STRATEGIC PLAN

Texas A&M
AgriLife Research
and Extension
Center at Overton

Texas A&M AgriLife Research

CONTENTS

Strategic Plan, Texas A&M AgriLife Research and Extension Center at Overton 3

Priorities of Texas A&M AgriLife Research 3

Synergistic Interactions Among Priorities 4

Process Used to Develop a Strategic Plan for Texas A&M AgriLife Research at Overton 4

Background and History 5

Mission of the Texas A&M AgriLife Research Overton Center 5

Areas of Research and Outreach 5

Soil Microbiology and Health 6

Horticultural Crop Production 7

Forage Crop Breeding 7

Forage Production and Utilization 8

Biomathematical Modeling of Production Systems 11

Animal Physiology and Management 12

Research Teams 14

Goals and Milestones 14

Goals 14

Milestones 15

Resources to Reach Excellence 17

Headquarters Facilities 17

Vehicles and Equipment 18

Research Farms 18

Livestock 19

Appendix: Texas Agriculture, Natural Resources, The Future 20

Agriculture 20

Natural Resources 22

The Future 22

STRATEGIC PLAN, TEXAS A&M AGRILIFE RESEARCH AND EXTENSION CENTER AT OVERTON

Priorities of Texas A&M AgriLife Research

Strategic priorities are areas that AgriLife Research will emphasize over the coming years to make measurable progress toward enhancing the resilience of agricultural systems and ensuring an abundant supply of high-quality, nutritious foods for our citizens. These are described in detail in the agency strategic plan.

Strategic Priority One: Leading-Edge Research and Innovations

Discover new innovations, technologies, and science-based solutions to enhance agricultural and ecological systems and the life sciences.

Strategic Priority Two: Sustainable Production Systems

Provide the translational research necessary to develop and produce high-quality, safe, and sustainable food and fiber systems with local, national, and global impacts.

Strategic Priority Three: Economic Strength

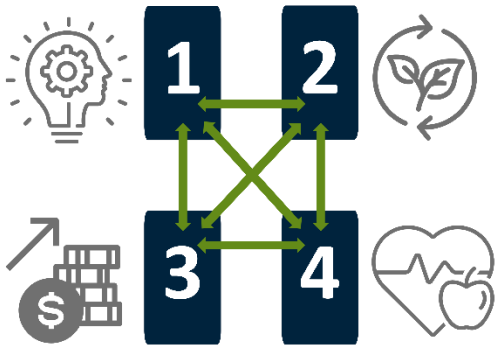
Enhance the efficiency, profitability, and resiliency of agriculture, natural resources, and food systems in the state of Texas and around the world.

Strategic Priority Four: Healthy Living

Discover, disseminate, and facilitate the adoption of scientific evidence at the intersection of nutrition, human health, and agriculture.

Synergistic Interactions Among Priorities

These four research priority areas interact synergistically to deliver healthy living to Texans. Innovative research is the foundation of this strategy, which empowers the nexus between agriculture and human health by cultivating science-based solutions to develop sustainable, profitable, and resilient agriculture that provides affordable, high-quality, nutritious food.



Process Used to Develop a Strategic Plan for Texas A&M AgriLife Research at Overton

The future research and outreach activities planned by and for the faculty and staff of the Overton Center are guided by and will contribute to the Strategic Priorities of Texas A&M AgriLife Research. The research program areas described are located at the Overton site because of their relevance to the ecosystem and primary commodities of East Texas Agriculture and to the suitability of Overton Center location, facilities and research farm characteristics. Historically these areas of research have proven to improve productivity in East Texas and to contribute to the body of science in the respective disciplines.

Faculty were asked to describe the manner in which anticipated areas of research related, supported and contributed to the Strategic Priorities. These descriptions are provided to facilitate reader understanding of the objectives, processes and anticipated outcomes of future research at Overton.

BACKGROUND AND HISTORY

Texas A&M AgriLife Research and Extension Center at Overton opened on June 1, 1967, thanks to the initiative of East Texas agricultural and community leaders and the Bruce McMillan, Jr. Foundation. The McMillan Foundation initially provided $300,000, 150 head of Hereford cattle, 22 acres of land and three twenty-five-year leases of an additional 1,221 acres. The J. T. Montgomery family donated 4.5 acres for the center headquarters building.

Research at the Overton Center targets specific needs that must be addressed in the East Texas ecosystem. Major contributors to East Texas' annual agricultural farm-gate income are livestock (primarily beef cattle), nursery crops, poultry and timber; other agricultural income is from feed crops (including hay), vegetables, recreation and dairy. Texas A&M AgriLife Research programs at Overton address beef cattle, hay and forage crops and horticulture with some attention to forestry and rural recreation. Center research focuses on 1) Forage-Based Beef Cattle Production Systems and 2) Horticultural Production.

