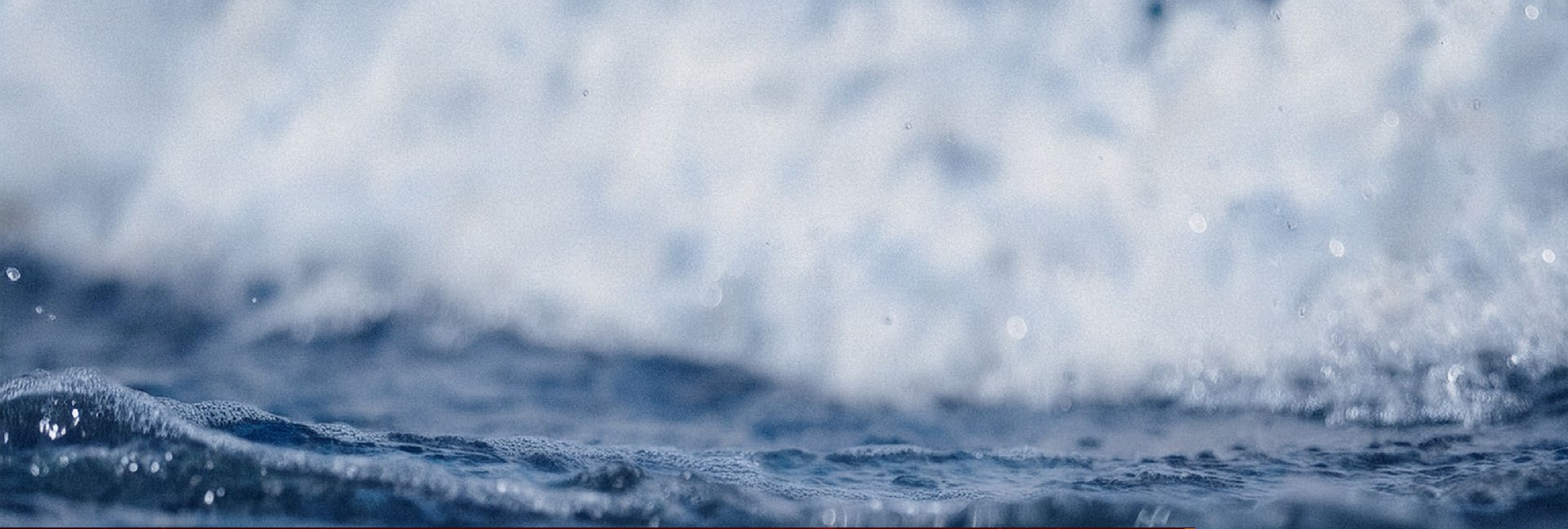


Texas A&M AgriLife Water Symposium

August 12-14, 2025

Texas A&M AgriLife Research and Extension Center- Dallas, TX

SPONSORS

This work was funded, in part, by the W.G. Mills Memorial Endowment administered through the Texas Water Resources Institute, a unit of Texas A&M AgriLife Research, which is part of the Texas A&M University System. Additional funding was provided by Texas A&M AgriLife Research and the Texas Water Resources Institute.

Texas A&M AgriLife Research

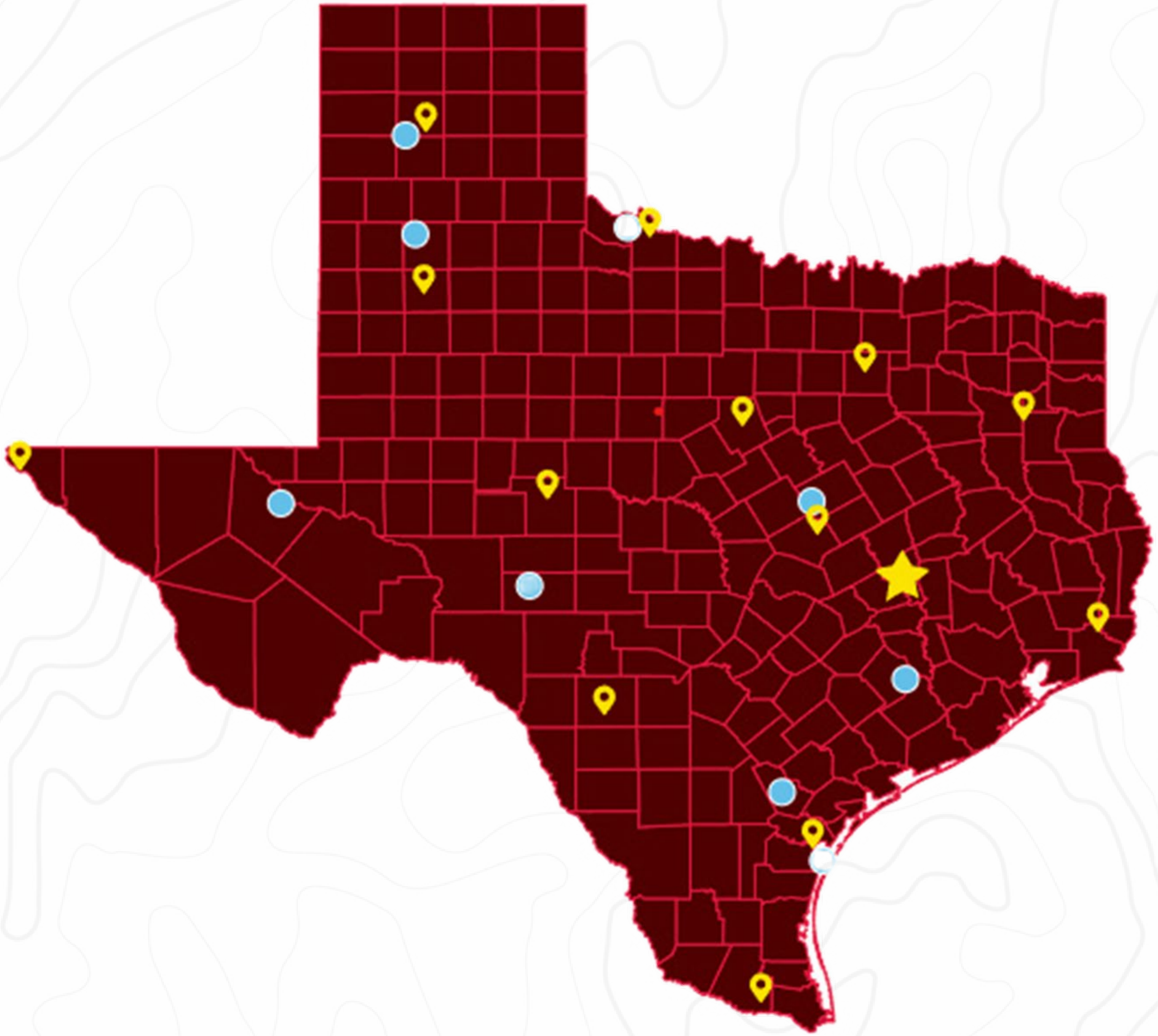
Texas Water Resources Institute

make every drop count

OBJECTIVE

To bring together faculty and staff working in water-related research, as well as industry stakeholders and leaders, to foster collaborations and address critical research needs within the Texas A&M system and the state.

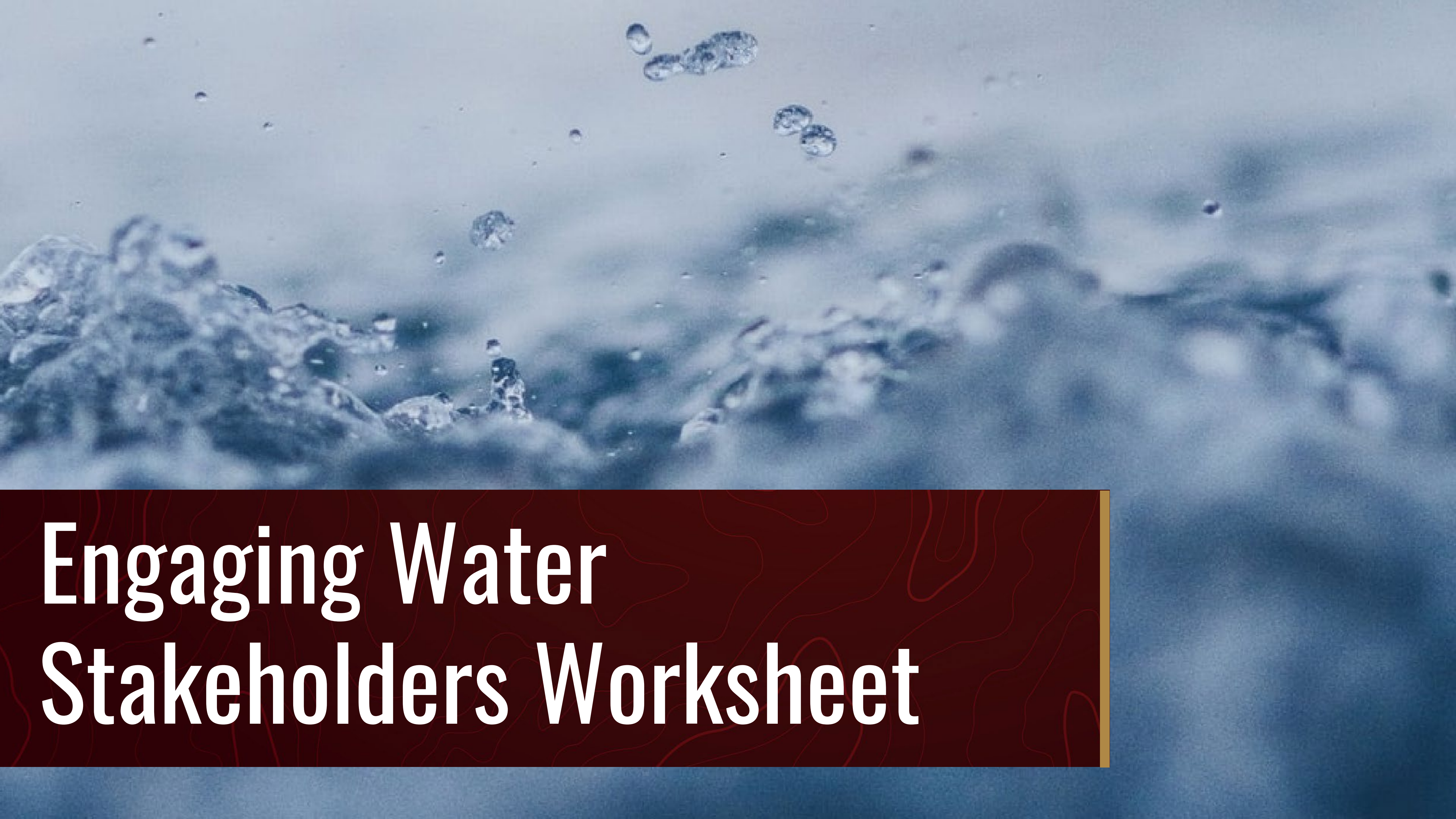
TEXAS A&M AGRILIFE



BRIEF INTRODUCTIONS

1. Your **name**
2. Your primary **affiliation & location**
3. Your area of **research/specialty**

"Hello! My name is Katie Lewis with Texas A&M AgriLife Research in Lubbock. I focus on soil fertility and soil water conservation."



Engaging Water Stakeholders Worksheet

WHO ARE YOU?

What organization do you represent? (i.e., Texas A&M AgriLife Research, Texas Water Foundation, etc.)

WHO ARE YOU?

What is your relationship with Texas water? (i.e., agricultural producer, water researcher, etc.)

WHO ARE YOU?

Approximately how many years have you been working on Texas water issues?

WHO ARE YOU?

What is your interest in Texas water? (i.e., maintaining agricultural production, water policy, securing municipal water supplies, etc.)

REFLECTION

What is the biggest challenge or issue facing water in Texas?

