme to improve silage storage.

• Investigators in the Department of Large Animal Clinical Sciences have developed improved methods for enhancing the quality of ejaculates and for insemination of mares. These developments are being used successfully in commercial breeding operations worldwide.
  o This group has also discovered a unique form of subfertility (impaired sperm acrosome reaction) primarily affecting Thoroughbred stallions. Collaborative research with a genomics scientist in Department of Veterinary Integrative Biosciences has led to identification of a susceptibility locus for this phenotype, thereby demonstrating a genetic predilection.
  o A test for this locus (FKBP6) is now available and is being utilized by stallion owners, veterinarians, and equine insurance companies worldwide.

• Research at Corpus Christi and Texas A&M University-Kingsville is evaluating applied reproductive management, accelerated lambing, age at puberty, and reproductive seasonality of Dorper sheep. This breed experiences a spring reproductive season that must be managed appropriately for greatest flexibility in lambing season. The feasibility of producing three Dorper lamb crops every two years in South Texas is encouraging and can add $150 per ewe per year income without substantial inputs. Future efforts will concentrate on stimulation of reproductive activity in April and May.

• Conservation tillage and legume integration is new in South Texas and will help conserve soil and water and enhance soil structure. Two projects at the Corpus Christi Center are in years 4 and 5, with the first set of data to be released via peer-reviewed publications. Water savings from conservation tillage increases cotton and sorghum yields in drought years, and legume cover crops grown for livestock grazing diversify income and provide $75 per acre in nitrogen fertilizer equivalent annually.
Helping other nations protect and expand livestock production and farming

Ukulima Farm, South Africa

- Texas A&M AgriLife Research, through the Norman Borlaug Institute for International Agriculture, is working with the Howard G. Buffett Foundation to promote African agricultural research, extension, and education at the 9,200-acre Ukulima Farm Research Station in the Limpopo Province of South Africa.
  - Its mission is to support science to increase African agricultural production, enhance rural livelihoods, and conserve natural resources through new models addressing the diverse needs of agriculture in Africa.
  - The Ukulima concept is grounded in the principle that technology must be developed and tested in Africa so that researchers can adequately address the many unique issues facing African agriculture.
  - The program is addressing the themes of smallholder agricultural systems, wildlife and ecosystem conservation, and conservation agriculture technology, including dryland systems.

Other nations

- A researcher in the Department of Soil and Crop Sciences has developed more than 35 cowpea varieties for release in Africa and more than 45 countries globally. His current research in India is helping to solve that nation’s problem with food and protein insecurity. Four new varieties of a heat-tolerant, photoperiod-insensitive, 60-day cowpea have been released. This new crop could be grown on up to 10 million hectares of wheat and rice lands in northern India.
  - The researcher is also adapting the short-season, drought-tolerant, disease- and insect-resistant cowpeas to Texas.

- The Department of Agricultural Leadership, Education, and Communications focuses on the diversity of human resources in agriculture, emphasizing working in a multicultural society and developing sensitivity toward different cultures. It also explores the interrelationships between the contributions of diverse individuals, the state, and the nation as they relate to the global success of agriculture. It is also broadening students’ awareness of agricultural infrastructure in the United States and in Namibia.
As part of an effort to learn more about global food systems and support agriculture and world peace, the Department of Agricultural Leadership, Education, and Communications has involved more than 90 farm families in its Texas-Poland young farmer exchange program, which involves more than 20 universities in Poland and Texas. In addition, government, business, and agricultural leaders; university faculty; and students have participated in an exchange program to visit farms and ranches in Poland and Texas. They study farming practices such as no-till maize production and the science behind GMOs.

- The past decade has been labeled Ten Years of Economic Success for Poland, as the size of farms has seen 14.2% growth per year and acreage planted in corn has increased by 84% since 2012.

- Agricultural Leadership, Education, and Communications faculty are working with non-profit organizations in Haiti to develop educational, demonstration, and outreach programs to relieve food insecurity in the region and train graduate students to acquire complex competencies needed to address global food security and malnutrition. They have introduced goat milk as a potential source of protein to help decrease malnutrition.

  - According to the USDA, one cup of goat milk yields about one-quarter of the required protein daily nutritional needs. A milking herd of 10 does can provide protein for about 10 people.

**Using ecosystem science to manage pests**

- Increasing occurrence of fever ticks on South Texas ranches has raised concerns about the ability to continue to control these insects and keep them in the quarantine zone.

  - Agricultural economists estimated the total yearly cost to control fever ticks to a smaller, limited outbreak in Texas would be $123 million.

  - Department of Entomology researchers have identified receptors in the cattle fever tick and the black-legged tick involved in fluid balance. These new receptors may represent novel targets for new acaricides that would be nontoxic to other organisms.

- Research at the Corpus Christi Center comparing the effectiveness of insecticide sprays to manage sugarcane aphids on sorghum helped develop a threshold of 50 to 125 aphids per leaf, before flowering-head emergence. If growers sprayed when aphid counts were at threshold, they were able to reduce aphid populations to manageable levels, while only slightly reducing predator populations.

  - In South Texas, research and outreach efforts helped control the sugarcane aphid in sorghum at a cost of about $5 million, with a benefit of $30 million to $60 million from protecting the harvest in 2014.

  - Savings were at least doubled in 2015, based on prevented losses using targeted insecticide use with assistance from early rainfall and beneficial insects.
• The destructive potential of a combination of six sucking bugs and the boll rot disease they introduce was studied at the Corpus Christi Center from 2011 to 2014. Based on these studies, growers have been able to improve pest detection in their fields and use insecticides to control them only where and when needed.

  o The Entomology Project at the Corpus Christi Center has worked with consultants to transfer this knowledge out to the cotton field.