Research simultaneously addresses issues of production parameters plus economic and environmental sustainability. The subject matter disciplines of soil science, plant physiology, plant and animal breeding and genetics, animal physiology and production system science are focused on fundamental, translational and applied research targeting highest priority issues. The discovery of new agricultural principles and the technology transfer of these principles and production applications are key components of research and outreach goals.

Mission of the Texas A&M AgriLife Research Overton Center

The mission of the Texas A&M AgriLife Overton Center is to generate, learn and share knowledge about agriculture and the life sciences that nourishes health, strengthens communities, protects natural resources, supports economies and enhances the well-being and quality of life of people.

AREAS OF RESEARCH AND OUTREACH

Soil Microbiology and Health – Led by Dr. Anil Somenahally
Horticultural Crop Production – To be led by Horticulturist to be hired
Forage Crop Breeding - Led by Dr. Gerald Smith
Forage Production and Utilization - Led by Dr. Monte Rouquette
Biomathematical Modeling of Production Systems - Led by Dr. Prem Oli
Animal Physiology and Management - Led by Dr. George Perry
Research Teams – Composed of faculty from Overton and cooperating units
Goals and Milestones – Metrics to reflect success and productivity US

Soil Microbiology and Health

Research and outreach activities in this project area will address the Strategic Priorities as indicated.

Strategic Priority One: Leading-Edge Research and Innovations

Program applies leading edge research within soil biogeochemistry and soil health management for improving soil ecosystem services and reducing environmental impacts of crop and livestock production systems. Research innovations within soil microbiome interactions and soil functional responses to agronomic management practices have been applied to improve key soil functions such as carbon sequestration and soil fertility. New research collaborations are focused on combining big data analysis and biogeochemical modeling and developing a digital tool for soil health assessment to predict soil health properties, soil carbon sequestration potential and subsequently for identifying effective climate-smart management practices in forage and grazing lands, range lands and cropping systems. Additional interdisciplinary collaborative research is validating novel soil sensing technologies for in-situ monitoring and reporting of soil health properties.

Strategic Priority Two: Sustainable Production Systems

Many research outcomes have resulted in reduced use of chemical inputs, improved soil health, productivity, and sustainability of natural resources. Project works have identified effective soil health management practices with most impacts on improving beneficial plant-microbiome interactions in acidity and salinity stressed lands, which have led to improvement in soil fertility and plant nutrition. Project outcomes have also benefited regional and national stakeholders through innovative management strategies for effectively increasing soil carbon sequestration and greenhouse gas mitigation. Current projects are focused on adopting soil health management guidelines for enhancing climate smart agriculture initiatives by regional stakeholders.

Strategic Priority Four: Healthy Living

Collaborative projects are in progress with an aim to discover linkages between soil health management and food quality and to apply novel food safety risk mitigation practices in organic and conventional production systems. Projects are also focused on identifying effective soil microbiome management practices to reduce soil disease pressure, reduce food safety risks and increase micronutrient density.

Horticultural Crop Production

Horticultural crops are a very important part of East Texas agriculture, providing about 25% of farm gate income. Bedding plants, woody ornamentals, fruits and vegetables are among the types of production in the region. Horticultural crops are an excellent rural-urban interface in that they provide employment and economic activity in both rural and urban settings. Improved nutrition as well as quality of life are among the benefits to consumers of these products.
In order for horticultural research to continue at Overton, a new faculty position is needed. The focus of the research regarding area of science and crop types addressed will be determined by administrative wishes and area of expertise and interest of the new person hired.
Horticultural research and outreach will address and support all four Strategic Priorities.

Forage Crop Breeding

Legumes and cool season grasses are very important forage crops in East Texas. These same forage crops also function as cover crops, wildlife browse and pollinator crops with big impacts in sustainable cropping systems, wildlife stewardship and natural resource conservation. For the past six years (2016-2021) the conservative total economic impact of five forage legume cultivars developed at Overton is $16 million per year. This includes seed sales, nitrogen fertilizer replacement, beef cattle calf gain, wildlife stewardship value and pollinator crop value.

Forage Legume and Grass Breeding program activities will address specific Strategic Priorities as indicated:

Strategic Priority One: Leading-Edge Research and Innovations

Germplasm evaluation, traditional plant breeding and marker assisted selection are all used to develop improved cultivars of forage legumes and grasses to enhance livestock-forage production systems for Texas and the U. S. Southern Region. A team approach, including plant breeding, molecular biology, plant physiology, nematology and plant pathology, is implemented to ensure that new cultivars will function as expected. Grazing animals are often used in both selection and evaluation of new forage cultivars. Partnerships with Texas and U. S. seed companies are actively pursued to enhance commercialization and licensing of new cultivars. A new cooperative agreement with USDA-ARS is now in place to enhance breeding and research directed at forage winter pea improvement for Texas.