REFLECTION

What are some things people should be doing to address/solve this challenge or issue?

REFLECTION

What practices should people implement to address/solve this challenge or issue?

REFLECTION

Who are some people or organizations that can help to address/solve this challenge or issue?

LOOKING FORWARD

What are some priority research and/or programming activities that you would like the Texas A&M University System to address **next year**?

LOOKING FORWARD

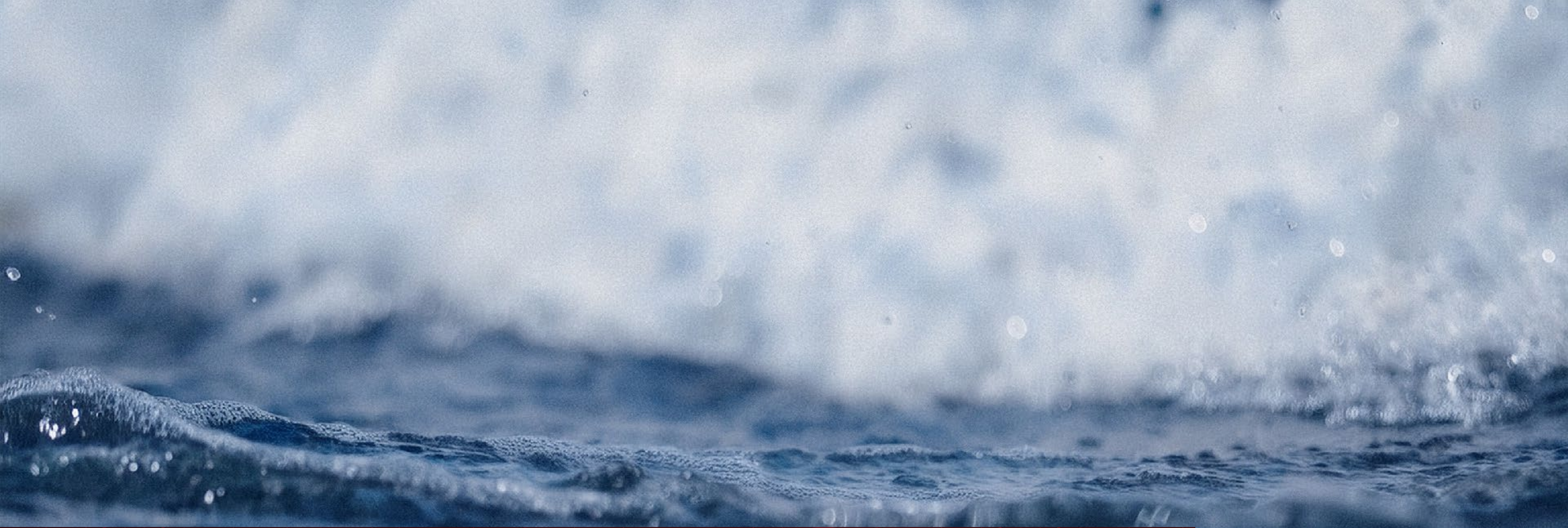
What are some priority research and/or programming activities that you would like the Texas A&M University System to address in the **next five years**?

LOOKING FORWARD

What are some priority research and/or programming activities that you would like the Texas A&M University System to address in the **next 10-15 years**?

LOOKING FORWARD

Assuming money was not a limiting factor, what is something that could improve the future of Texas water?



Texas A&M AgriLife Water Symposium

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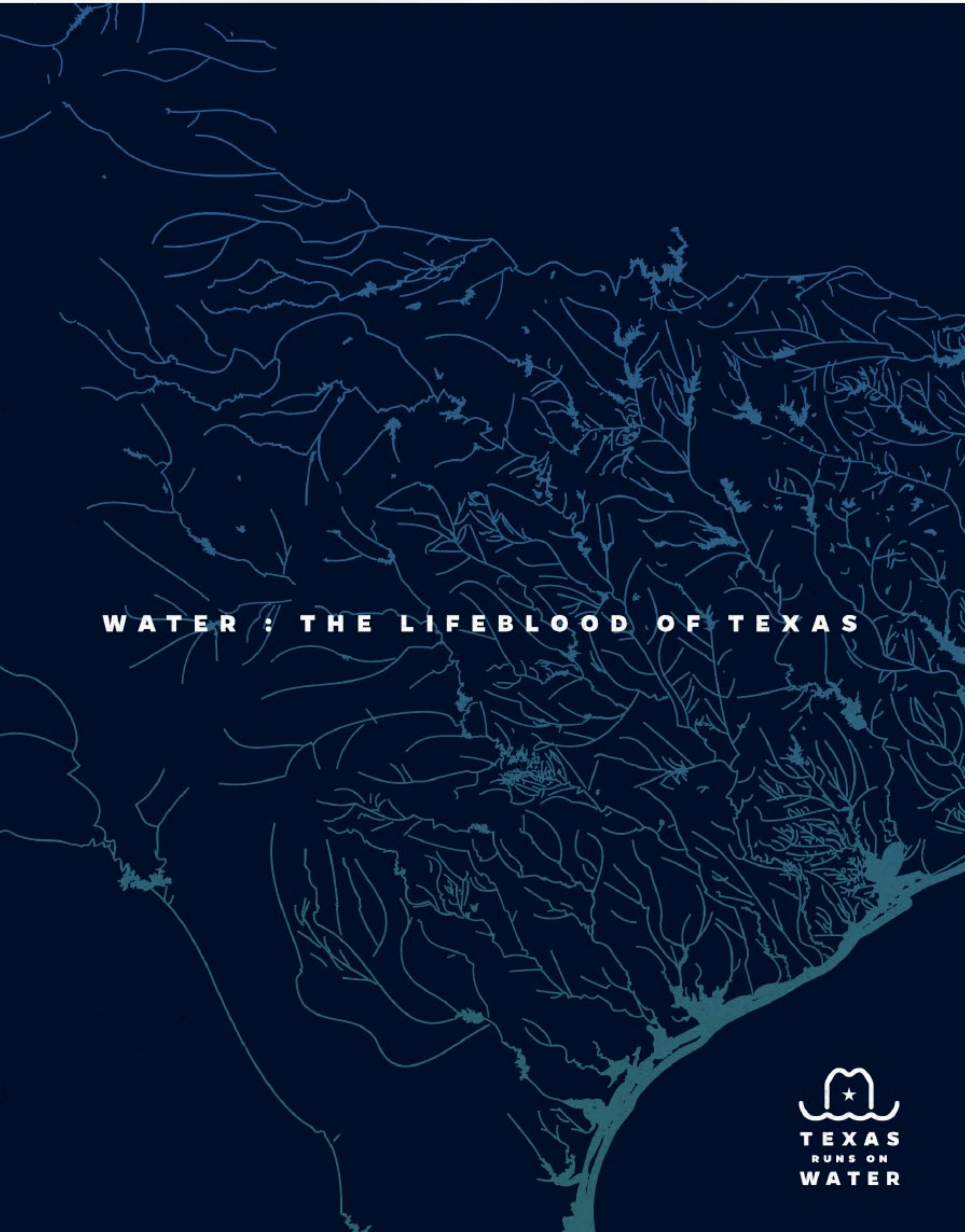
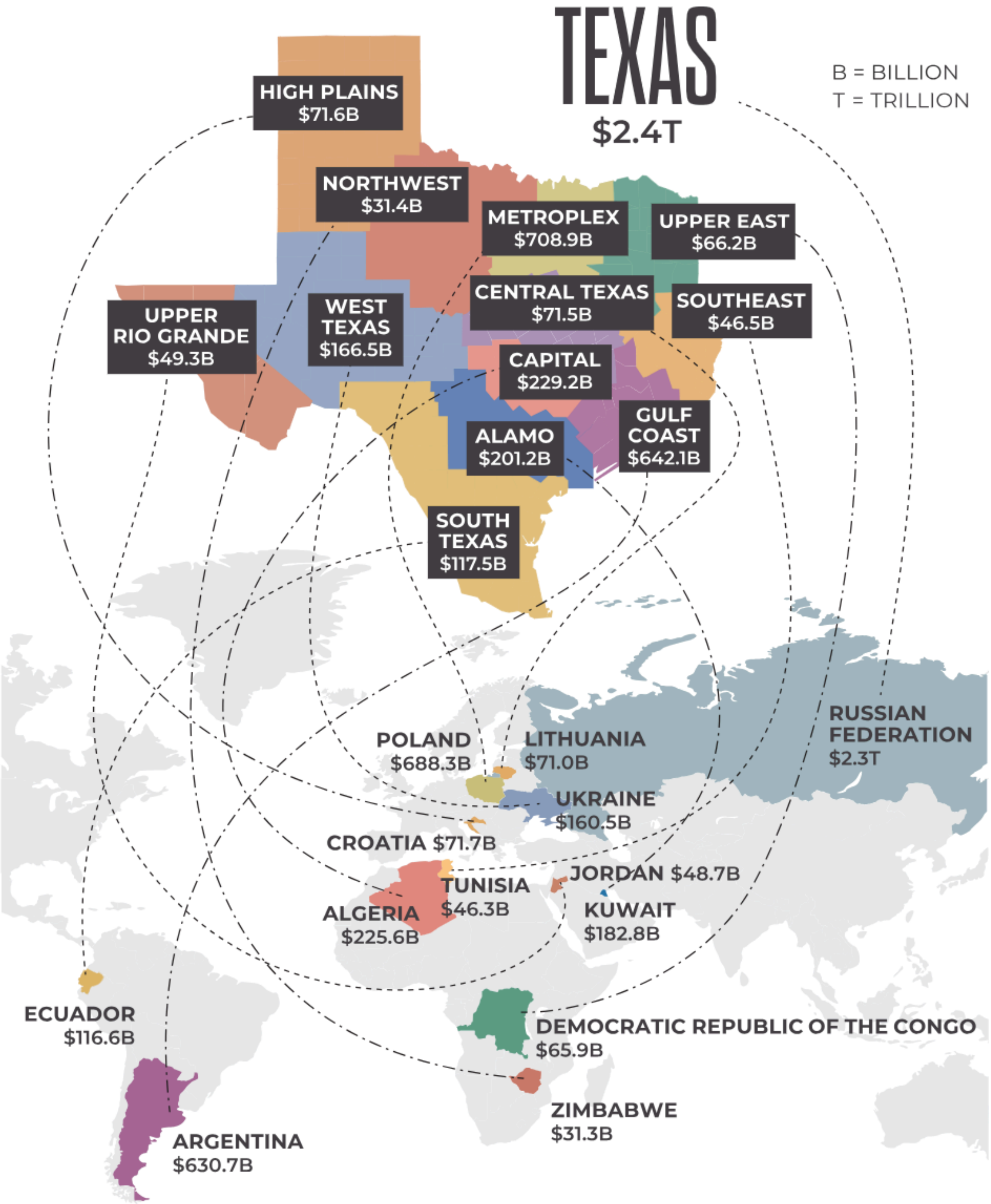
Texas A&M AgriLife Research and Extension Center- Dallas, TX