**Keeping growers up-to-date on best practices**

• Beaumont researchers produce the Texas Rice Production Guidelines. Thousands of copies of these guidelines are downloaded each year.

  o They also produce the Texas Rice Newsletter, providing cutting-edge information on rice research in Texas, the United States, and around the world.

• Overton research on the effects of heat delay on breeding lines of poinsettia is helping producers learn how to mitigate these effects and will facilitate future varietal selections to reduce this problem for Texas producers.

• Annual bedding plant adaptability research at Overton is providing information for producers and landscapers to help them choose the ornamental plant crops that will enhance sustainability of their businesses.

**GOAL**

*Add value to raw agricultural products and expand market channels through new product development and enhancements to existing commodities.*

**PROGRESS**

• Agricultural Economics researchers evaluated the economic impacts of the U.S. milk promotion check-off program funded by dairy farmers, milk processors, and importers. Results indicated that for each $1.00 spent on promoting dairy products, dairy producers gain another $5.78 in income.

  o The total economic impact of promotion programs for the U.S. dairy industry was estimated to be $2.4 billion. These reports were provided to the industry and to the U.S. Congress.

• Department of Animal Science researchers determined that as fatty tissue differentiates, monounsaturated fats increase, primarily due to oleic acid that increases the healthfulness of beef. Their research has led to production and marketing of leaner beef, labeled as “Select” beef.

  o Historical research on nutrient composition of beef improved beef products for healthier consumers and provided the beef industry with economic incentives to produce leaner beef.

  o They also found that ground beef from grass-fed and grain-fed cattle have equal nutrient values and consumer acceptability and that electrical stimulation of beef carcasses early postmortem increases tenderness.
• Overton researchers released ‘Rio Verde’ lablab, a new crop for the Texas seed and forage industries.
  o New lablab cultivars with improved Texas seed production are currently in breeding trials.

PROGRESS

Focusing on ways to market agricultural products

• The Overton Center’s Texas Superstar® Program continues to grow, founded on research trials conducted to evaluate Texas-hardy plant varieties. The program features major plant promotions for the public.
  o Each promotion increases sales and promotes the use of ornamental plants that are well adapted statewide.
  o Texas Department of Agriculture cooperative efforts included television ads to promote the program and funding to update brochures describing the plants.

• Overton Center researchers initiated a collaborative project with Kilgore College to train students in producing and marketing organically produced vegetable crops.

• Overton Center field days, tours, and industry event presentations improve marketing efforts, product performance, and sustainability of the Texas bedding plant industry.

• The Cattle Value Discovery System (CVDS), for both beef and dairy cows, was developed by Animal Science faculty to maximize production efficiency in the feedyard by marketing cattle individually to reduce excess fat produced, increase consistency and quality of products, enhance productivity, and increase economic returns. This technology has been used by prominent Texas companies, including Cactus Feeders, to manage cattle individually.

• Department of Agricultural Economics researchers estimated that widespread adoption of existing technologies to eliminate E. coli in the U.S. beef supply chain would increase income by $277 million annually and add 3,026 jobs as a result of eliminating the effects of E. coli in beef nationwide.
GOAL
Minimize the impacts of foodborne hazards and biosecurity threat agents.

PROGRESS

Developing procedures to ensure the safety of food and consumer products

• Scientists from the Department of Veterinary Integrative Biosciences and Texas A&M AgriLife Extension published epidemiological studies of the interacting effect of weather, farm management, and local environment on the probability and level of pre-harvest contamination of produce with generic E. coli as an indicator of fecal foodborne pathogens.
  o These findings will aid in the development of new and improved strategies to enhance microbial safety of fresh produce.

• Scientists from the Department of Veterinary Integrative Biosciences, Veterinary Pathobiology, and Texas A&M AgriLife Research are conducting an intervention trial to reduce fecal shedding of E. coli O157:H7 in finishing cattle through better management of cattle drinking water.
  o Preliminary findings support that water management may serve as a novel, simple, and inexpensive strategy to control E. coli O157:H7 in finishing cattle and protect public health.

• A researcher in Veterinary Integrative Biosciences is conducting epidemiological studies to identify novel methods for reducing contamination of produce with foodborne pathogens at the pre-harvest level.
  o These findings will be disseminated to produce growers, government officials, and researchers in classroom, workshop, and conference settings and through peer-reviewed publications.

• A Plant Pathology and Microbiology researcher confirmed the antifungal activity of nonthermal plasma and showed its potential as an effective disinfection technique to reduce seedborne pathogens in food crops.

• Department of Nutrition and Food Science researchers are developing new techniques to ensure the safety of foods. Among them are:
  o Applying strain-specific molecular diagnostics to detect and quantify food safety cultures in consumer products and assess the inhibition of bacterial pathogens.
  o Determined the effect of low-dose irradiation on whole fresh peaches and provided this information to the USDA Animal and Plant Health Inspection Service for consideration of increasing the use of this technology.
  o Determining the role of surface factors on the contamination and survival of pathogens in fresh produce grown in Texas and Mexico.
• Department of Biological and Agricultural Engineering scientists have made many advancements in food safety, including the following:
  o Developed a technology that ensures microbiological safety of fresh and fresh-cut fruits and vegetables.
  o Developed a method for accurate dosimetry calculation using 3D visualization and computer simulation techniques.
  o Standardized a method to calculate absorbed dose when irradiating fresh produce.
  o Developed a method to reduce the amount of ionizing radiation required to decontaminate pathogens in fresh produce.
  o Developed a method to decontaminate Salmonella in pecans using irradiation and food-packaging technologies.
  o Established the appropriate procedure for treatment of fresh eggs using irradiation technology.
  o Developed a risk assessment tool to predict the potential of a foodborne outbreak while handling and processing fresh baby spinach.

