STRATEGIC PLAN

Texas A&M AgriLife Research and Extension Center at Amarillo/Canyon

TEXAS A&M AGRILIFE RESEARCH

CONTENTS

STRATEGIC PLAN, TEXAS A&M AGRILIFE RESEARCH AND EXTENSION CENTER AT AMARILLO/CANYON

Vision

First among equals in research impact, employee satisfaction, and administrative effectiveness among the agency's 13 off-campus research centers.

Mission

Texas A&M AgriLife Research-Amarillo fosters profitable agricultural enterprises, thriving communities, and healthy ecosystems in the Texas Panhandle and beyond through discovery and application in agricultural sciences and engineering.

Signature Programs and Regional Context

The identity of the Texas A&M AgriLife Research Center at Amarillo centers on two commodity-specific signature programs (beef and wheat) and two cross-cutting signature programs (cropping systems and environmental quality/natural resources). As of 06 Mar 2023, our Center is within two miles of the main offices of the Texas Cattle Feeders Association (TCFA) and the Texas Wheat Producers Board (TWPB; a. k. a., "Texas Wheat"), both of which provide vital political and financial support for our research programs. Our researchers also work closely with groundwater conservation districts and the Region A Water Planning Group.

As befits a research center located in the "Cattle Feeding Capital of the World," our beef programs center on ruminant nutrition and respiratory health for cattle fed in confinement and include those aspects of cattle production upstream of the feedyard (i. e., cow/calf and stocker operations) that affect cattle-feeding profitability. With the increased integration of dairy steers into the beef supply chain and the growth of the milk and cheese industries in the region, our livestock program increasingly attends to the dairy industry's needs for (a) alternative forages and silages and (b) quantification and modulation of sustainability outcomes. Much of our environmental-quality research (see below) pertains directly to the sustainability of the beef and dairy industries in the southern High Plains.

Our small grains improvement program, which is one of such two Centers of Excellence within Texas A&M AgriLife, has statewide reach and features both wheat genetics and traditional wheat breeding. Inasmuch as more than 50% of the acres planted to wheat in Texas may be used primarily for cattle grazing, our wheat-improvement program seeks advances in the yield and quality of grain *and* forage.

Our cross-cutting research in cropping systems for semi-arid climates includes high-profile programs in agronomy, entomology, plant physiology, plant pathology, and irrigation engineering. With the accelerating decline in ground water availability from the Ogallala Aquifer, our research portfolio features increased emphasis on crops that can be reliably grown under limited-irrigation and/or rain-fed conditions: sorghum, cotton, and winter small grains. We also evaluate the region's potential for high-value specialty crops, especially where limited irrigation water can be focused on smaller acreages while preserving or increasing farm profitability.

Our environmental quality and natural resources research features primarily the agricultural engineering disciplines in irrigation water management, agricultural air quality, and manure and mortality management for the beef and dairy industries. We also evaluate cropping systems for their contributions to the carbon, water, and ecological footprints of regionally adapted agricultural systems.

Our primary institutional partners and collaborators include the Texas A&M AgriLife Research Centers at Lubbock, Vernon, and Stephenville, TX; Texas A&M AgriLife Extension Service at Amarillo, Lubbock, and Vernon; Texas A&M University's College of Agriculture and Life Sciences; USDA-Agricultural Research Service at Bushland, TX; West Texas A&M University in Canyon, TX; and Texas Tech University in Lubbock, TX.

Research Domains and Faculty (9.75 FTE)

Ruminant Nutrition and Health (RNH)

- Dr. Vinicius Gouvea, Assistant Professor of Ruminant Nutrition (1.0 FTE)
- [vacant], Assistant Professor of Ruminant Animal Health (0.45 FTE)[1]

Small Grains Improvement (SGI)

- Dr. Jackie Rudd, Professor of Wheat Breeding (1.0 FTE)
- Dr. Shuyu Liu, Professor of Wheat Genetics (1.0 FTE)

Cropping Systems for Semi-Arid Climates (CRS)

[1] On 07 Jun 2022, Director Dr. G. Cliff Lamb approved by email a joint request with CVMBS-VTPB to refill this position as a minority (0.45 FTE) AgriLife Research appointment upon the resignation of Dr. Sarah Capik, which was effective on 18 Oct 2022.