TEXAS WATER
FOUNDATION



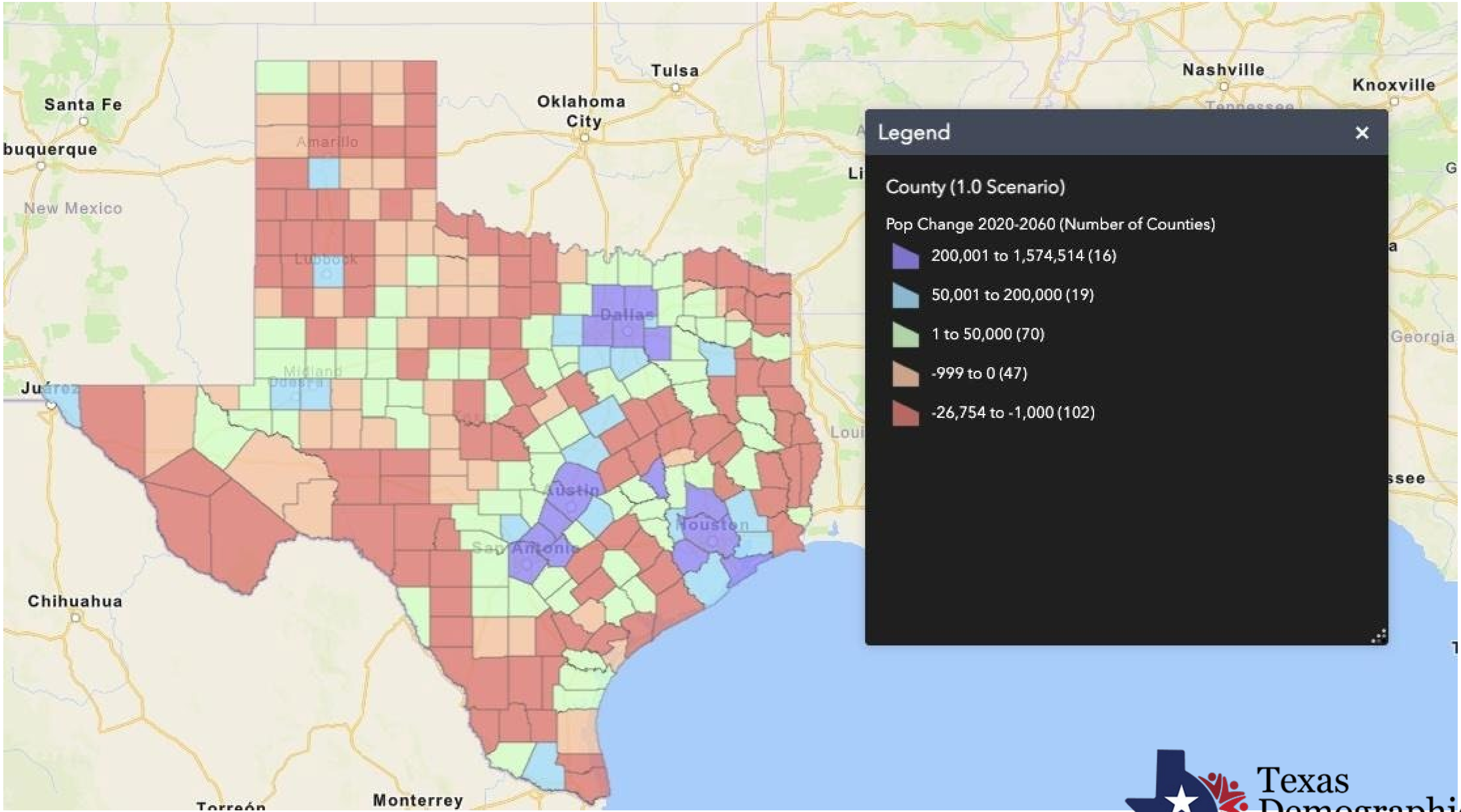
Texas Economy: 8th globally



Texas Economy: 8th globally

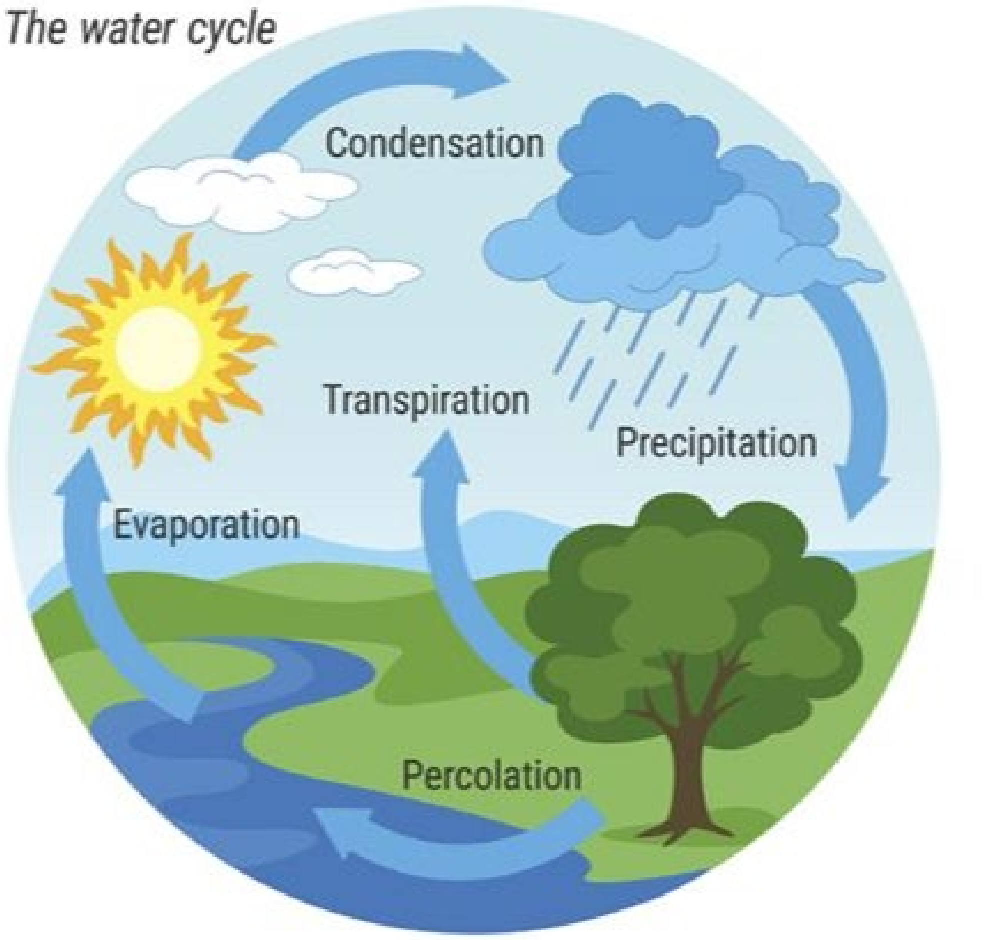
Texas is a high water risk state

WATER RISK – the possibility of experiencing water-related challenges (e.g., water scarcity, water stress, flooding, aging infrastructure, drought)



Texas Demographic Center

Where do Texans get water?

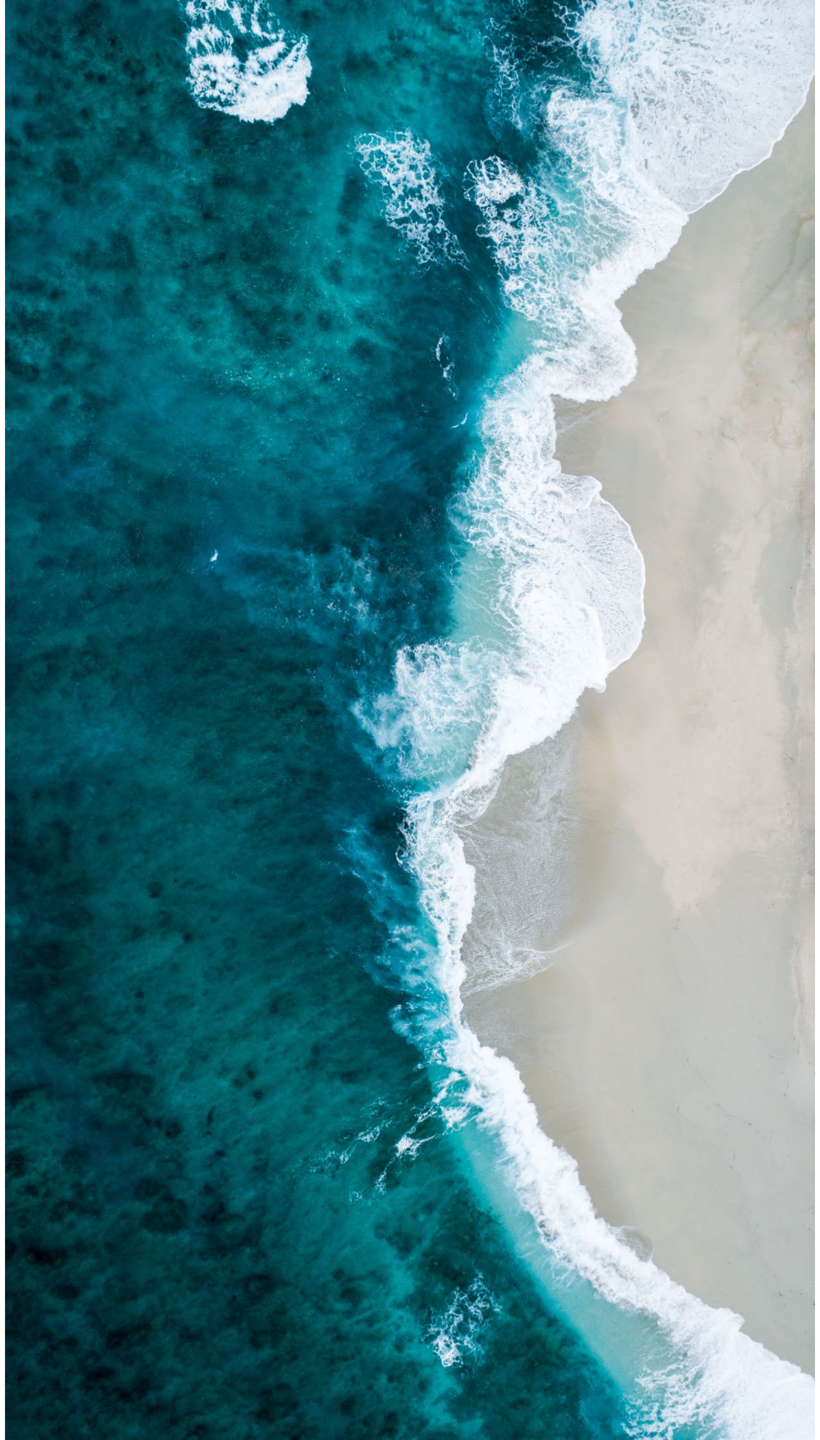


Urban

- Public Water Utilities
- Groundwater & surface water rights
- Diverse Strategies:
  - Reuse
  - Desalination

Rural

- Groundwater Wells
- Small or private water utilities



Unique Legal Framework

Surface Water

Prior Appropriation

Groundwater

Rule of Capture

…Its either mine, ours, or yours

Water Governance

Federal

- Environmental Protection Agency
- International Boundary and Water Commission
- US Army Corps of Engineers
- US Fish & Wildlife Service
- US Geological Survey
- US Bureau of Reclamation
- Natural Resource Conservation Service