• A scientist in the Department of Veterinary Integrative Biosciences has developed and is characterizing new enterosorbent strategies and therapies to mitigate dietary risk factors for disease in humans and animals.
  o Based on this work, Texas A&M University has launched two companies: Texas Enterosorbents, Inc. (Bastrop) and Salient Pharmaceuticals, Inc. (Houston).

**Monitoring and ensuring the safety of animal feeds**

• The Office of the Texas State Chemist provides regulatory oversight of the manufacture and distribution of over 18 million tons of animal feed in Texas by approximately 3,000 establishments.

• The Texas State Chemist’s Office developed new methods for detecting biological and chemical hazards, including:
  o *Listeria monocytogenes* in raw milk that may be used in animal feed
  o *Heavy metals* in animal feed matrices (mineral mix, minerals, and fish meal products)
  o *Polycyclic aromatic hydrocarbons* in fish meal
• The Texas State Chemist’s Office successfully managed the disposition of high-aflatoxin corn from annual corn harvests and approved blending plans that ensured corn used for feed met safety standards.

• The office introduced a new rule approving the use of aflatoxin binders and approved products for use by seven companies.
  o This was the first such action in the United States toward mitigating the impact of this Group I carcinogen and toxin in customer-formula animal feed.

• The State Chemist’s Office trains individuals from seven countries in the application of Hazard Analysis and Critical Control Point (HACCP) principles to improve food safety.

**Detecting and responding to animal and human disease outbreaks and biosecurity threats**

• Agricultural economists have analyzed the interrelationship between climate change and animal disease, showing that climate change has increased the probability of avian influenza outbreaks.

• The Institute for Infectious Animal Diseases (IIAD) develops agricultural screening tools that aid in early detection and response to high-consequence diseases such as foot and mouth disease, classical swine fever, African swine fever, and other naturally occurring endemic livestock diseases.
  o IIAD is working with the USDA and the Department of Homeland Security to implement a system that can be used in business continuity, emergency response, and recovery from a major disease outbreak.

**GOAL**

Prevent transmission of human disease agents through development of improved methods of vector control.

**PROGRESS**

• AgriLife Research and Extension scientists in the Department of Entomology developed a mobile phone application, The TickApp, to identify ticks as vectors of Lyme disease and greatly reduce the cost of diagnosis and treatment.
  o Each case of Lyme disease costs $100,000 to diagnose and treat.
  o Annually, 20,000 new cases of Lyme disease are diagnosed in the United States, with 70–130 cases in Texas.

• A scientist in the Department of Veterinary Integrative Biosciences is conducting epidemiological studies to identify novel methods for preventing Lyme disease.

• Researchers in Entomology discovered that silver nanobeads can penetrate the cuticle of the yellow fever mosquito to deliver insecticides without harming the environment.
GOAL
Develop wholesome, healthful, and affordable foods through scientific discovery, novel technologies, and new processes.

Soil and Crop Sciences researchers have developed specialty wheat lines with traits that eliminate the need for current additives in tortilla flour. The project could have a $150 million annual impact on the tortilla industry by providing additive-free flour with a more consistent quality.

PROGRESS

Developing new food products and processes

- The Texas A&M AgriLife Vegetable and Fruit Improvement Center (VFIC), in the Department of Horticultural Sciences, conducts research to develop healthy and flavorful vegetables and fruits. VFIC scientists demonstrated that high-pressure processing extends the shelf life and minimally alters the levels of health-promoting compounds in grapefruit. In addition, methods were developed to separate coumarins and polymethoxyflavonoids in citrus using flash chromatography.

- Soil and Crop Sciences researchers have developed specialty wheat lines with traits that eliminate the need for current additives in tortilla flour. The project could have a $150 million annual impact on the tortilla industry by providing additive-free flour with a more consistent quality.

- Refinements in diet formulations and feeding practices of red drum, hybrid striped bass, and channel catfish in the Department of Wildlife and Fisheries Sciences have saved money by reducing the costs of production, increasing the efficiency of diet utilization, limiting potential negative environmental consequences, and improving the nutritional value of resulting products.
  - Fish diet costs make up over 50% of production costs for farmed fish. To reduce costs, the department has evaluated protein concentrates from algae, barley, corn, and soybean as alternatives to fishmeal, which is one of the most expensive feedstuffs used in fish feeds.
  - Wildlife and Fisheries Sciences nutrition and physiology research has also benefited the red drum stock enhancement program operated by the Texas Parks and Wildlife Department. This program, in which hatchery-produced red drum are released into Texas bays to enhance recreational fishing, contributes an estimated $1.3 billion annually to the Texas economy.

- Wildlife and Fisheries biologists have determined that shrimp abundance is associated with tidal height and river discharge, suggesting the importance of coastal wetlands for shrimp production. They have also investigated the interactions between shrimp and recreationally important fish species and found that shrimp are important forage species for these fish.

- Forage management and stocking strategy research at Overton has enhanced the efficiency of producing natural forage-fed beef.