- Dr. Jourdan Bell, Associate Professor of Agronomy (0.3 FTE)
- Dr. Craig Bednarz, Associate Professor of Agronomy (0.5 FTE)
- Dr. Qingwu Xue, Associate Professor of Plant Physiology (1.0 FTE)
- Dr. Kiran Gadhave, Assistant Professor of Field Crop Entomology (1.0 FTE)
- [vacant], Assistant Professor of Plant Pathology and Microbiology (1.0 FTE)[2]

Environmental Quality and Natural Resources (EQNR)

- Mr. Thomas Marek, Senior Research Engineer/Irrigation Water Management (1.0 FTE)
- Dr. Ken Casey, Associate Professor of Air Quality Engineering (1.0 FTE)
- Dr. Brent Auvermann, Professor and Center Director (0.5 FTE)[3]
- [vacant], Assistant Professor of Waste Management Engineering (0.0 FTE)[4]

Allied Extension Specialists (6.6 FTE)

Our research programs overlap to a significant degree with Extension's District 1 (DS01) specialists within Extension's Agriculture and Natural Resources (ANR) programming area, including ruminant livestock (beef and dairy), crop stress, engineering, and agronomy. The following Extension specialists in DS01 routinely collaborate with our research faculty:

- Dr. Jourdan Bell, Extension Agronomist (0.7 FTE)
- Dr. Jason Smith, Extension Beef Cattle Specialist (1.0 FTE)
- Dr. Juan Piñeiro, Extension Dairy Specialist (1.0 FTE)
- Dr. Justin Benavidez, Extension Agricultural Economist (1.0 FTE)
- Dr. Ken Obasa, Extension Plant Pathologist (1.0 FTE)
- Dr. David Parker, Extension Irrigation Engineer (0.5 FTE)
- Dr. Tim Steffens, Extension Rangeland Specialist (0.4 FTE)
- Dr. José Gonzalez, Extension Entomologist (1.0 FTE)[5]

[2] On 01 Apr 2022, Dr. Charlie Rush retired from this position. On 07 Jun 2022, Director Lamb approved by email a joint request with PLPM to refill this position at 1.0 FTE research. As of 06 Mar 2023, we have concluded the interview process and expect to extend an offer during the first two weeks of March.

[3] In his role as Professor and Center Director, Dr. Auvermann is expected to maintain an active research program at about 0.5 FTE, with 0.5 FTE allocated to Center administration and agency service. He is academically affiliated with the Department of Biological and Agricultural Engineering (BAEN).

[4] On 01 Feb 2017, Dr. Auvermann vacated this position (0.35 FTE research, 0.65 FTE Extension) upon his appointment as Center Director. To date, no request has been submitted to refill the position, but the position remains badly needed.

[5] Dr. Gonzalez' appointment was effective early Jan 2023.

Assumptions

1. Research faculty and their technical support staff are the primary sources of our Unit's value to the taxpayers of the State of Texas and to our agency.
2. Unit administration exists to:
   - facilitate the productivity, advancement, and satisfaction of faculty and staff;
   - invest wisely and strategically in Unit infrastructure and capacity;
   - harden the Unit against contingencies and process failures;
   - optimize administrative processes with respect to risk and efficiency;
   - coordinate the use and optimization of shared and adjacent resources with agency and institutional partners (Extension, USDA-ARS, WTAMU, TAMU);
   - represent effectively the Unit's accomplishments, priorities, interests, and needs to agency leadership and external stakeholders;
   - manage resources cost-effectively; and
   - model and foster accountability throughout the Unit.

SCIENTIFIC/PROGRAMMATIC PRIORITIES

On 09 Sep 2022, Dr. Cliff Lamb, Director of Texas A&M AgriLife Research, released the new Strategic Plan for the agency, establishing four statewide priorities:

P1. Leading-edge research and innovations
P2. Sustainable production systems
P3. Economic strength
P4. Healthy living

The applied-research portfolio of Texas A&M AgriLife Research – Amarillo emphasizes practical solutions to challenges faced by large-scale production agriculture characteristic of the southern High Plains, the sustainability of which must attend to our harsh, windy, semi-arid climate and the declining availability of ground and surface water. Consequently, our unit's Strategic Plan aligns most closely with Agency priority P2 but overlaps to a significant degree with agency priority P3.