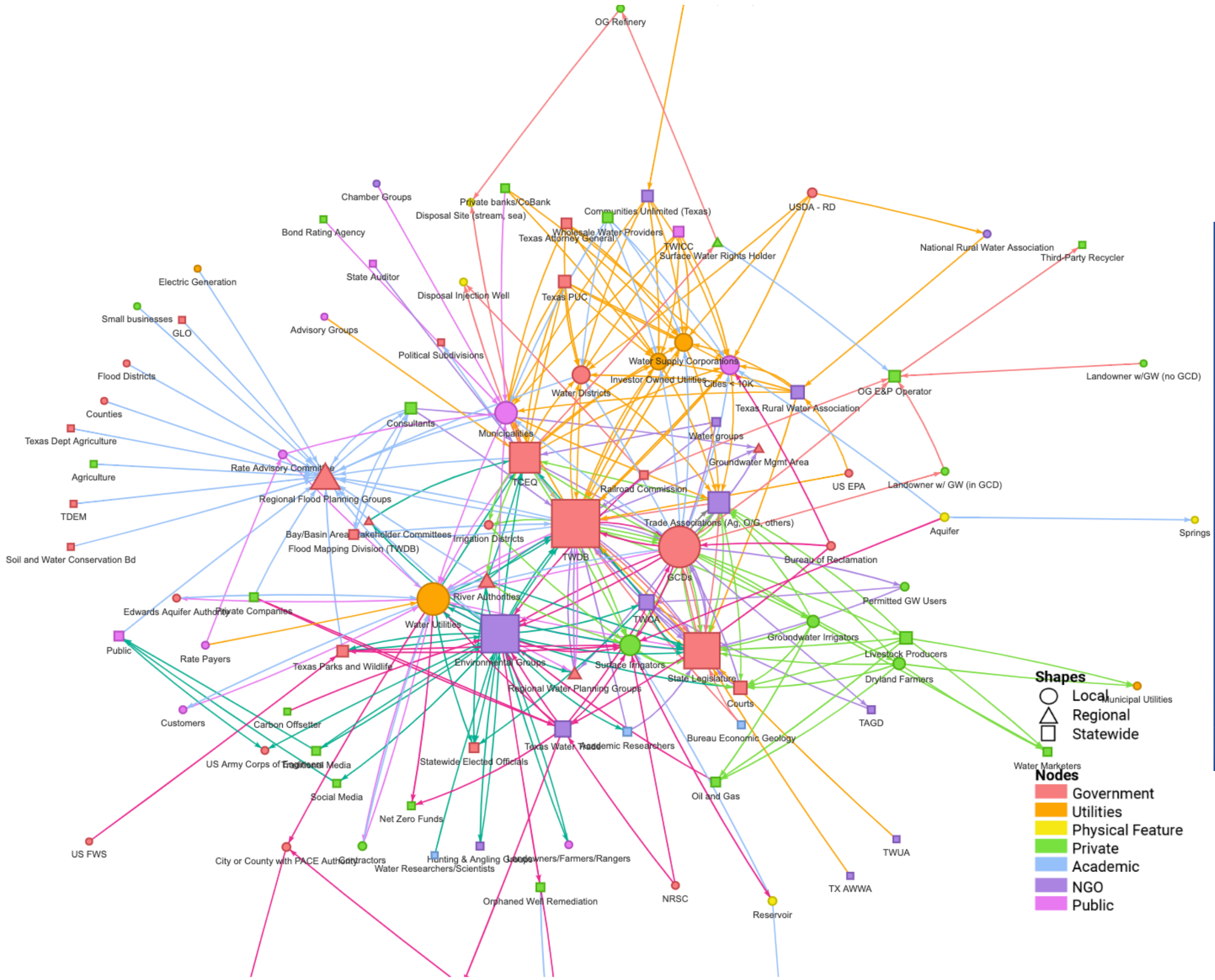
State

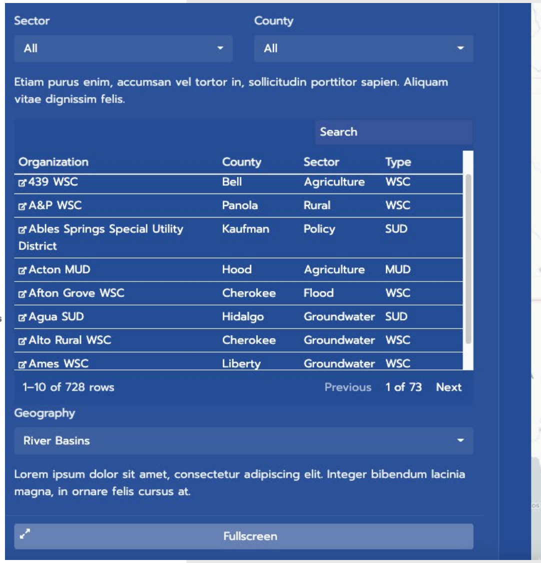
- Texas Commission on Environmental Quality
- Texas Water Development Board
- Texas Park & Wildlife Department
- Public Utility Commission
- Railroad Commission
- Texas State Soil & Water Conservation Board

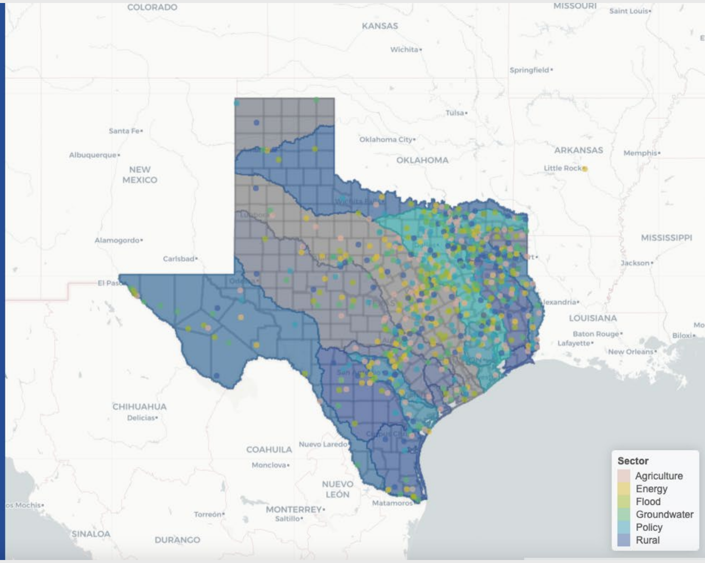
Local & Regional

- River Authorities
- Groundwater Conservation Districts
- Water Utilities
- Municipal Utility Districts
- Soil & Water Conservation Districts
- Irrigation Districts
- Levee Improvement Districts
- ….

TEXAS WATER SYSTEMS MAP





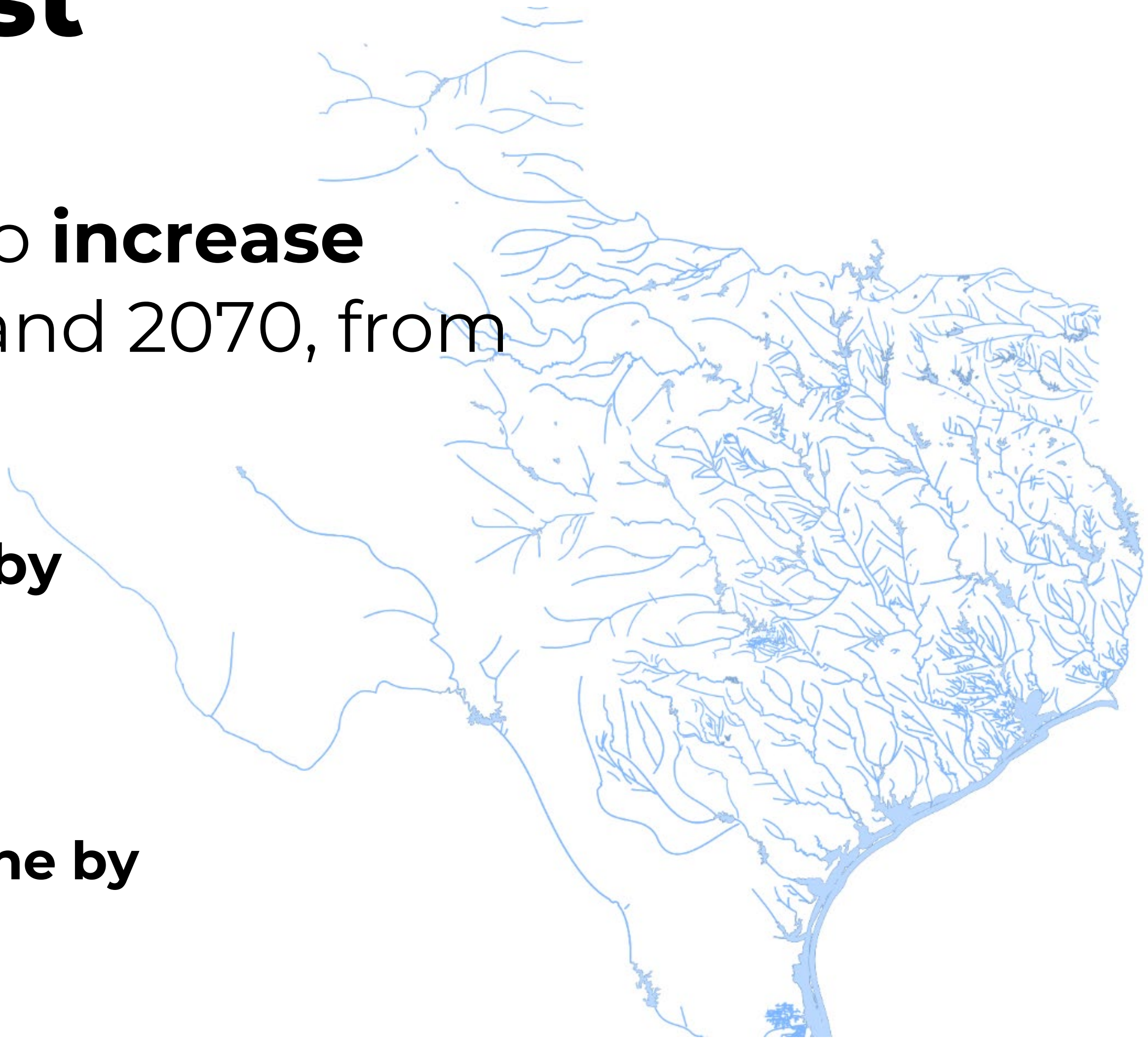


Texas Water Forecast

Texas' population is expected to **increase more than 70%** between 2020 and 2070, from **29.5 million to 51 million**

Water demands are projected to **increase by approximately 17%**

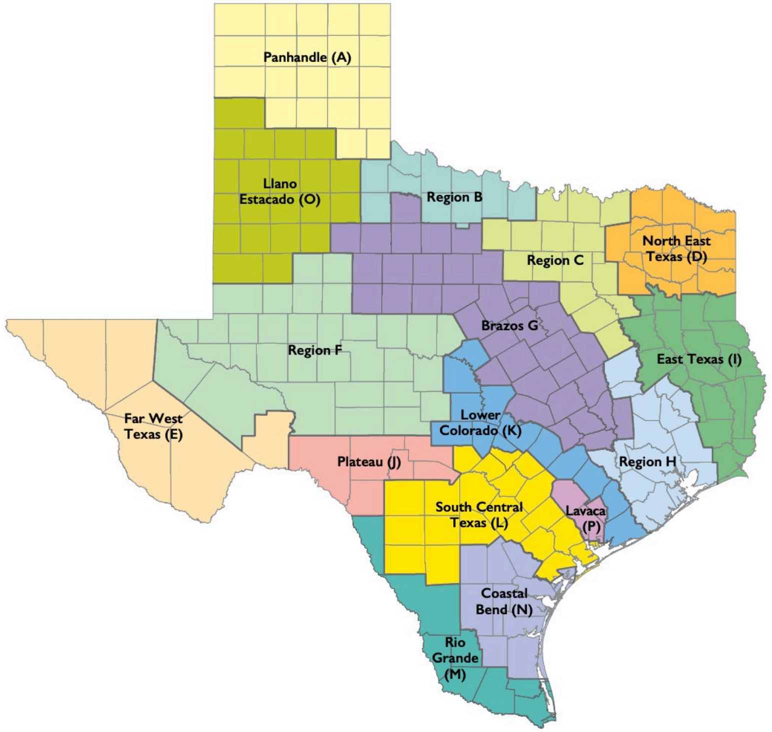
Existing water supplies are expected to **decline by approximately 18%**



Compiled from data found in the 2022 State Water Plan

Yes! We have a plan

2022 State Water Plan proposes 5,800 water management strategies to provide an additional 7.7 million acre feet of water by 2070