- Nutrition and Food Science research in processing led to the commercialization of açai oil.
• Biological and Agricultural Engineering scientists developed an effective vacuum-frying technology to produce lower-fat-content fruit and vegetable fried snacks, including mangoes, potatoes, sweet potatoes, and apples. Other innovations include:
  
  o Developed an edible coating than can extend the shelf life of fresh-cut fruits and vegetables such as cantaloupe, watermelon, papaya, and pineapple by 7–10 days.
  
  o Demonstrated that nanoparticles made of PLGA polymer can be used as effective carriers of natural antimicrobial components when incorporated into edible coatings.
  
  o Evaluated biological materials to function as inexpensive and green polymeric matrices for delivery of antimicrobials, antioxidants, and nutritional compounds to a wide variety of foods.
  
  o Enhanced the nutritional quality of Meals-Ready-to-Eat rations using intelligent packaging and reformulation with healthier ingredients.

GOAL

Promote healthy lifestyles and nutrition to prevent acute and chronic illness.

Scientists in the Department of Nutrition and Food Science have identified innovative and plant-derived compounds that elicit a protective effect against gastrointestinal diseases.

PROGRESS

Assessing and promoting the disease-preventing properties of foods

• Scientists in the Department of Nutrition and Food Science have identified innovative and plant-derived compounds that elicit a protective effect against gastrointestinal diseases.
  
  o They have also discovered new mechanisms by which plant phytoestrogens suppress the formation of colon cancer.
  
  o They are exploring the ability of plant-derived compounds to alter the development and growth of colonic stem cells.
  
  o Nutrition and food scientists have worked with colleagues to identify a complex interaction between specific diet-derived compounds, microorganisms in the gastrointestinal tracts, and the normal intestinal physiology of the host animal.

• Nutrition and Food Science researchers are currently identifying the mechanisms by which diets modulate metabolic genes and/or inflammatory genes to create pathogenic conditions such as type 2 diabetes, steatohepatitis, and atherosclerosis.
  
  o They are providing basic information for developing effective preventative or therapeutic approaches to resolve metabolic disease.
Nutrition and Food Science researchers are assessing many foods to determine how they can protect against environmental contaminants and disease. Their work includes:

- Investigating the chemoprotective effects of natural products to understand how stem cells respond to factors such as diet, chronic inflammation, and carcinogens.
- Characterizing the regulation of choline transport in brain cells to mediate oxidative stress induced by cadmium exposure and the protective effects of zinc supplementation to explain how zinc disrupts stress-induced intracellular signaling and exchange of molecules across cellular barriers.
- Assessments of phytochemicals and polyphenolic extracts from grapes, green tea, curcuminoids, plums, mangoes, peaches, cowpeas, and wines have shown that many of these compounds reduce cellular inflammation in both colon and breast cancer models.
- Testing phytochemicals derived from açai and mango in human clinical trials to determine their protective effect against colon cellular inflammation and carcinogenesis.

Reseaching the relationship between diet and disease

AgriLife Research scientists in the Department of Horticultural Science and the Vegetable and Fruit Improvement Center have shown that stone fruit phenolics (especially in plums) are an excellent source of antioxidants, inhibit the oxidation of low-density lipoprotein, inhibit platelet aggregation, selectively inhibit the proliferation of breast cancer cells over normal breast cells in the laboratory, and suppress the oxidative and inflammatory processes involved in the pathogenesis of vascular diseases. They have also shown that peach and plum juice consumption protected obese rats against obesity-induced metabolic disorders.

Nutrition and Food Science researchers are studying various aspects of tumor formation, growth, detection, and prevention, including:

- Determining mechanisms by which omega-3 polyunsaturated fatty acids modulate tumor formation and cell death, including the suppression of colonic inflammation-induced tumor progression.
- Classifying dietary effects on genetic signatures during colon cancer initiation and progression.
- Using messenger RNA populations to characterize transcriptional and posttranscriptional changes to monitor responses to diets that reduce chronic inflammation and carcinogenesis.
- Developing a noninvasive molecular biomarker to detect colon cancer using sloughed colon cells in stool samples.
Providing training in other nations for animal and human health

- A Recreation, Park and Tourism Sciences professor led a 2014 One Health Immersion study-abroad course in Senegal and Gambia that focused on the impact of water, animal, and environmental health on foodborne diseases, nutrition, health-professional training, public health, and family and youth programming.

Using structural biology and bioinformatics to discover new drug treatments

- Researchers in the Department of Biochemistry and Biophysics study the three-dimensional structure of proteins and nucleic acids to find structural vulnerabilities that can be targeted with new drugs to help treat diseases.
  - The labs use X-ray crystallography to view the structure of molecules that cannot be seen with a microscope.
  - This allows researchers to study the interaction between proteins and potential drug compounds in the search for novel drugs to treat Alzheimer’s disease, malaria, tuberculosis, non-Hodgkin’s lymphoma, and other cancers as well as other diseases that are difficult to treat, often fatal, and can become resistant to current drugs.
  - The Junjie Zhang Lab has solved the structure of the tuberculosis ribosome using electron microscopy.
  - The Meek Lab synthesized and characterized a novel inhibitor of both falcipain and cruzain, two cysteine proteases that are drug targets for malaria and Chagas’s disease.
  - Through structure-guided medicinal chemistry, the Sacchettini Lab has led to development of leads that target two enzymes that generate important components of the mycobacterial cell wall. Pharmacology and toxicity studies have been promising, and mouse studies are being carried out. These projects are funded by the Bill and Melinda Gates Foundation and the National Institutes of Health.
  - The Sacchettini Lab has screened over 50,000 drug-like compounds to test effectiveness against an enzyme that causes drug resistance in gram-negative bacteria like Klebsiella and are poised to begin trials of their best compounds in a mouse model.
  - The Sacchettini Lab has completed several of the required preclinical studies on their cancer drug for clinical trials in drug-resistant ovarian cancer. They are in negotiation to conduct phase I clinical trials.
The Pellois Lab has developed a technology that allows the efficient introduction of proteins into live human cells. This unique technology relies on a simple co-incubation protocol with a membrane-active peptide they have discovered, named dfTAT. This technology can be used in cell biology applications that involve cultured live human cells, and it serves as a promising foundation for the future design of agents for delivering therapeutics in vivo. Several companies have expressed interest in licensing this technology.