Strategic Priority Two: Sustainable Production Systems

Improvement and cultivar development of forage legumes are major goals of this breeding program; legumes in forage or cover cropping systems are key components of sustainable agriculture. Legumes through symbiosis with *Rhizobium* and related bacteria can fix atmospheric nitrogen into compounds usable by plants. This biological N fixation can then fuel the N cycle in pastures and other cropping systems, eliminating or reducing the requirements for fertilizer N. Annual ryegrass is a valuable cool-season forage used in warm-season perennial grass systems as an overseeded winter/spring grazing crop. Overseeded ryegrass extends the grazing season of warm-season perennial grass pastures and provides high forage yield in combination with high nutritive value. Our breeding program on annual ryegrass seeks to improve forage yield, seed yield, acid soil tolerance and disease resistance in this important annual forage.

Strategic Priority Four: Healthy Living

The Overton active program in improvement and cultivar development in forage cowpea produced two cultivars released in the last four years. The Southwestern U. S. does not have a widely used summer legume grain crop to use in crop rotations or double cropping systems. Improved multi-use cowpea cultivars could fill that void with a heat tolerant and low water use crop. We have expanded our investigations to develop multi-use cowpea with a variable suite of phenotypes that could fit forage systems, cover crops, double crop systems and human edible pulse crops for Texas and the Southwestern U. S. Both marker-assisted selection and wide hybridization are used in this breeding program.
Cowpeas and other dry beans are one of the most nutritionally complete foods available. They are an inexpensive source of complex carbohydrates, protein, minerals and soluble fiber. Expanded production of multi-use cowpeas in Texas will provide a new, locally produced crop with potential to enhance agricultural production systems and to provide more healthy food choices for all consumers.

Forage Production and Utilization

This research program combines the soil-plant interface of sustainability and environmentally compatible impacts of nutrient cycling under grazing and stocking conditions with the plant-animal interface that assesses biological components of efficiency of utilization and birth-to-harvest attributes of beef cattle. The pasture-animal research targets utilization strategies of forages in various grazing systems for conception-to-consumption of beef production and has focused on: a) evaluation of forage cultivars for dry matter, nutritive value, persistence, and sustainability for livestock; b) effects of stocking rate, forage species, and fertilization regimens on soil nutrient status, forage stand maintenance, biodiversity of forages, and nutrient cycling in pastures under grazing; c) effects of stocking rates and strategies, stocking methods, and forage

utilization systems on forage persistence and cow-calf and stocker performance; and d) describing biological efficiencies of pasture systems and project economic implications on lifetime performance of tropically-adapted beef cattle breed types.
The on-going, long-term (>35 years) stocking experiments on bermudagrass overseeded with ryegrass + N vs clover without N are one-of-a-kind in the U. S. Primary contributions have included documentation of soil nutrient status via nutrient cycling. This was the first research in the U. S. to quantify and identify bermudagrass ecotype diversity evolving under long-term stocking with cows and calves.

Stocking rates, stocking methods, and stocking strategies using cow-calf and stocker cattle with bermudagrasses and ryegrass, clover, or small grain + ryegrass pastures have defined Forage Allowance and Average Daily Gain relationships. This research was one of first to document the effects of Forage Allowance on ADG of both lactating cows and suckling calves.
Supplemental protein and/or energy for stockers at levels of 0.25% BW on bermudagrass or small grain + ryegrass pastures was shown to be the optimum level for biological and economic returns for stockers.

Soil nutrient status of pastures has documented carbon sequestration and soil P, N, K, Mg, Ca, and pH dynamics. The long-term cow-calf nutrient cycling on pasture database has served to re-direct fertility inputs, sustainable use of legumes in pastures, and stocking strategies for environment-compatible and economic sustainable pastures in East Texas and Southeastern U. S. Pasture-animal performance studies have been conducted with horses, Corriente steers, Holstein heifers, and tropically adapted cattle breed types including Brahman, Bonsmara, Tuli, Senepol, and Romosinuano with English and Continental sires that provide benchmark standards of production systems for stakeholders. This is the only project in Texas and perhaps in the U. S. that evaluates component performance of beef cattle from birth through cow-calf and post-weaning stocker-grazing systems to feedlot to carcass attributes to sensory evaluations of meat.
The Forage-Animal Modeling Team at Overton has produced the first model that predicts forage nutritive value of bermudagrass pastures on a dynamic, daily basis. Other models with bermudagrass includes effects of rainfall events of El Nino, La Nina, and Neutral conditions in addition to nitrogen application rates on dry matter production.

Research and outreach activities in this project area will address the Strategic Priorities as indicated.

Strategic Priority One: Leading-Edge Research and Innovations

Forage Germplasm Evaluation for Forage Production.

These Forage Project activities are involved as a collaborator in evaluation of forage germplasm for seed production traits, forage mass and nutritive value, cover crop alternatives, persistence under fertility regimens, and stand maintenance under grazing conditions.

Development of new Forage-Animal Simulation Models.