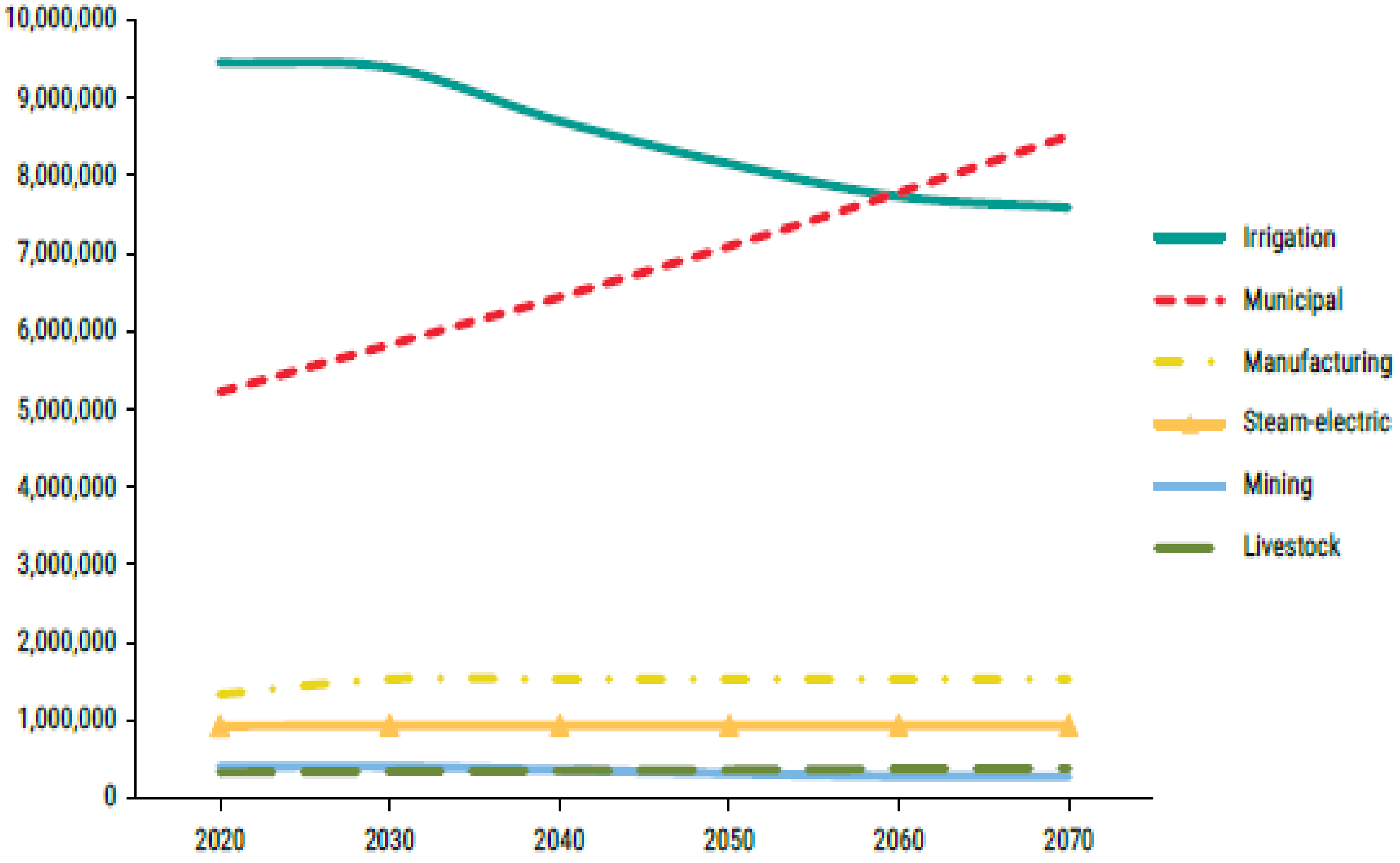


45% of Texas' future water will come from **conservation and reuse**

Municipal demand is increasing.

TEXAS WATER DEVELOPMENT BOARD

*Figure 4-5. Projected annual water demand by water use category (acre-feet)**



** Water use categories are presented in the order listed in the legend.*

The high price for Texas' water future

Jeremy B. Mazur, Senior Policy Advisor
4 days ago

TEXAS 2036

New water supplies: $80 billion over the next 50 years

Fixing aging, deteriorating drinking water systems: $45.15 billion over the next 20 years

Fixing aging, deteriorating wastewater systems: $11.8 billion over the next 20 years

Building Flood Control and Mitigation Projects: $38 billion

In February 2025, **Governor Greg Abbott** called for a **"Texas sized investment in water infrastructure"** as an emergency item, which the Legislature answered with **$2.5 billion** in **supplemental funding** for the **Texas Water Development Board** (TWDB) in House Bill 500, and a proposal for dedicated and continuous funding.

At a Glance

TX 89th Legislative Session

Top Water Conversations in Texas

DRAFT

January 1 – May 29, 2025

Water Supply

Mentions: 1,826
+32% from May 2023

Mentions: 817
+110% from May 2023

Water Infrastructure

Mentions: 976
+29% from May 2023

Mentions: 841
-4% from May 2023

Leaky Pipes

Mentions: 759
+262% from May 2023

Mentions: 875
Not available

Top keywords (IN PROGRESS)

Texas Water Foundation
@TexasWaterFND

Generational water legislation seems to always make it rain.

Congratulations @electcharles and @CodyforTexas for the passage of SB 7 and HJR 7. For the first time, continuous dedicated funding for water will be considered by Texas voters.

#txlege #txwatercaucus #txwater

16:18 · 5/30/25 From Earth · **519** Views

Constitutional Amendment Overview

Constitutionally Dedicated Funding Overview

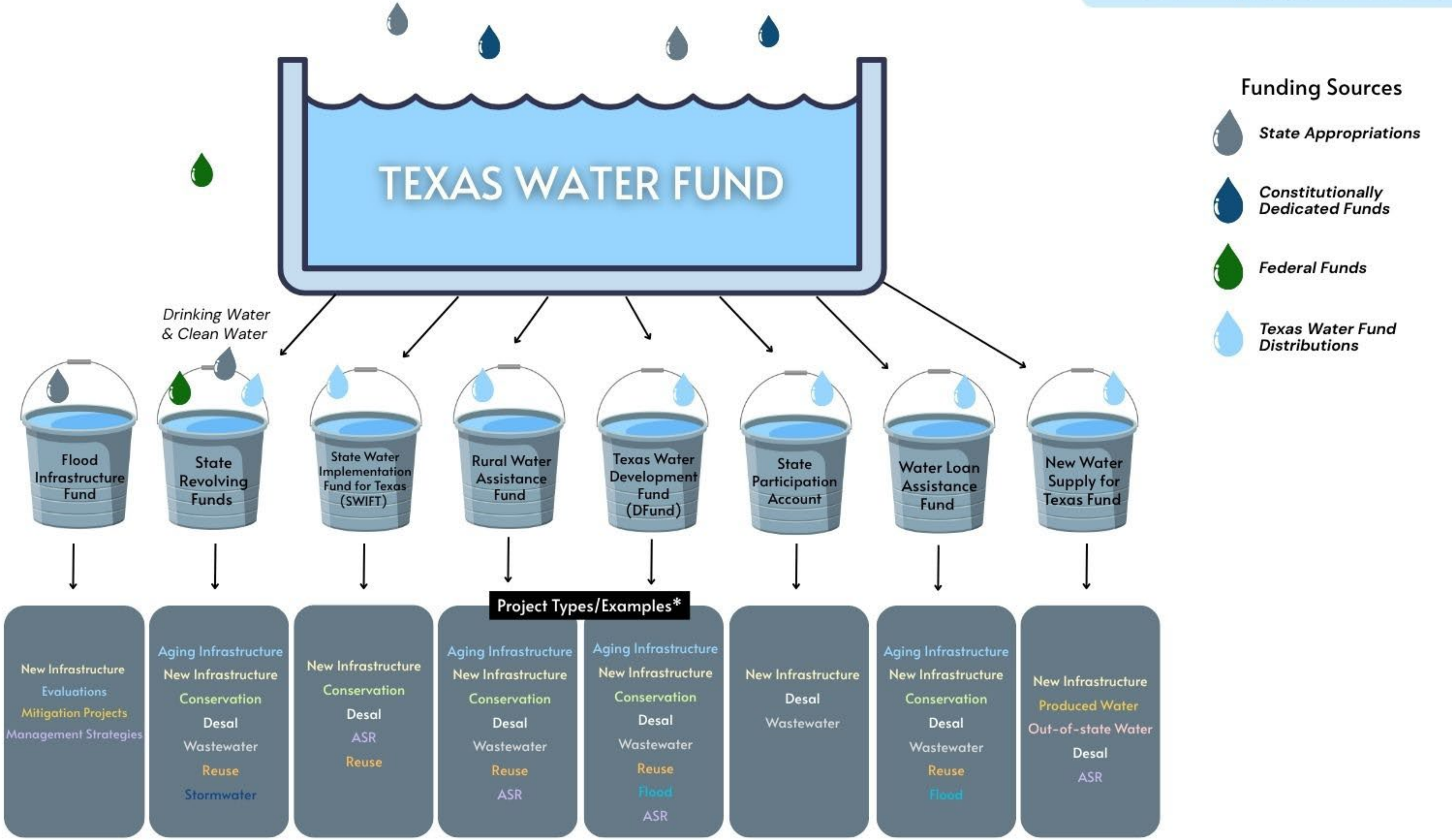
Prop 4 (HJR 7) would dedicate up to **$1 billion annually over 20 years** from state sales and use tax revenue once collections reach **$46.5 billion** in a fiscal year. This dedication would begin on **September 1, 2027**.

- **Prop 4** defers to **statute or legislative resolution on required distributions** within this **$1 billion** across **TWDB** programs.
- **Prop 4** authorizes **adjustments** to this allocation **during disaster declarations**, with intent to restore the funding when practicable.
- **Prop 4** prohibits funds sent to the **New Water Supply for Texas Fund** to be used for the production or transport of fresh groundwater.