The Polymenis Lab and collaborators published a paper describing enhanced longevity by ibuprofen that has generated considerable notice, with over 20,000 views in the first month, a highlight in Science, and features on mass media television outlets. Just 24 hours after online publication, the story received 1.2 billion views from 89 million unique visitors from around the globe.

The Gohil Lab has filed a patent application for a novel use of the existing investigational anti-cancer drug elesclomol in the treatment of rare mitochondrial disorders.

The team is also working to find nontoxic “smart drugs” that can be delivered directly to sites of disease in the body through the use of nanoparticles as carriers. These drugs fight only diseased cells rather than also targeting healthy cells, as some conventional drugs do.

As part of a long-standing collaboration with the Dwight Look College of Engineering’s Department of Computer Science and Engineering, the center combines structural biology with bioinformatics to rapidly discover new potential drug candidates by screening thousands of compounds at a time and solving the structures of protein inhibitor complexes.

Working with the Texas A&M Institute for Genomic Medicine (TIGM), the Center for Structural Biology in the Department of Biochemistry and Biophysics is developing first-in-class high-throughput screening procedures for mouse stem cells involving state-of-the-art robotic equipment and pioneering screening procedures.

Once proven in animals, new drugs can be designed for human use that would block the infection or toxin’s access to particular human genes.

Utilizing clinical trials to develop novel drugs and therapies to benefit both animals and humans

The oncology group in Small Animal Clinical Sciences in the College of Veterinary Medicine and Biomedical Sciences has a robust portfolio of canine-based cancer clinical trials. They have published studies on new investigational drugs that have impact in lymphoma and bone cancer as well immunotherapeutic approaches. As companion animals are physiologically similar to humans and share the same environment, these prototypical One Health research projects contribute to knowledge about drugs, devices, and diagnostics of mutual benefit to animal and human health.
The gastrointestinal (GI) laboratory is internationally recognized for contributions in the area of small domestic species gastrointestinal health and disease. This year, high-impact contributions included publication of studies characterizing the GI microbiome in dogs and cats as well as validation of markers for mast cell and eosinophilic inflammation in the intestinal tract of dogs.

- The neurology group in Small Animal Clinical Sciences is heavily focused on studies that define the basic biology of canine spinal cord injury and evaluation of therapies for injury that hold promise in humans.
  - During the past year, the group had key publications on the release of cytokines and chemokines into the cerebrospinal fluid after injury; definition of MRI-based markers of injury and recovery; and evaluation of neuroprotective therapies for injury.
  - Neurology clinician-scientists have expanded collaborations with The University of Texas MD Anderson Cancer Center to explore natural disease models of glioma.

- The clinical cardiology group in Small Animal Clinical Sciences continues to participate in multi-center clinical trials. One particularly important study, on the effect of pimobendan on dogs with chronic heart valve disease, was just completed. Studies on biomarkers of canine and feline heart disease continue to be published by this group.

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GOAL

Provide policy makers, producers, and consumers with scientifically sound data regarding carbon cycling and sequestration.

PROGRESS

- A Soil and Crop Sciences researcher has provided national and international leadership in developing methods of using VisNIR spectroscopy to quantify soil constituents such as organic carbon. Collaborations based on this research led the USDA’s Natural Resources Conservation Service to use the technology in its rapid carbon assessment project.

- Soil and Crop researchers have determined that removing brush on the Edwards Plateau (long recommended by state and federal agencies and water authorities) does not improve water recharge in the Edwards aquifer. In addition, brush overgrowth improves carbon sequestration in the area. Therefore, the researchers do not recommend brush removal on the plateau, other than for its positive impact on livestock production.

- A Soil and Crop Sciences study on carbon dynamics in the Southern Cotton Belt found that biomass sorghum, perennial grasses, and dryland cotton are carbon sink ecosystems compared to intensively managed irrigated cotton in the region. A separate study found evidence to support bioenergy sorghum as a net carbon-sequestering crop. These results support bioenergy sorghum as a good choice in meeting the U.S. renewable fuel standards and will have long-term implications on Texas and U.S. cropping systems.
A Recreation, Park and Tourism Sciences professor is conducting research on the role of ecotourism and interpretation in addressing climate change. Enhancing environmental literacy creates an informed citizenry and increases civic participation in policymaking for climate change mitigation. One research project was at the Great Barrier Reef in Australia.

A researcher in Recreation, Park and Tourism Sciences has studied the human dimensions of natural resources in the context of hurricanes, floods, and wildfires, finding that the major factor in conservation and protection of natural resources is the human factor — the way individuals and communities can form partnerships to protect people, communities, and property from disaster while successfully managing natural resources.

- The role of social media and technology has increased, especially among younger people, when making evacuation decisions during natural disasters.

Data from a 30-year project at the Overton Center have shown that carbon sequestration has been enhanced by stocking rate, fertility regimen, and overseeding of ryegrass or clover in Bermudagrass pastures.