Novel forage-animal simulation models have been developed in Decision Support System for Agrotechnology Transfer. The modeling team was first to publish a model that predicts forage nutritive value of bermudagrass on a dynamic, daily basis. Two additional modeling "firsts" include modifications of the summative equation for estimating total digestible nutrients (TDN), and modifications of the NRC model for predicting stocker calf gains from bermudagrass pastures. These new and modified equations-models will have direct application for forage-animal nutritionists and commercial forage laboratory analysis interpretations. Extramural funding will create opportunities for decision support systems for biological and economic demands.

Strategic Priority Two: Sustainable Production Systems

Long-term nutrient cycling under grazing experiments at Texas A&M AgriLife Research at Overton represent the longest continuous stocking research of this kind in the U. S. and will serve to redirect and reduce fertility inputs for more environmentally friendly pastures in East Texas and the southeastern U. S. Soil analysis data have confirmed impacts of sod-seeding and stocking regimens on the soil-pasture ecosystem, and the most effective soil health, efficient carbon sequestration, and N dynamics on pastures. An archival database, BeefSys, was created to incorporate more than 45 years of soil-plant-animal data from this research program. This has resulted in complete birth-to-harvest histories for over 6,500 cattle, and documentation of long-term soil and pasture profiles that will provide a basis for designing sustainable systems.

Current cropping systems modeling efforts are targeted at sustainable production systems using double-cropping and cover cropping cowpeas to project production without N fertilizer. The grazing and cropping production systems will provide the background documentation of confirmational evidence to secure extramural funding.

Strategic Priority Three: Economic Strength

Collaborative team research has led to the release of 11 forage cultivars for livestock and wildlife and 5 disclosures-licenses for Texas A&M AgriLife. Three annual ryegrasses have been used to sod-seed about 4.5 million acres. Farm Gate seed and calf sales from these three ryegrasses have been about $2.3 Billion. Farm Gate legume seed and calf sales plus fertilizer savings from N fixation totaled about $0.5 Billion. Total Economic Impact and Value Added for ryegrass and legume cultivars from Overton has been about $5.5 Billion. With the expected release of new forage germplasm as new varieties, there will be an increased demand by commercial seed companies and stakeholders for these enhanced forages.

Strategic Priority Four: Healthy Living

Pasture-animal experiments and management strategies have resulted in food products from Pasture-Finished and Grass Fed Beef Systems. Some previous experiments that have documented forage production, utilization, and carcass traits for healthy living include carcass

characteristics of calves at weaning and on 3 stocking rates; effects of electrical stimulation and stocking rate on carcasses of calves; forage systems for producing slaughter calves at weaning; and natural beef production with steers stocked on rye and ryegrass. These past experiments will provide the baseline for opportunities to secure extramural funding for the increasing concerns of the public sector for safe, nutritious, and healthful foods.

Biomathematical Modeling of Production Systems

Increasing agricultural productivity sustainably, adapting agroecosystems to climate change, and mitigating climate change are the three intertwined challenges that need to be addressed together for food security and agricultural development. In Texas, the prevalent agroecosystems include cotton-, grain sorghum-, and wheat-based cropping systems; warm-season perennial grasses- and cool-season annual forage-based pasture systems; and beef-based livestock production systems. The production practices used in these systems are primarily conventional: highly productive, but highly resource demanding. The conventional systems have degraded much of our land and accelerated ecological meltdown. Thus, agricultural production systems need to be sustainable. To sustainably increase the productivity of the current agroecosystems, farming methods that can enhance resource-use efficiency and farming approaches that are sustainable, regenerative, and climate-smart must be explored and adopted. Climate change is impacting agriculture through extreme events and unpredictability of weather patterns. To achieve agricultural production security, adaptation to climate change is necessary. To help our agroecosystems adapt to climate change, techniques that can build their resilience to the climate change-related risks have to be identified and applied. Conventional agriculture has been a net producer of greenhouse gas emissions. To switch from current agroecosystems that use conventional production practices to the ones that are more resilient to climate variability and helpful to climate change mitigation, innovative farming approaches and practices that can reduce emissions and enhance soil carbon sink must be discovered and implemented.

Discovering innovative practices, methods, or approaches that can help sustainably increase the productivity of various agroecosystems in Texas and beyond, assist them to adapt to climate change, and contribute to reducing agricultural emissions from and enhancing soil carbon sink in these ecosystems through modeling is one of the goals of the Overton unit. Creating and utilizing novel mathematical models and critical metrics to assess the performance of these ecosystems is a vision of this unit. This specialty will contribute to enhancing the crop and livestock industries associated with these agroecosystems in Texas and beyond by ways of developing and disseminating information and strategies to stakeholders for optimizing the performance of these ecosystems.