Texas Water Fund Today

Texas Water Caucus

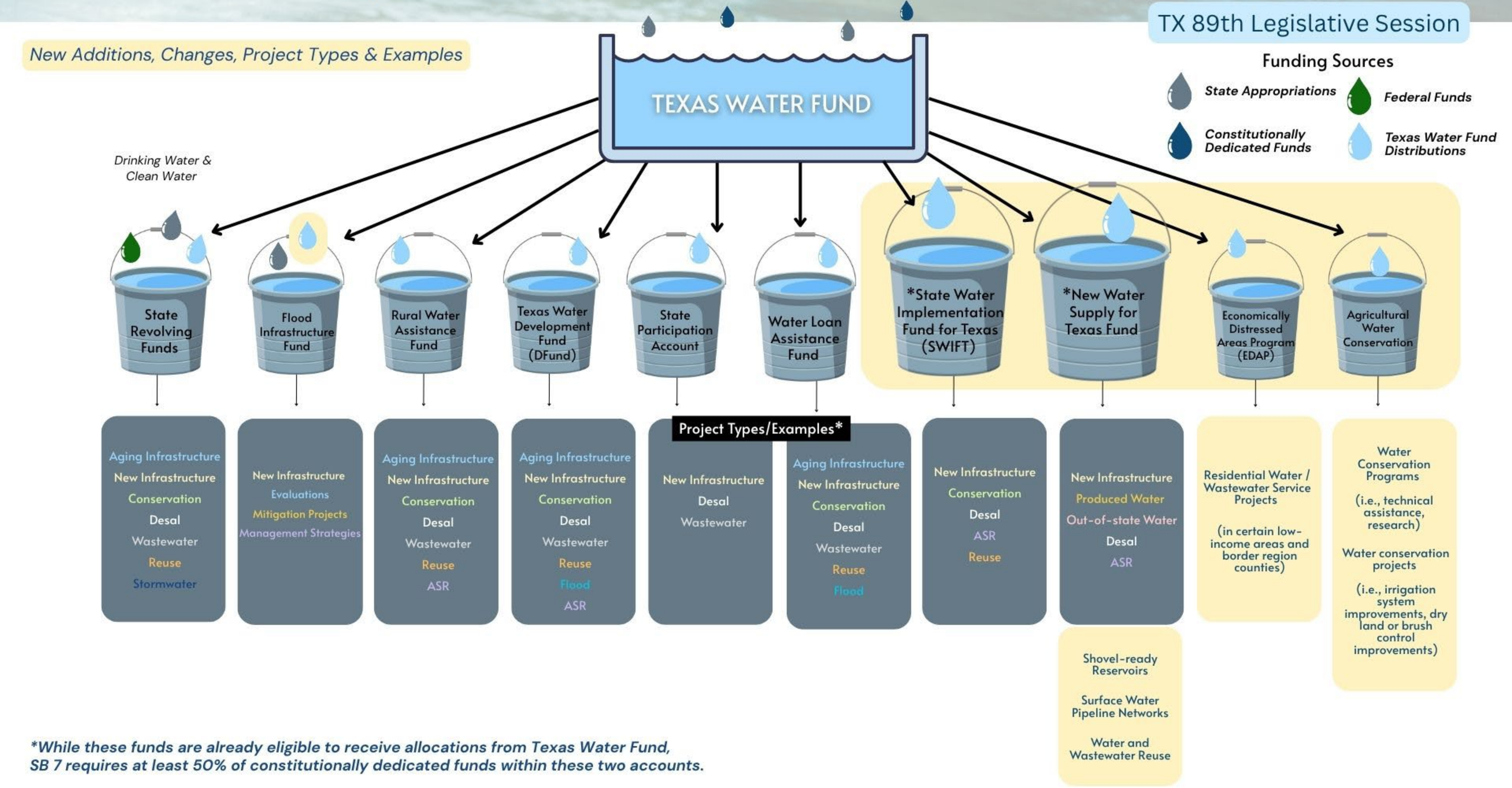
TX 89th Legislative Session



**Funding assistance is dependent on eligibility and funding availability.*

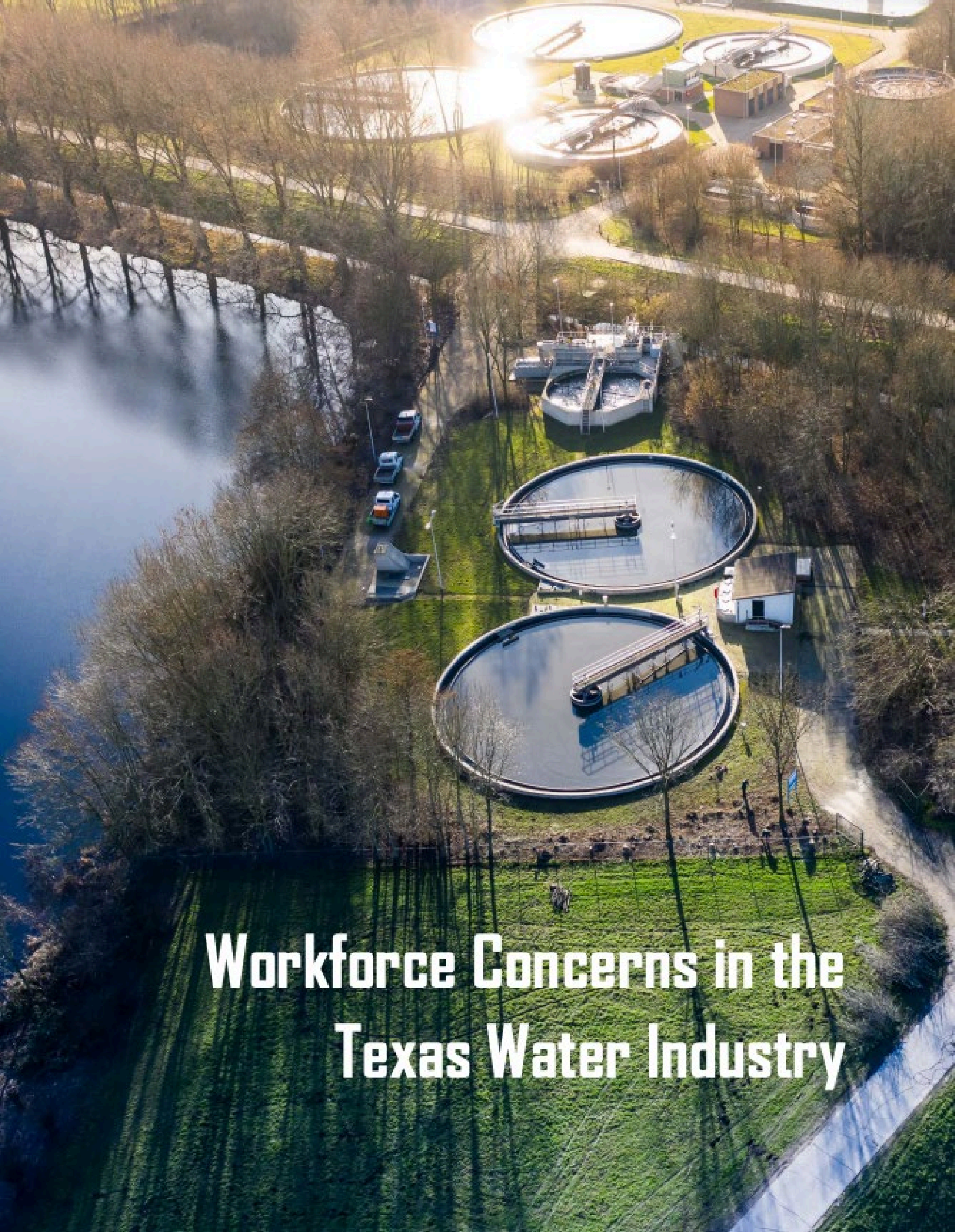
Note: Texas Water Fund also provides funding to the TWDB Statewide Water Public Awareness Account and for TWDB statewide awareness program activities.

Texas Water Fund September 1, 2025



*While these funds are already eligible to receive allocations from Texas Water Fund,
SB 7 requires at least 50% of constitutionally dedicated funds within these two accounts.


TEXAS RUNS ON WATER
Senator
Charles Perry
SIMFLO CEO
Troy Pickering
Speaker
Dustin Burrows
Representative
Cody Harris
PROMISES MADE
PROMISES KEPT.



New Data Reveals Texas Water Workforce Challenges

A new study released by **Texas Water Foundation** and prepared by the Houston Advanced Research Center details results from a Texas water workforce survey and reveals that **attracting and retaining a skilled workforce is a significant concern** among other Texas water infrastructure challenges.

More than **270** individuals representing **water utilities, local government, state agencies, energy production, nonprofits, and research organizations** from all parts of Texas participated in the survey. Of those respondents, more than **70%** were executives or managers.

63% *of respondents indicated that they are currently experiencing* ***workforce-related challenges****.*

76% *indicated* ***hiring and retaining qualified employees*** *as a medium to high risk posed to their organizations in the future.*

Results indicate that the top four top workforce challenges are staffing shortages, talent attraction, retention, and providing competitive wages.

According to the U.S. Bureau of Labor Statistics, the mean annual wage of a water or wastewater treatment plant and systems operator in **Texas is $41,240, falling significantly short of California's $73,100** and **well below the national average of $52,320.**

Other significant challenges ranked by respondents include:

79% *indicate* ***extreme weather****, such as heatwaves, freezing, storms, floods, and droughts, as a medium to high risk*

78% *indicate* ***aging infrastructure*** *as a medium to high risk*

68% *indicate* ***financing for capital improvements*** *as a medium to high risk*

Read the full report at www.texaswater.org/policy

TEXAS WATER FOUNDATION

State of Texas Water Summary

- Texas is facing **increasing water risk**
- Texas' built water **infrastructure is aging** and fragile
- Texas' **natural water infrastructure** is fragile
- Texas water **workforce is aging** and fragile
- **Half of our projected water supply** will have to come from **conservation, efficiency, and reuse**
- We need more **data and investment** to make that possible

INFRASTRUCTURE

PLANNING

WORKFORCE

DATA

sarah@texaswater.org

Municipal Water Supply Panel

Balancing Growth, Conservation, and Resilience

Moderator: Ambika Chandra, Ph.D.
Associate Director
Texas A&M AgriLife Research and Extension Center- Dallas

Mrs. Allison Strube, P.E.

Engineering Services Manager

Colorado River Municipal Water District

Whitney Milberger

Certified Arborist and Licensed Irrigator at BGE, Inc.

Communications & Conservation - Manager, North Fort Bend Water Authority

Ron Garcia

Irrigation Superintendent

City of Frisco

Lance Jones

Utilities Operations Superintendent

City of Frisco

Allison Strube

Whitney Milberger

Ron Garcia

Lance Jones

Municipal Water Supply Panel

Balancing Growth, Conservation, and Resilience

Moderator: Ambika Chandra, Ph.D.
Associate Director
Texas A&M AgriLife Research and Extension Center- Dallas

Water Policy in Texas Panel

Moderator: Lucas Gregory, Ph.D.
Associate Director
Texas Water Resources Institute

Amy Hardberger

Robert Mace

Sarah Schlessinger

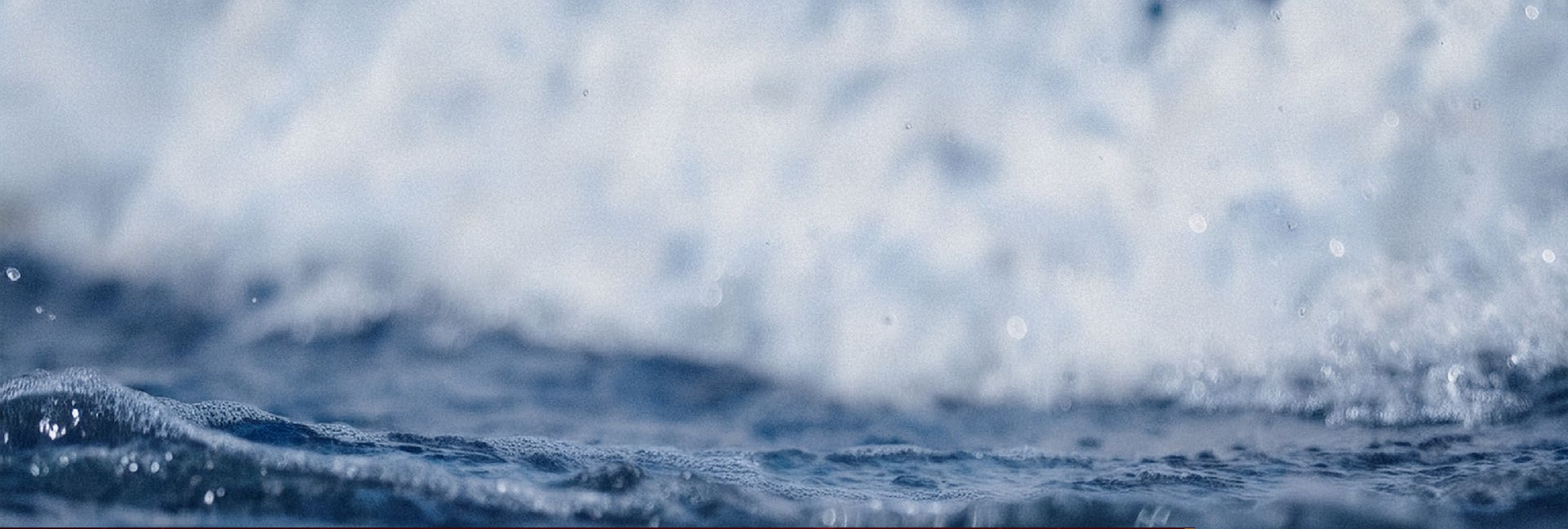
Stacey Steinbach

Water Policy in Texas Panel

Moderator: Lucas Gregory, Ph.D.
Associate Director
Texas Water Resources Institute