Ruminant Nutrition and Health (RNH)

Goal 1.0: Evaluate and optimize beef and dairy feedstuffs for profitability (P3)

Objective 1.0.1: Update feeding values of modern varieties of grains, forages, adjuncts, and silages

Objective 1.0.2: Evaluate carcass and meat quality associated with feeding strategies and tactics
Objective:1.0.3: Evaluate feeding strategies and tactics for their environmental-quality outcomes
Objective 1.0.4: Evaluate value-added processing approaches for grains, forages, and silages
Objective 1.0.5: Growth and efficiency
Objective 1.0.6: Optimize diet-formulation criteria with respect to external influences on feedstock availability
Objective 1.0.7: Understand whole-system implications of feeding strategies and tactics

Goal 1.1: Evaluate innovative feeding technologies and management strategies (P2)

Objective 1.1.1: Evaluate new feeding technologies for feed-to-product (gain, milk) efficiency
Objective 1.1.2: Evaluate innovations in feeding management (timing, frequency, limit vs. *ad libitum*) with respect to efficiency, yield, and labor requirements

Goal 1.2: Promote ruminant animal health in confined and extensive production contexts (P2)

Objective 1.2.1: Understand and modulate immune-response mechanisms
Objective 1.2.2: Understand and mitigate stressors and pathogens
Objective 1.2.3: Optimize preconditioning and preventative health-management practices
Objective 1.2.4: Devise and demonstrate speed and accuracy of new diagnostics
Objective 1.2.5: Devise and evaluate efficacy of therapeutic interventions

Goal 1.3: Adapt advanced sensing technologies, big data, and artificial intelligence (P2)

Objective 1.3.1: Characterize animal physiology and estimate growth rates via remote sensing
Objective 1.3.2: Associate livestock behavior with health status via digital video
Objective 1.3.3: Evaluate greenhouse-gas and dust emissions potential of cattle feedyards
Objective 1.3.4: Incorporate artificial intelligence and machine learning into data analysis

Small Grains Breeding and Genetics (SGI)

Goal 2.0: Develop, license, and document superior plant materials (P2)

Objective 2.0.1: Develop superior cultivars with excellent intrinsic grain and forage qualities
Objective 2.0.2: Develop varieties and germplasm adapted for grain, forage, and silage
Objective 2.0.3: Optimize participation in regional, national, and international nurseries and variety trials
Objective 2.0.4: Refine criteria for regional and interstate evaluation of agency-owned germplasm

Goal 2.1: Meet end-use requirements for social, economic, and environmental outcomes (P2)

Objective 2.1.1: Evaluate grain- and forage-quality parameters for varieties in the breeding program
Objective 2.1.2: Elucidate the genetic and molecular basis of high end-use quality in germplasm
Objective 2.1.3: Incorporate newly defined quality attributes into breeding and genetics targets

Goal 2.2: Integrate conventional and biotechnological research and development (P1)

Objective 2.2.1: Improve our understanding of the molecular genetics of wheat, triticale, and rye
Objective 2.2.2: Incorporate molecular genetic traits into adapted germplasm for production and quality outcomes
Objective 2.2.3: Accelerate the release of new, high-potential varieties through advanced technology
Objective 2.2.4: Integrate field-based research and development with on-campus laboratories dedicated to genomics, gene editing, and tissue culture

Goal 2.3: Leverage remote-sensing, sensor, and data-analytics technologies (P1)

Objective 2.3.1: Incorporate midseason remote-sensing data into variety-selection decisionmaking
Objective 2.3.2: Support the use of UAS-based remote-sensing data by crop consultants to optimize agronomic practices

Cropping Systems for Semi-Arid Climates (CRS)

Goal 3.0: Advance the water-use efficiency of irrigated crops in the southern High Plains (P2)

Objective 3.0.1: Enhance use of scarce rainfall
Objective 3.0.2: Estimate the maximum achievable specific yields (yield/ac-in) for field crops
Objective 3.0.3: Update the water-use production functions for regionally relevant crops
Objective 3.0.4: Devise and evaluate advanced irrigation technologies
Objective 3.0.5: Devise and evaluate strategies to mitigate drought, extreme heat, and other abiotic stresses

Goal 3.1: Advance the sustainability of dryland/rain-fed crops in the southern High Plains (P2)

Objective 3.1.1: Optimize agronomic management systems for rain-fed row crops
Objective 3.1.2: Evaluate regionally adapted production systems for alternative and niche crops

Goal 3.2: Evaluate strategies to improve soil health under agricultural production (P2)

Objective 3.2.1: Devise methods to accelerate carbon sequestration in regional soils
Objective 3.2.2: Characterize the soil microbiome by soil type and cropping system
Objective 3.2.3: Quantify greenhouse-gas emissions associated with agronomic practices
Objective 3.2.4: Evaluate irrigation water requirements to achieve soil-health metrics

Goal 3.3: Identify, diagnose, and mitigate biotic stresses in High Plains cropping systems (P2)