Strategic Priority One: Leading-Edge Research and Innovations

Innovations and science-based solutions related to the above-mentioned agricultural systems will be discovered to enhance their productivity and sustainability through computer simulation and modeling. The Overton unit will work with other Texas A&M AgriLife units and various state,

federal, and international collaborators to strengthen its research- and engineering-oriented modeling capabilities in the areas stated above.

Strategic Priority Two: Sustainable Production Systems

Using simulating modeling approach, the translational research necessary for developing and producing high-quality, safe, and sustainable agroecosystems across Texas and beyond will be provided. Through developing collaborative linkages with various relevant state, federal, or international agencies, the Overton unit will develop and disseminate authentic and reliable decision support tools that could be used by stakeholders for improved management of agroecosystems.

Strategic Priority Three: Economic Strength

The efficiency, profitability, and resiliency of agroecosystems in Texas and beyond will be enhanced through modeling studies. Working with relevant state, federal, or international agencies, the Overton unit will conduct modeling studies on the economic effects of changes in farming system, production practice, climate change, price, and other economic and policy variables associated with the above-mentioned agroecosystems.

Strategic Priority Four: Healthy Living

The adoption of scientific evidence at the junction of agriculture, nutrition, and human health will be discovered by way of modeling and disseminated/facilitated by working with relevant extension agencies and stakeholders. Collaborating with relevant agencies, such as the Texas A&M University College of Medicine, the Overton unit will develop a system to predict the effects of various management and environment factors, such as fertilizer application-induced water pollution and climate change, on various disease vectors and human health.

Animal Physiology and Management

Beef cattle are a major contributor to the Texas and the U.S. agricultural economy. In 2019, U.S. per capita retail beef supply represented 30% (over 19 billion pounds of retail product) of total retail meat (USDA, 2022), and the retail value of beef production was $123.3 billion (USDA, 2020). The Beef industry makes up roughly 22-24% of the total meat produced worldwide, and with it being estimated that the world's population will exceed 9 billion by 2050; food production must more than double to meet the growing world demand. The greatest benefit for the beef industry is its ability to convert low quality forage (which is not usable for human food) into a high-quality food source for humans. However, as the world population increases, resources available for beef production become even more limited. Therefore, the efficiency of beef production must increase to meet the rising demand. It has been estimated that a 5% increase in the number of cows that conceive in the first 21 days of the breeding season would

increase the pounds of beef weaned by 1,550 pounds per every 100 cows. Thus, to enhance the sustainability of cattle production, further efforts to understand reproductive efficiency are essential. *Therefore, the long-term goal of the Animal Physiology and Management research at the Overton Center is to discover, develop and disseminate management practices that improve reproductive efficiency of cattle in Texas and around the world.*
Research and outreach activities in this project area will address the Strategic Priorities as indicated.

Strategic Priority One: Leading-Edge Research and Innovations

New innovations, technologies, and science-based solutions associated with increasing the efficiency of beef cattle production will be studied and developed. The focus will be on development of new methods for identifying and evaluating factors influencing sperm survival and fertilization. As new information is gleaned from this research, improved technologies to store semen and increase conception rates through AI may be developed. Furthermore, pregnancy loss after a single service is 40 to 50% for beef cows and heifers through day 30 of gestation. This is the single greatest economic loss for beef cows. Development of new methods for evaluating what factors may influence embryo survival will greatly impact the beef industry. These potential findings could be a game changer for the beef industry.

Strategic Priority Two: Sustainable Production Systems

Data collected on over 10,000 cows/heifers synchronized with recommended fixed time AI protocols identified a 27% improvement in conception rates among animals with elevated concentrations of estradiol. Those results mean estradiol prompted the opportunity for an extra 27 calves out of every 100 cows. Combining increased control of follicular development with improved conception rates will result in the development of management strategies that improve the percentage of cows that conceive in the first 21 days of the breeding season, thus increasing the sustainability of beef cattle operations.

Strategic Priority Three: Economic Strength

If pregnancy maintenance targeted by this research can be increased by just 10%, beef production would be increased by ~3,100 pounds per 100 cows (31 lbs/cow). This would increase the number of pregnant beef cows in Texas by 0.39 million head (3.9 million x 0.10 = 0.39 million) and translate into an economic impact of roughly $181 million in Texas (31 lbs/cow x 3.9 million cows = 120,900,000 lbs x $1.50/lb = $181,350,000 million).

Strategic Priority Four: Healthy Living

In both cattle and humans, stress can have harmful consequences on reproductive success, not only for the current pregnancy but possibly for subsequent generations. Collaborative research between Texas A&M AgriLife Overton, Texas A&M Department of Animal Science, and the University of Wisconsin has been investigating the role of a mild stress during pregnancy on embryo development and transgenerational impacts. Understanding how stressful events during

pregnancy may not only impact the current pregnancy but may impact pregnancy success for years/generations to come will impact not only the beef industry but also human health.

RESEARCH TEAMS

The six areas of research and outreach will operate as directed by the respective research leaders. They will train graduate students and publish research findings in order to build national and international reputations.