Water Supply in Texas Panel

Moderator: Joseph Burke, Ph.D.
Assistant Professor
Texas A&M AgriLife Research and Extension Center- Lubbock



Texas A&M AgriLife Water Symposium

August 12-14, 2025

Texas A&M AgriLife Research and Extension Center- Dallas, TX

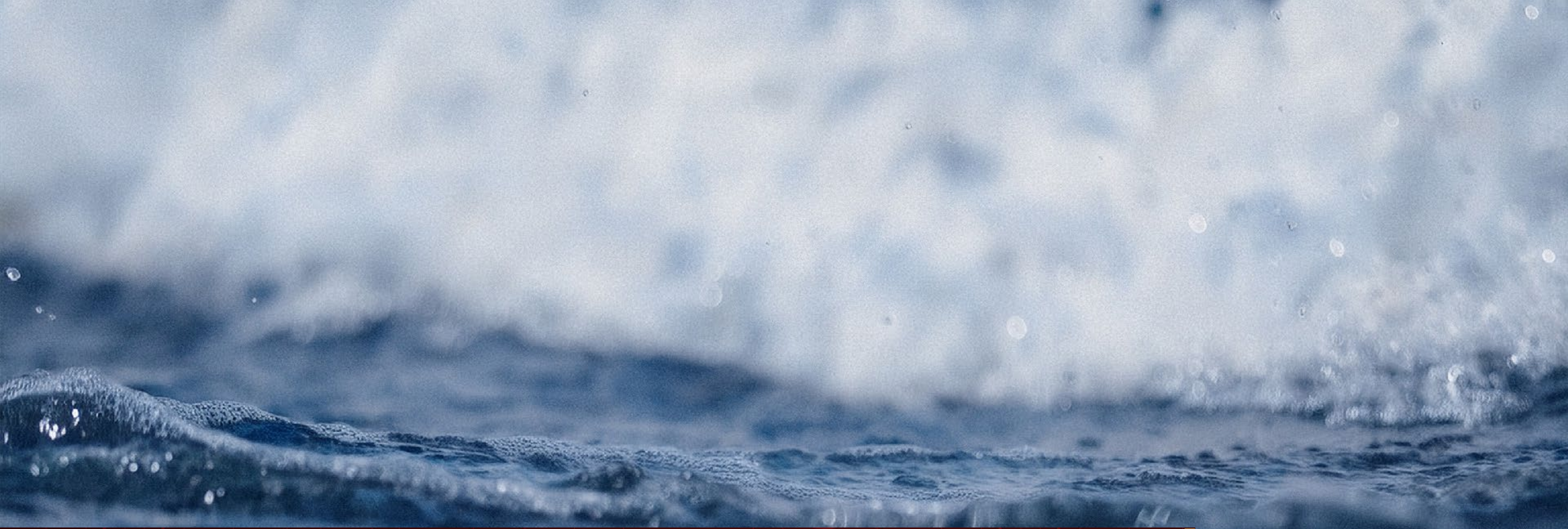
August 13th- Day 2

8:00 AM- Registration

8:30 AM- Day 2 Opening and Kickoff

1:00 PM- Keynote Speaker- Cliff Lamb, Ph.D.

5:30-7:00 PM- Social & Mixer



Texas A&M AgriLife Water Symposium

August 12-14, 2025

Texas A&M AgriLife Research and Extension Center- Dallas, TX

Texas A&M AgriLife Research and Extension Center- Amarillo

Brent Auvermann, Ph.D.- Center Director

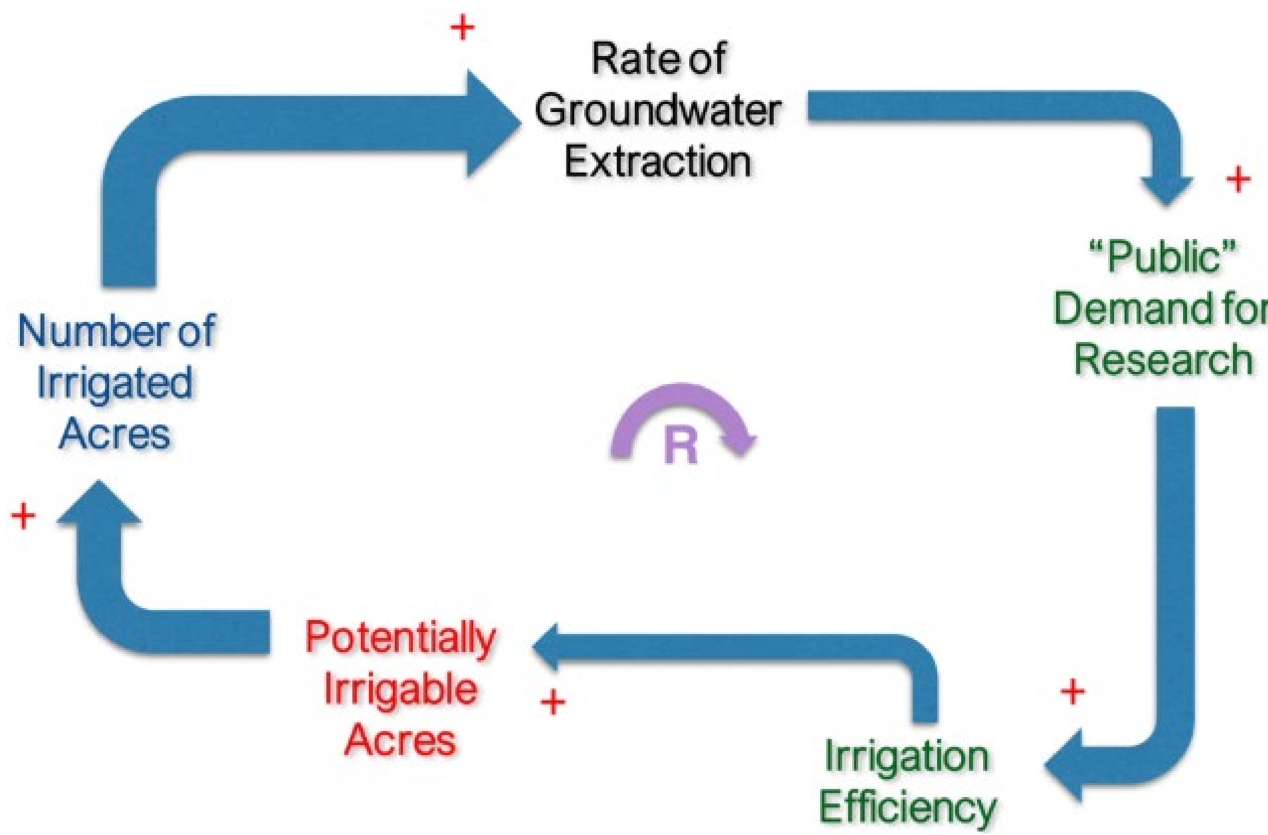
Texas A&M AgriLife High Plains Research and Extension Center

SIGNATURE PROGRAMS AT THE HIGH PLAINS REC

- Wheat breeding and genetics
- Beef cattle nutrition and health
- Irrigation/water management
- New for 2025: water-limited forages
- Crosscutting programs – biotic stresses, physiology, soil health, EQ

MAJOR WATER-RELATED CONCERNS

- Declining Ogallala water table, low surface-water availability
- Brackish alternatives (Santa Rosa/Dockum; Lake Meredith)
- Human behavior
  - Historical reliance on advances in irrigation efficiency (Jevons' Paradox)
  - Regional water planning assumes business as usual
  - Poor incentives to plant water-efficient crops (insurance; price premium; end-use quality)



MAJOR WATER-RELATED CONCERNS, CONTD

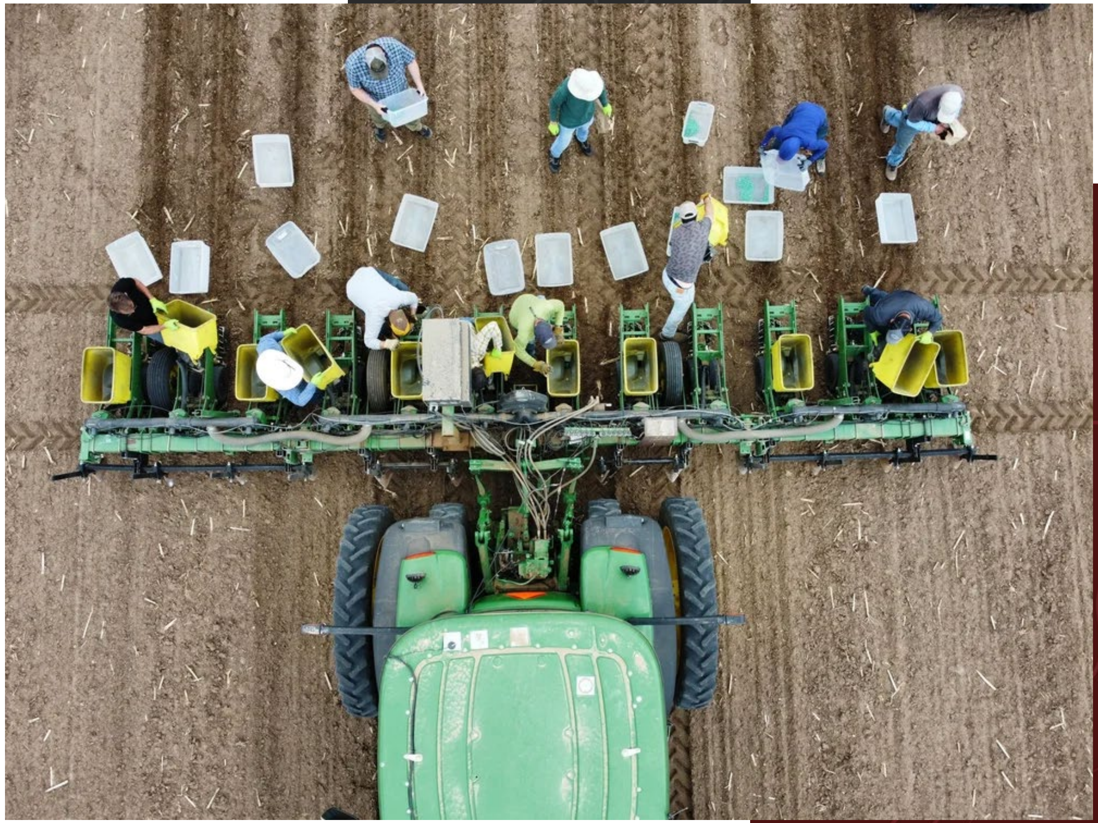
- Major cattle-feeding region – can source grains and adjuncts from a distance, but not forages/roughage
- Fast-growing dairy region – increasing demand for highest-quality forages (digestibility; irrigation demand)
- C3 turf predominates in residential, commercial landscapes
- Water-extraction data (well metering) not widely available

SELECTED, RECENT ADVANCES IN RESEARCH

- Bolt-on smart controllers for center-pivot irrigation systems (multiple IP disclosures, including a TAMU Innovation award)
- TAM wheat varieties dominate TX planted acreage
- Standardizing ASCE terminology and concepts for ET community
- ID physiological traits conferring drought tolerance in wheat
- Life-cycle assessment of U. S. wheat production, including water consumption