Objective 3.3.1: Identify and characterize insect stressors, and devise management practices to mitigate them economically
Objective 3.3.2: Identify and characterize crop pathogens, and devise management practices to mitigate them economically
Objective 3.3.3: Characterize insect-vectored plant diseases, and optimize agronomic practices to mitigate them economically

Goal 3.4: Advance the profitability of forage crops for regional beef and dairy production (P3)

Objective 3.4.1: Optimize management of irrigated winter pasture for stocker cattle
Objective 3.4.2: Quantify water footprints of forage sorghums and silages
Objective 3.4.3: Evaluate perennial forages as alternatives to annuals for beef and dairy cattle
Objective 3.4.4: Describe economic and policy factors influencing grain- and forage-production costs

Goal 3.5: Expand the applicability and productivity of controlled-environment agriculture (P2)

Objective 3.5.1: Refine management of regionally adapted horticultural crops in high tunnels
Objective 3.5.2: Devise broader systems frameworks for economically sustainable production of feed crops (cereals and forages) in controlled environments
Objective 3.5.3: Devise and demonstrate pest-management strategies for controlled-environment production
Objective 3.5.4: Optimize water consumption and recycling techniques for greenhouses and high tunnels
Objective 3.5.5: Devise profitable uses for/management of high tunnels during midsummer
Objective 3.5.6: Identify engineering solutions to management problems characteristic of the southern High Plains

Environment and Natural Resources (ENR)

Goal 4.0: Understand, quantify, and mitigate air emissions from beef and dairy production (P2)

Objective 4.0.1: Understand and reduce environmental risk associated with fugitive bioaerosols
Objective 4.0.2: Evaluate strategies to reduce NH_3 emissions and ecological effects of NH_3 deposition
Objective 4.0.3: Quantify enteric CH_4 emissions from beef and dairy cattle on range and pasture
Objective 4.0.4: CH_4 and N_2O emissions from dairy manure land application
Tactic: Measure gaseous emissions from forage sorghum fertilized with dairy manure products

Goal 4.1: Understand the ecological footprints of southern High Plains production agriculture (P2)

Objective 4.1.1: Quantify eco-footprint components of regional cropping systems
Objective 4.1.2: Quantify eco-footprint components of regional livestock production

Goal 4.2: Optimize unit processes for manure treatment (P2)

Objective 4.2.1: Characterize energy yield vs. manure composition and AFO[6]-management tactics
Objective 4.2.2: Understand the ecological effects of biorefinery by-products
Objective 4.2.3: Understand market factors that modulate manure flows to biorefineries
Objective 4.2.4: Optimize blended manure streams from beef and dairy AFOs for biofuel feedstocks

[6] "AFO" refers to an "animal-feeding operation," which feeds any number of animals in unvegetated confinement (as distinct from pasture-based production systems). A sub-category, the "concentrated animal-feeding operation" (CAFO), is a regulatory category that includes cattle feedyards and dairies capable of feeding >1,000 animal units at one time in unvegetated confinement. In approximate terms, 1,000 animal units are equivalent to 1,000 beef steers or 700 lactating cows.

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

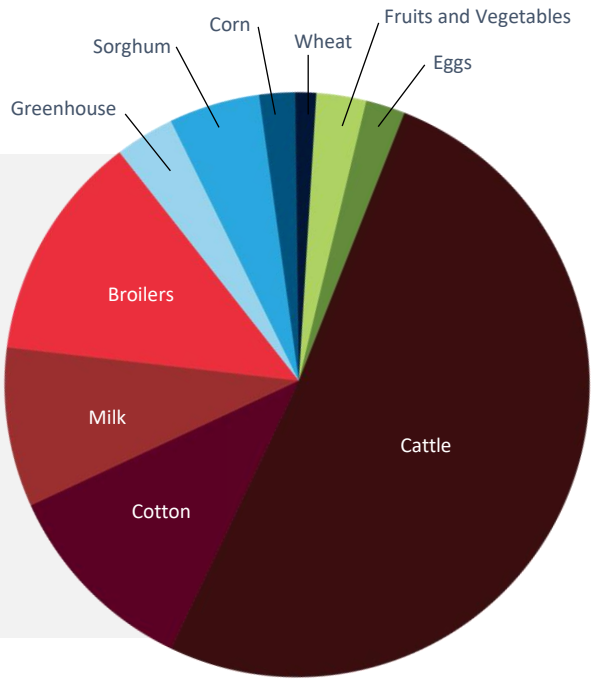

Figure 3. Texas top 10 commodities in terms of market value

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."