- The pastures were fertilized with nitrogen or managed with legumes and tested with three levels of grazing pressure.
- Research on soil carbon and nitrogen levels in cropping systems is in its second year of data collection.

A Beaumont Center researcher developed a daily version of the DayCent soil carbon and greenhouse-gas emissions model for use in flooded production systems such as rice.

Beaumont researchers propose to expand the center’s modeling of carbon sequestration and greenhouse gas emissions by conducting detailed field validation studies to allow accurate assessment of the environmental impact achieved through a range of existing conservation measures and incorporating the DayCent models into their modeling system.

Agricultural Economics researchers continue to document impacts of climate change on a global scale through research collaboration with the United Nations Intergovernmental Panel on Climate Change (IPCC).

- Carbon dioxide is a major contributing factor to climate change, but researchers found that it also accounts for 40% higher yields in cotton produced in some regions of Texas.
GOAL

Create economically feasible, sustainable alternative energy systems through basic and translational research in feedstocks, logistics, and conversion technologies.

PROGRESS

Developing feedstocks and production systems for cellulosic biofuels

- Scientists at the Overton Center have completed the third year of evaluating bioenergy feedstocks and sustainable biomass production systems, including soil, water, and wildlife stewardship.

- In their research on the use of sorghum as a feedstock for biofuels, the Mullet Lab in the Department of Biochemistry and Biophysics has described the physiological and genetic basis of stay-green drought tolerance and the molecular mechanism that regulates flowering time in sorghum in response to photoperiod.

- Biological and Agricultural Engineering researchers have studied the thermochemical conversion of biomass using pyrolysis, gasification, and liquefaction. Techniques for gasification of various biomass sources have been identified, and the technology for producing electricity from gasification of municipal solid waste has been licensed and is being commercialized by a Dallas company that is selling gasification units domestically and internationally.

- Beaumont Center scientists developed the Biomass Economic Variability Analyzer, a complete life cycle analysis model for estimating site- and year-specific, cultivar-specific biomass production potential as well as the optimal location for siting cellulosic biorefineries, taking into account transport distance and costs.
  - They have received a USDA-NIFA grant to develop management practices for sustainable bioenergy sorghum production in the southern United States. This project focuses on determining the effects of tillage, fertilization, biomass incorporation, and crop rotation on sustainability, with regards to the quality and yield of biomass sorghum, carbon sequestration, soil quality, nutrient cycling, and greenhouse gas emissions.
  - In collaboration with scientists from Purdue University, the University of Massachusetts-Amherst, and the University of Nebraska-Lincoln, this project team has submitted a research proposal to the Department of Energy’s Systems Biology Research to Advance Sustainable Bioenergy Crop Development program.
AgriLife researchers are cooperating with the Environmental Protection Agency on the design of rules for the amount of greenhouse gas offsets when a stationary source uses agricultural commodities in production, primarily for bioenergy. The rules will be part of future clean air policies that address greenhouse gas emissions.

### Developing the production of biofuels from algae

- The microalgalae team at Corpus Christi has continued research in conjunction with Sandia National Laboratories and Open Algae on a Department of Energy funded project to advance the use of a low-cost recycled nutrient, struvite, for the production of microalgalae biomass. They have demonstrated that microalgalae grown using struvite have biomass productivities equal to more expensive, non-recycled nutrients. Optimizing the application of struvite led to a 15% reduction in struvite addition without a decrease in production, thereby further reducing production costs.
  - Additional nutrient optimization has produced microalgalae biomass from mixed algae cultures with protein content near 50%. The high-protein content of this microalgalae biomass makes it a strong contender as a sustainable protein substitute for fishmeal, and growth trials will begin soon using the biomass as a fishmeal replacement in marine and freshwater fish diets.

- Scientists in the Department of Biological and Agricultural Engineering have conducted federally funded research into algae cultivation, harvesting, lipid extraction, catalysis to fatty acid methyl esters, and systems engineering.
  - They also conducted federally funded research into the development of sensors to enhance algae biomass and lipid production.

- The Devarenne Lab in the Department of Biochemistry and Biophysics, with collaborators at Texas A&M, has developed a microfluidic photobioreactor device to use with oil-producing microalgae as a high-throughput screening system to identify high-oil-producing strains of algae. This information could be directly used for scaling up the growth of microalgae on the industrial scale for biofuel production.

### Researcuing the economics of biofuels

- Agricultural Economics researchers have developed economic feasibility studies for alternative renewable energy feedstocks, ranging from sweet sorghum to algae.
  - These studies have been widely cited in the industry and led to requests for further analysis as the technologies near commercialization.
  - Recent research estimates that, in a developed cellulosic ethanol industry, energy sorghum could increase Texas agricultural income by $818 million and the Texas economy by almost $7 billion annually, accounting for 11,000 new jobs.
• Biological and agricultural engineers have enhanced the viability of bioenergy systems by researching cost-effective methods and improved logistics for harvesting and delivering energy biomass.

• Department of Ecosystem Science and Management researchers have devised an approach for determining optimal forest biomass removal for energy production when considering profitability, long-term land productivity, and greenhouse gas consequences.
  o They have also developed a model for analyzing forest biorefinery supply chains, including biomass-use allocation, siting, and size of biomass storage and conversion plants in East Texas.

GOAL
Enhance viability of bioenergy systems by developing markets for co-products of cellulose, algal, and other alternative energy products.

PROGRESS
• Corpus Christi researchers have developed plans to grow and use macroalgae for biofuels, human consumption, terrestrial and aquatic feed ingredients, and bioproducts, and they determined that algal residue has potential as a safe and effective fertilizer.