In many cases, feasible solutions to production problems require multidisciplinary teams that address the issues in a systems context. The Overton Research Program has a history of developing and supporting teams of faculty members and graduate students from Overton and from other units in AgriLife and beyond. This approach has been very effective and rewarding and will continue to be encouraged and supported. Overton research faculty members will continue to collaborate as appropriate in these teams.

GOALS AND MILESTONES

Metrics that reflect success and productivity of research and outreach activities include refereed journal articles, conference presentations and abstracts, technical reports, field days, graduate degrees earned, external funding secured and other measures depending on the subject matter area addressed. Major breakthroughs in technology are less frequent and difficult to predict.

Goals

The goals in collective metrics for faculty and graduate students working at Overton are as follows:

- Publish 30 refereed journal articles each year, four or more per faculty member.
- Present 40 papers with abstracts at scientific conferences each year.
- Earn, on average, 2 graduate degrees per year.
- Publish 15 technical reports and/or popular press articles each year.
- Participate in 10 workshops and/or field days each year.
- Release, on average, at least 1 variety or cultivar per year.

- Secure, as a unit, $2,000,000 in external funding per year with each faculty member a partner on five or more significant proposals.
- Increase research faculty number to 9 in the next five years in the areas of horticulture and forage-based livestock systems.
- Secure significant endowments to support future research and outreach activities.

Milestones

The milestones that will be sought by faculty and staff at Overton are as follows:

- Develop a digital tool for soil health assessment, to predict soil health properties, soil carbon sequestration potential and subsequently for identifying effective climate-smart management practices in forage and grazing lands, range lands and cropping systems.
- Facilitate and implement adoption of soil health management practices for enhancing climate smart agriculture by regional stakeholders.
- Develop and release a ryegrass cultivar that will produce with low soil ph.
- Develop and release a new annual sweet clover cultivar with low coumarin; high seed and forage yield; and multi-stemmed crowns.
- Develop and release a series of new multi-use cultivars of cowpea adapted to specific Texas ecoregions; traits to include are high seed and biomass yield, drought tolerance and pest resistance.
- Develop and release a new forage winter pea cultivar with resistance to powdery mildew.
- Document impact of long-term grazing on soil nutrient status, soil health parameters, and forage stand maintenance.
- Develop stocking and management strategies for using cover crops for soil benefit and grazing opportunities.
- Develop and implement a system where an animal growth model and multiple forage crop models in the DSSAT system could run simultaneously to optimize the average daily gain (ADG) of beef cattle throughout the grazing season.
- Develop and apply an effective plant-animal interface model to manage and evaluate alternative production system decisions.

- Develop a decision support system on grazing-based beef cattle production to be used by stakeholders in Texas.
- Develop and disseminate technology to increase calf crop weaning percentage by 10% of cows exposed.
- Develop and disseminate technology to increase pregnancy percentage to artificial insemination by 10 percentage points.

RESOURCES TO REACH EXCELLENCE

Headquarters Facilities

Headquarters buildings of the Overton Center are on 26 acres donated to the Agency in 1966 and located on FM 3053 at the north city limits of Overton. The 28,000 square foot **Moore-McMillan Headquarters Building** contains offices, laboratories, meeting rooms and the Bruce McMillan, Jr. Auditorium which seats 275 and was added in 1979 when the original building was expanded. There are 2 updated laboratories in this building that support the soils and the physiology projects, respectively. *Needs include renovation of the entire building floors, walls, windows, doors, etc. and upgrading of laboratory space and equipment.*

The Parking Lot and Equipment Yard

These facilities provide space, respectively, for employee and visitor vehicles and for Center vehicles, tractors and equipment. *Renovation of these parking areas and associated spaces is needed.*

The new Shop Building

This building houses a modestly equipped shop as well as a sample grinding room with adjacent sample and supply storage areas with lockers and freezers. *Needs include up to date shop equipment.*

The Tractor Shed

The shed provides space for tractors and equipment and covered workspace for certain tasks as well as a wash rack with power washer.

The Chemical Storage Building

This building contains lockers for secure storage of chemicals for individual projects and users. *Needs include removal and renovation of evaporation bed areas.*

A Headhouse and 7 Greenhouses

Provide space for research activities requiring controlled temperature environments. *Needs include renovation of the headhouse and cool rooms and deferred maintenance on headhouse and greenhouses.*

Vehicles and Equipment

A number of highway and farm use vehicles, several tractors, a variety of farm equipment and related items are available for all research and support activities. *Needs include replacement and/or upgrades of all vehicles and equipment.*

Research Farms

Three research farms are available for research and outreach activities:

North Farm

Located four miles north of Headquarters is this **six-hundred-acre farm** consisting of pastures, hay meadows and plot ground. Facilities include a **Reproduction Field Laboratory**, a **Horticulture Field Laboratory**, a **Tractor Shed**, complete **Cattle Working Facilities and Pens** and two **Water Wells**. *Needs include deferred maintenance of structures and replacement of old fences.*

South Farm

Located immediately north of Headquarters is this **six-hundred-acre farm** consisting of pastures, hay meadows and plot ground. Facilities include a **Feed Mill and Pens**, complete **Cattle Working Facilities and Pens**, and a **Water Well**. *Needs include deferred maintenance of structures and replacement of old fences.*

East Farm

Located three miles east of Headquarters is this **four-hundred-fifty-acre farm** consisting of pastures, hay meadows and plot ground. Facilities include an **Education Building**, a **Bunkhouse** for visiting students, a manager's **Residence**, complete **Cattle Working Facilities and Pens**, a **Water Well w**ith irrigation capabilities, a modestly equipped **Shop,** a **Barn,** and several **Sheds**

for storage of equipment. *Needs include deferred maintenance of structures, replacement of old fences and upgrades of shop equipment.*

Livestock

Two research herds of cattle are maintained on Overton Center farms and a third is being developed. These herds support research in physiology, grazing management and related projects.

Registered Brahman Cattle

This herd consists of 200 cows along with bulls, replacement heifers and calves.

F1 Hereford-Brahman Cattle

This herd consists of 110 young cows along with Angus and Simmental bulls, calves and crossbred stockers.

Simmental Cattle

This herd is very small at this time but planned to number about 50 head of cows. The purpose of this herd is to add *Bos taurus* cattle and crosses into our physiology research project to expand applicability of results and enhance attractiveness to funding entities.

APPENDIX: TEXAS AGRICULTURE, NATURAL RESOURCES, THE FUTURE

Agriculture

By 2050, the U.S. and world population are expected to increase by 30%, and global real incomes per capita are expected to double. Population and income growth translate into higher demand for both staple products and high-valued foods, such as more animal and plant proteins, fruits, and vegetables. Higher real incomes also mean a growing demand for livestock and feed for livestock. As a result, agricultural productivity has increased dramatically over the years. Today's farmers produce 262% more food with 2% fewer inputs than in 1950. A major component of this increase in agricultural productivity is due to investments in public agricultural research with a benefit-cost ratio of 32, which means that every dollar spent on public agricultural research and extension returns 32 dollars to society. Therefore, large benefits exist for investments in U.S. public agricultural research.

Rapid agricultural productivity increases, relative to gains in other food sectors of the U.S. economy, have translated into falling real prices of food consumed at home. For example, in 1948-2018, the share of U.S. household income spent on food at home declined from 22.3% to 6.4%, while total food consumption increased. With Americans spending 6.4% of their income on food, the other 93.6% is available for spending on a wide range of other goods and services, including recreation, housing, transportation, education, and health care. Therefore, the long-term rise of civilization and living standards worldwide largely tells a story about increasing agricultural productivity. The U.S. is the largest exporter of agricultural products. Since 95% of the world's population lives outside the U.S., the possibilities and opportunities to continue feeding the world are endless.

Agriculture has long been a mainstay of the Texas economy, and the success of Texas agriculture has paved the way for the development of new industries and sustained the diversification of our economy.

The food and fiber systems' contribution to the Texas gross domestic product (GDP) was valued at $145.8 billion in 2017. This represented 9.1% of the state's total economic activity. The top ten commodities in market value are cattle, cotton, milk, broilers, greenhouse, sorghum, wheat, fruits, vegetables, and eggs (Figure 3).

Additionally, agriculture-related activities such as hunting, fishing, and recreation, among others, are worth over $2 billion.

Cattle	$12.3 billion
Broilers	$2.9 billion
Cotton	$2.6 billion
Milk	$2.1 billion
Corn	$1.1 billion
Greenhouse	$840 million
Fruits and Vegetables	$629 million
Eggs	$500 million
Sorghum	$490 million
Wheat	$276 million