• Researchers at the Corpus Christi Center’s Mariculture Laboratory at Flour Bluff conducted synchronous cultivation of two microalgal species (Nannochloropsis salina and Phaeodactylum tricornutum) in outdoor raceways. Growing these two species together produced biomass at higher levels than growing them separately, regardless of season.
  o Biomass production was over 1,800 gallons of lipid per year per acre when grown together, compared to 1,400 and 700 gallons of lipid per year per acre for the N. salina and P. tricornutum, respectively, when grown separately.

• Corpus Christi Center USDA-NIFA funded research in collaboration with the University of Louisiana at Lafayette and Texas A&M University-Corpus Christi quantified responses of N. salina to light and temperature and integrated these into a simulation model that generates trends of light dynamics, growth, and lipid production. The model indicated that lipid production could be optimized to 4.2 times the current production in outdoor raceways, which would increase the value of a metric ton of biomass from $347 to $1,475.
  o Research currently underway is focused on N. salina culture’s carbon-use efficiency, biomass conversion efficiency, and nutrition optimization for maximizing biomass production and cost reduction.

• Researchers in the Department of Plant Pathology and Microbiology used synthetic and systems biology approaches to engineer algae, cyanobacteria, and high-cellulose plants to produce terpene at high titer and efficiency. The new platform enables photosynthetic systems to directly reduce carbon dioxide into energy-dense and high-value products ranging from pharmaceutical and nutraceutical chemicals to jet fuel components. The production has been scaled up, and collaboration with major corporations is under development.
• In other research in Plant Pathology, synthetic microorganisms were developed to convert lignin into valuable products like bioplastics and biofuels, reducing the cost of biomass conversion for biofuel. Overall, the synthetic and systems biology research will enable more affordable renewable energy, provide novel healthcare solutions, mitigate global climate change, and help protect the environment. It will also boost local economic development and promote economic competitiveness in Texas.

GOAL

Develop novel technologies and systems that enable producers and consumers to improve energy efficiencies.

PROGRESS

• Overton Center researchers have developed forage production systems that use no applied nitrogen and therefore reduce the global need for fossil fuels to produce nitrogen fertilizer. This could have a large long-term impact on global meat production.

GOAL

Model and understand the dynamic relationships among biological molecules to genetically improve production, disease resistance, and environmental adaptability of plants and animals used to produce food, fiber, and bioenergy.

PROGRESS

Developing process-based crop models

• The Beaumont Center is an international leader in the development of process-based crop models, an approach that integrates knowledge across biological scales, from the molecular to organ, plant, and population levels.
  
  o Process-based models allow clarification of genotype x environment interactions, which is not possible in models with less physiological detail.
  
  o This effort led to the first implementation of a marker- and model-assisted selection program.

• Beaumont Center scientists have advanced knowledge of how key primary phenotypic traits impact rice and energycane crop growth, development, and yield. They have also developed possibly the most advanced physiologically based rice model that can rapidly evaluate the putative impact of hundreds of thousands of combinations of key primary phenotypic traits in terms of crop growth, development, yield, and aspects of grain quality. Many of these methods can be translated to other crops.
  
  o The crop modeling system can link a crop’s genetic makeup to primary physiological traits; it enhances the ability to identify traits that contribute to yield improvement and to predict crop performance under different input conditions and environmental stresses.
This model is structured to easily incorporate additional morphological, physiological, and biochemical improvements.

The center has also developed a strong relationship with the Texas Rice Research Foundation, which is committed to partnering with Texas A&M AgriLife Research in developing a hybrid rice-breeding program.

### Producing genetically modified livestock for disease resistance

- Researchers in the Reproductive Sciences Laboratory in the College of Veterinary Medicine and Biomedical Sciences have generated transgenic cell lines that contain a gene coding for RNA that blocks the production of foot and mouth disease virus or vesicular stomatitis virus.

- The Reproductive Sciences Laboratory and partners have produced two transgenic calves, one bull and one heifer, with genetic resistance to Staphylococcus aureus, the most frequent cause of mastitis in cattle.

- Using stored DNA samples from cattle identified as either susceptible or resistant to brucellosis, the Reproductive Sciences Laboratory and partners are conducting a genome-wide study to identify genetic polymorphisms that are associated with brucellosis resistance.
  - The goal is to develop a simple DNA-based test that can be used to identify cattle that are naturally resistant to Brucella.
  - When combined with other marker-assisted selection technology, the addition of genetic resistance to disease will greatly enhance livestock production in the United States and around the world.

### Using next-generation sequencing and biotechnology tools for a wide range of research

- The Texas A&M AgriLife Genomics and Bioinformatics Service Facility (TAGS) addresses the need for access to the latest genomic technologies across The Texas A&M University System.
  - TAGS launched a marker-assisted breeding platform for researchers and has sequenced the genomes of thousands of energy sorghum breeding lines, approximately 800 bacteria, a large number of plant pathogens, and animals ranging from companion animals and birds to livestock.
  - It is also involved in human cancer research.
  - TAGS has supported more than 250 researchers representing over 20 departments, six colleges, the Texas A&M Health Science Center, and many A&M System agencies.
  - It is involved with more than 100 grant applications, representing millions of dollars in possible funding, including launching a highly successful genomic seed grant program with the largest response in Texas A&M AgriLife history.
GOAL

Capitalize upon data from high-throughput sequencing, proteomics, metabolomics, metagenomics, and other advanced technologies to develop systems biology tools for improving agricultural productivity.

PROGRESS

• Overton researchers use rumen microbe pyrosequencing to assess relationships between rumen microbes and efficient digestion of starch and/or cellulose to document efficiency in beef cattle performance.