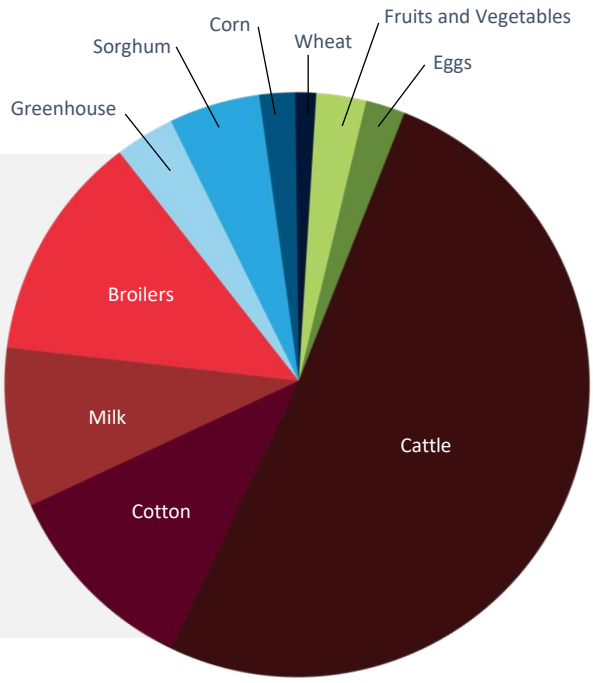


Figure 3. Texas top 10 commodities in terms of market value

Texas is the top state in the nation for producing crude oil, natural gas, and wind-based energy, which provide significant competitive advantages. In 2020, Texas accounted for 43% of the nation's crude oil production and 26% of its marketed natural gas production. Texas also has abundant renewable energy resources. It is first in the nation in wind-generated electricity and a leader in biomass-based renewable energy. With many sunny days across vast distances, Texas is also a leader in solar energy potential. Ranking second in the nation in both population and economy, Texas consumes a large share of the nation's energy. Therefore, as U.S. and world economies grow, two main variables sustain such growth — energy and food — and Texas is a key player in both. Integrating and taking advantage of the synergies of both industries will contribute greatly to the continued growth of the Texas and U.S. economies.

Natural Resources

Texas's natural resources are expansive, with nearly 172 million acres of landmass. The state is home to more than 142 mammal species as well as 615 bird species, of which half are migratory.

Freshwater lakes, ponds, and reservoirs cover about 1.2 million Texas acres. This includes nearly 185,000 miles of river, more than 350 miles of coast along the Gulf of Mexico, and 1,254 miles along the Rio Grande bordering Mexico. Texas waters house more than 250 freshwater fish species and 1,500 saltwater species.

Within this natural ecosystem, 141 million acres — more than 80% of the state's total acreage — consist of privately owned working lands and more than 60,000 working landowners. Texas working lands are privately owned farms, ranches, and forests producing agricultural products. This includes 25.8 million acres of cropland, 105.8 million acres of grazingland, 8 million acres of timber, 5.3 million acres of wildlife management, and more than 780,000 acres of other working lands.

At the same time, from 1997 to 2017, Texas lost approximately 2.2 million acres of working lands converted for nonagricultural uses. Of those acres, 1.2 million were converted in the last five years.

The Future

Texas is becoming an urban state and is home to four of the top 10 most populous cities in the country (Houston, San Antonio, Dallas, and Austin) and 69 of the top 780 cities. The Census Bureau estimates that Texas has three of the ten fastest-growing counties in the country (Hays, Comal and Kendall) and almost a quarter of the top 100 fastest-growing counties. Although Texas has a large rural population, almost 4.5 million, it only accounts for about 15% of the total, which means that around 25 million people live in urban areas.

The COVID-19 global pandemic pushed the world several years prematurely into cyberspace and wreaked havoc on the global food supply chain, causing tremendous decreases in food security. Texas was no exception. COVID-19 exposed Texans' poor health status regarding obesity, hypertension, diabetes, heart diseases, and other chronic diseases related to diet and nutrition. COVID-19 also revealed the need to examine food production and distribution systems, uncovering the need for a more

agile food supply system that provides nutritious, affordable, and accessible food to consumers while financially supporting our farmers, ranchers, and agricultural workers, even when there are multifactored disruptions at one time throughout the supply chain.

We are keenly aware that hunger, specifically undernutrition, is one of our most important global issues. Both a cause and a symptom of poverty, it can ultimately lead to conflict, mass migrations, and the rise of terrorism, all of which can impact Texans. We believe that we can help alleviate human suffering associated with hunger and poverty through agricultural science and, in that way, help prevent these outcomes while building a better world for present and future generations. With proper investment today, AgriLife Research will set the foundations of the infrastructure necessary to ensure food security for future generations.

Over-nourishment presents a double-burden paradox that affects nutrition and increases the risk of chronic diseases. Texas agriculture and AgriLife Research are uniquely positioned to partner to improve public nutrition and health by providing a healthier, more nutritious, and abundant food supply.

As Texas agriculture grows, it has a positive multiplier effect throughout the economy. For every dollar of agricultural production in Texas, another $2.19 is generated by other industries in the state to support this additional output. The interconnected nature of Texas agriculture to other sectors of the economy — and the everchanging relationships across these sectors — make it imperative that AgriLife Research is positioned to anticipate and respond to critical needs and emerging challenges.

AgriLife Research's roots are firmly embedded in production agriculture and natural resources. We seek to expand the agency's focus to apply the power of fundamental life sciences to solve real-world issues. Discoveries in genetics, crop and animal management systems, and links between poor human nutrition and chronic diseases are accelerating our impacts on sustainable food and fiber supply chains. Our approach integrates basic and applied research to create, as stated in our vision, "healthy lives and livelihoods improved through abundant, affordable, and high-quality food and agricultural products in Texas and the world."