• A Beaumont researcher is determining the genetic basis for heavy metal and nutrient uptake in rice, using proteomics and metabolomics approaches.

• Ecosystem Science and Management researchers have developed individual chromosome isolation approaches using laser capture microscopy and whole genome amplification for resequencing the complete conifer genome for loblolly pine, a major timber and biofuel crop.

• DNA sequencing of soils in Ecosystem Science and Management revealed that invasive mesquite trees support increased soil bacterial and fungal diversity and harbor a distinct fungal community relative to the native grasslands that are being replaced by mesquite woodlands.

Exploring genetic selection for enhanced disease resistance in dairy and beef cattle

• A researcher in the Department of Veterinary Pathobiology is developing genomic prediction and selection protocols that will be used in U.S. breeding programs to reduce the prevalence of bovine respiratory disease complex (BRDC). This researcher has established a leadership role in demonstrating that the multi-pathogen BRDC phenotype, once considered a trait with low heritability and low selection potential, is actually moderately heritable among dairy and beef cattle; it also is well suited for modern genomic prediction and selection protocols. BRDC is a leading economic obstacle for the U.S. beef and dairy industry.

GOAL

Model and understand dynamic relationships among behavioral and economic factors that influence the development and sustainable adoption of new technologies for the benefit of consumers, producers, and society.

PROGRESS

• The Pasture and Livestock Management Workshop for Novices developed at the Overton Center encourages new landowners to adopt the newest technologies for efficient and environmentally sustainable production.
To help Texas communities redevelop downtown areas to better integrate parks and other public spaces, researchers in the Department of Recreation, Park and Tourism Sciences have provided economic development districts and planners with recommendations for trails and wayfinding as well as locations for new parks and enhanced streetscapes.

- They are also working with the National Park Service's Rivers, Trails, and Conservation Assistance Program to gather data related to work it conducts with Texas communities. The program helps communities identify park and trail resources that can be planned and developed to support use and conservation of natural resources in urban areas.

- Another project in collaboration with the Brewster County Tourism Council has examined visitor attitudes toward nature-based recreation to help tourism businesses and land managers make decisions about topics ranging from service quality to recreational use zones.

- Agricultural Economics researchers, with Texas A&M AgriLife Extension and the USDA Farm Service Agency, made a major impact on U.S. Farm Bill implementation by educating producers nationwide. Their research on 2014 farm bill policy options led to the completion of 264 education programs nationally, with more than 19,000 producers attending.

  - They also conducted 14,000 YouTube sessions and received more than 1,700 calls on the Texas A&M help desk.

  - Their Farm Bill Decision Aid guided farmers on program participation decisions and the implementation of farm bill provisions.

  - More than 49,000 producers, landowners, and agribusinesses in all 50 states were provided data on and received decision output while viewing nearly 3 million pages in 136,000 sessions of materials developed by this team.

- The Temple Center’s Grazingland Animal Nutrition Laboratory processed over 10,000 forage and fecal samples providing management recommendations to over 2,000 livestock producers across the nation. Since 2010, interest in GANLAB analyses and advisories has grown 25%–40% per year.

- Researchers in the Department of Agricultural Leadership, Education, and Communications’ Digital Media Research and Development Laboratory have completed the second year of their heuristic modeling project, which will enable researchers and practitioners to account for, and eventually correct for, errors in data that enable them to understand the human capital characteristics of rural regions.

  - Without correcting for errors, subject characteristics may vary by more than 50%. The heuristic modeling project may reduce the error to less than 25% and eventually to less than 10%.
• Researchers in the Digital Media lab have developed three new field-research methods that have increased response effectiveness by up to 60% over traditional data-collection methods. These methods have been tested in people in seven western states and have accounted for more than 12,000 contacts.

• Undergraduate and graduate students in the Digital Media lab have completed two years of the “public engagement with agriculture” modeling project. Results of research conducted in five Western states have increased effectiveness and efficiency of industry partners’ marketing efforts, including economic impacts exceeding $68 million annually. Nationwide content analyses have led to consumer-choice experiments to test the visual effects of animal-based protein products in print advertisements.

• Through national professional development, service, and educational outreach, Agricultural Leadership, Education, and Communications faculty work with over 4,500 secondary-level agriscience programs. Through student experiential learning projects, these programs developed over $278 million in economic impacts, a 50% increase from 2014.

• A large international agricultural corporation is implementing the results of Agricultural Leadership, Education, and Communications research on how the trust level between sales representatives and producers has a positive impact on choice to purchase seed.
  
  o  In an extremely competitive market, investing money into training programs for sales reps and focusing on establishing producer trust will ensure seed corporations keep their current customers and expand their customer base.

• Through a Texas Department of Agriculture–funded project, Agricultural Leadership, Education, and Communications faculty are measuring demand preferences for the $100 billion Texas agricultural industry, including such products as shrimp, other food and fiber products, and tourism.

• Student work disseminated through the Agricultural Leadership, Education, and Communications website and social media outlets inform the public about issues affecting voting and purchasing decisions. Students use photography, infographics, and multimedia productions to help consumers become more literate about science and agricultural issues, reaching more than 500 potential consumers daily.

• The Texas A&M Instructional Materials Service Poultry Science Manual, 6th edition, helps train students nationwide for employment in the poultry industry; it is used annually by about 20,000 students in 5,000 schools and has also been adapted for school use in Christianville, Haiti. Improving skills related to the poultry industry can help smallholders address niche market opportunities and increase their income from egg sales by about 12%.