FUTURE COLLABORATIONS

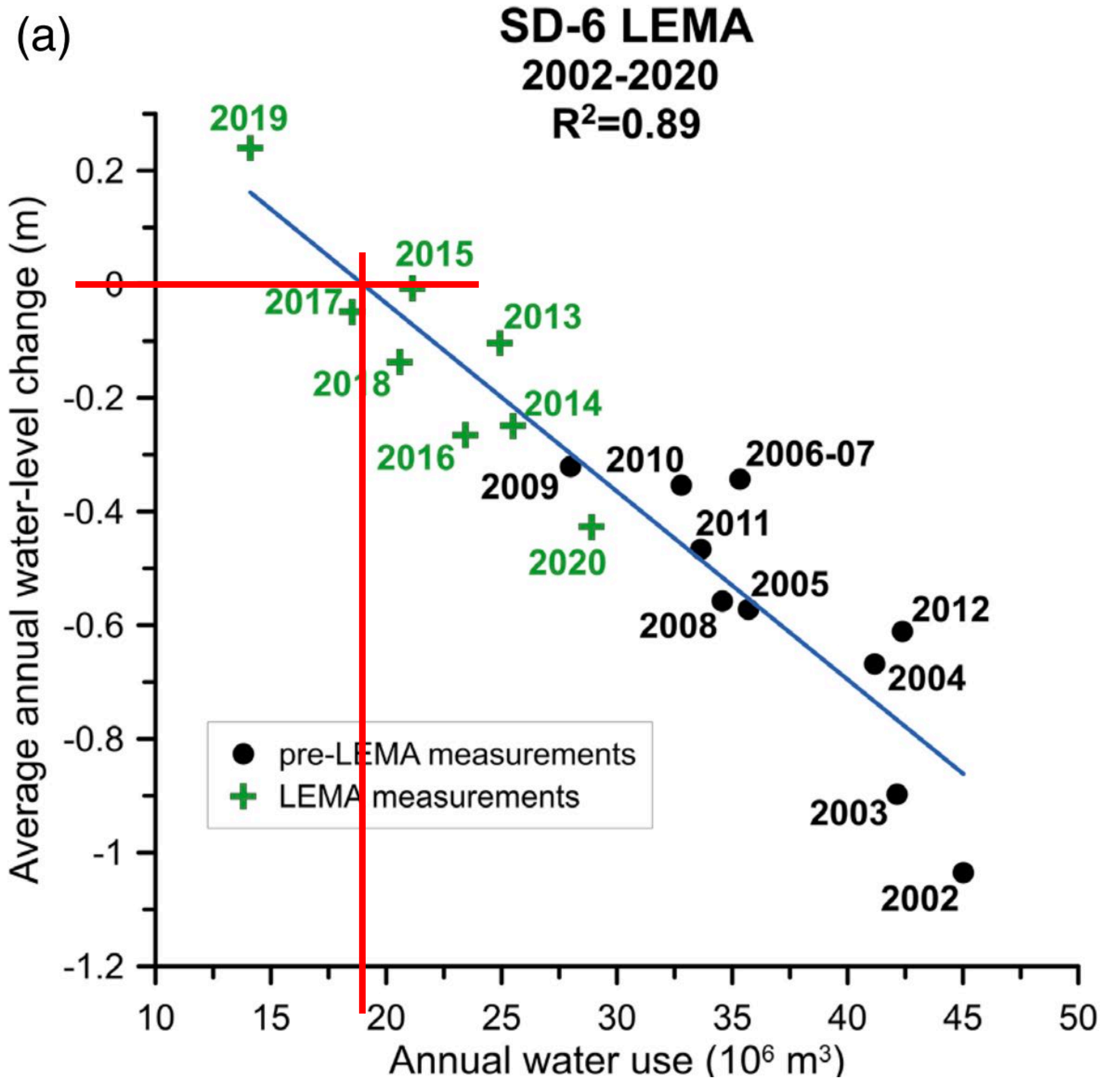
- Water-limited forage agronomy/physiology/breeding – OVER, STEP, LUBB
- Testing Ag Performance Solutions (TAPS) farming competitions – LUBB, WTAMU, STEP
- Cold-hardy C4 turfgrass alternatives – DALL, LUBB, CPRL



TEX TAPS
TESTING AG PERFORMANCE SOLUTIONS

FUTURE COLLABORATIONS, CONTD

- Wheat, corn, and sorghum breeding for drought tolerance – VERN, LUBB, SCSC
- Evaluating biochar soil amendments – STEP, WTAMU, CPRL
- Estimating Q-Stable across the Ogallala – WTAMU, CPRL
- Cotton irrigation scheduling – CORP, TTU, WTAMU



"DANGEROUS QUESTIONS"

- *How might we* increase the adoption of real-time pump metering… without inviting "Big Brother" into our dining rooms?
- *How might we* learn from other states on water policy…without Californicating ourselves?
- *How might we* shift our aggregate focus from "more crop per drop" to…"reduced absolute extraction?"
- *How might we* shift our thinking from "what can we get THEM to do" to…"what might WE do differently to contribute to the solution?"
- *How might we* reposition our questions with "how might we" framing?

Texas A&M AgriLife Research and Extension Center-Lubbock

Joseph Burke, Ph.D.

Texas A&M AgriLife

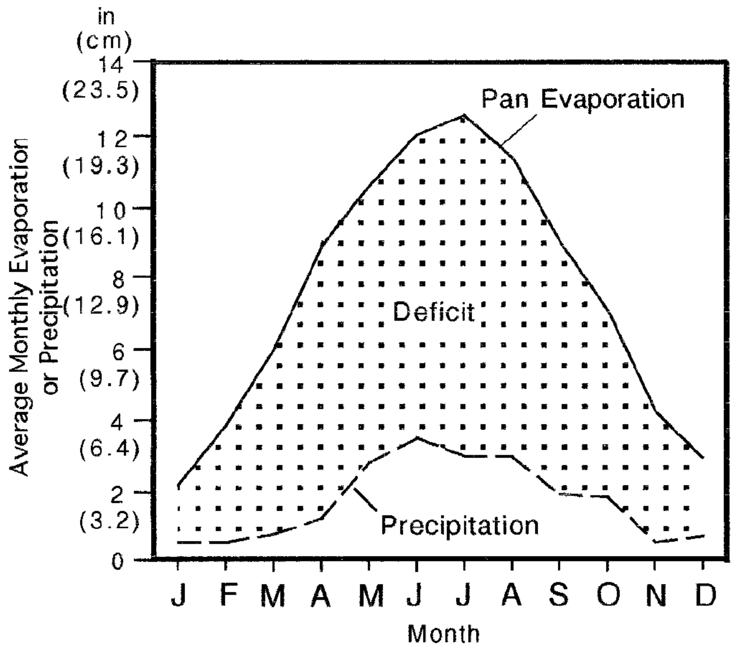
WATER ON THE TEXAS HIGH PLAINS: INNOVATIONS AND OPPORTUNITIES

Joseph A. Burke, Ph.D., Assistant Professor of Cropping Systems Agronomy
Extension Soil and Water Specialist
13 August 2025 | Texas A&M AgriLife Water Symposium, Dallas, TX

Photo by Chris Cobos

THE TEXAS HIGH PLAINS

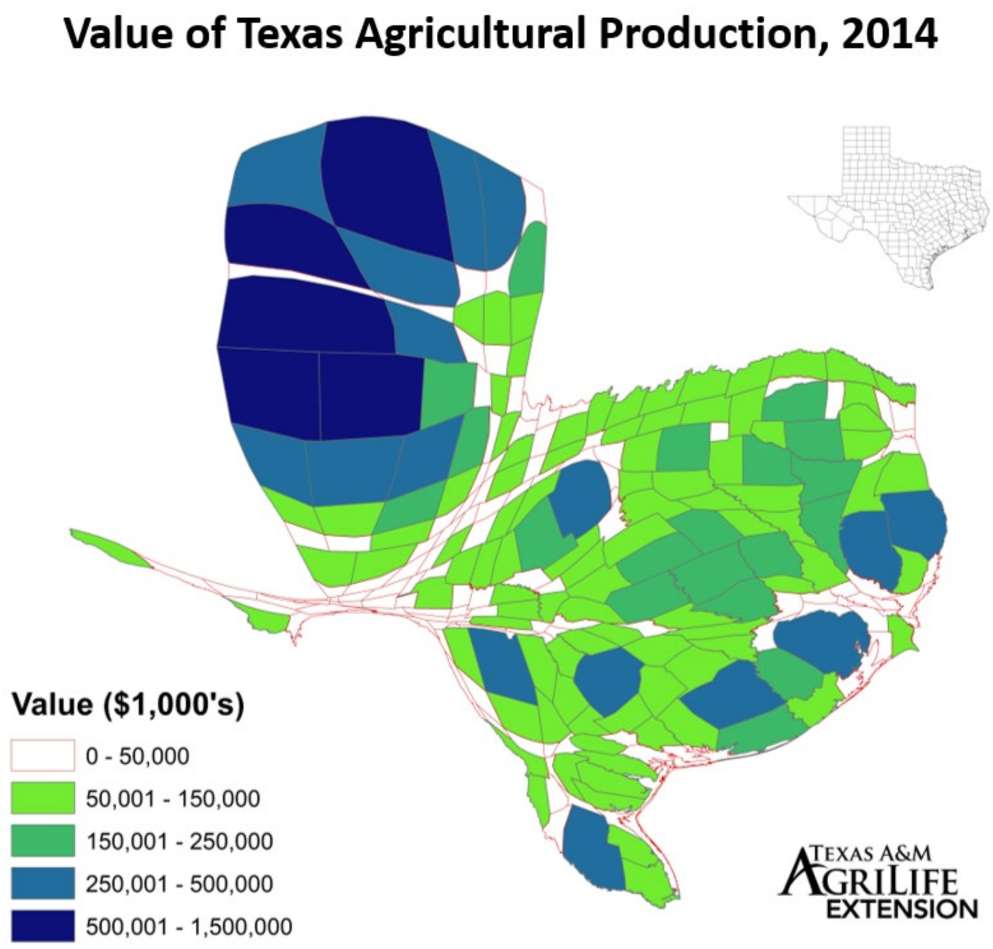
Temperature: 13-17 °C
Precipitation: 405-560 mm
Frost-free days: 195-255 days y^{-1}
Wind speed: 19.8 km h^{-1}



Gustovson and Holliday, 1999

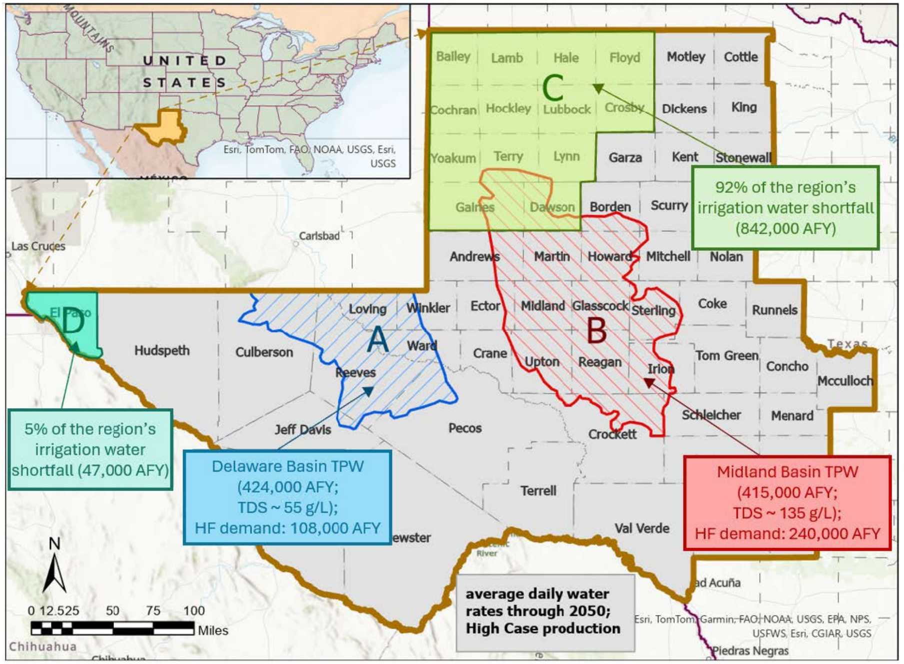
Baird, 2015

THE TEXAS HIGH PLAINS

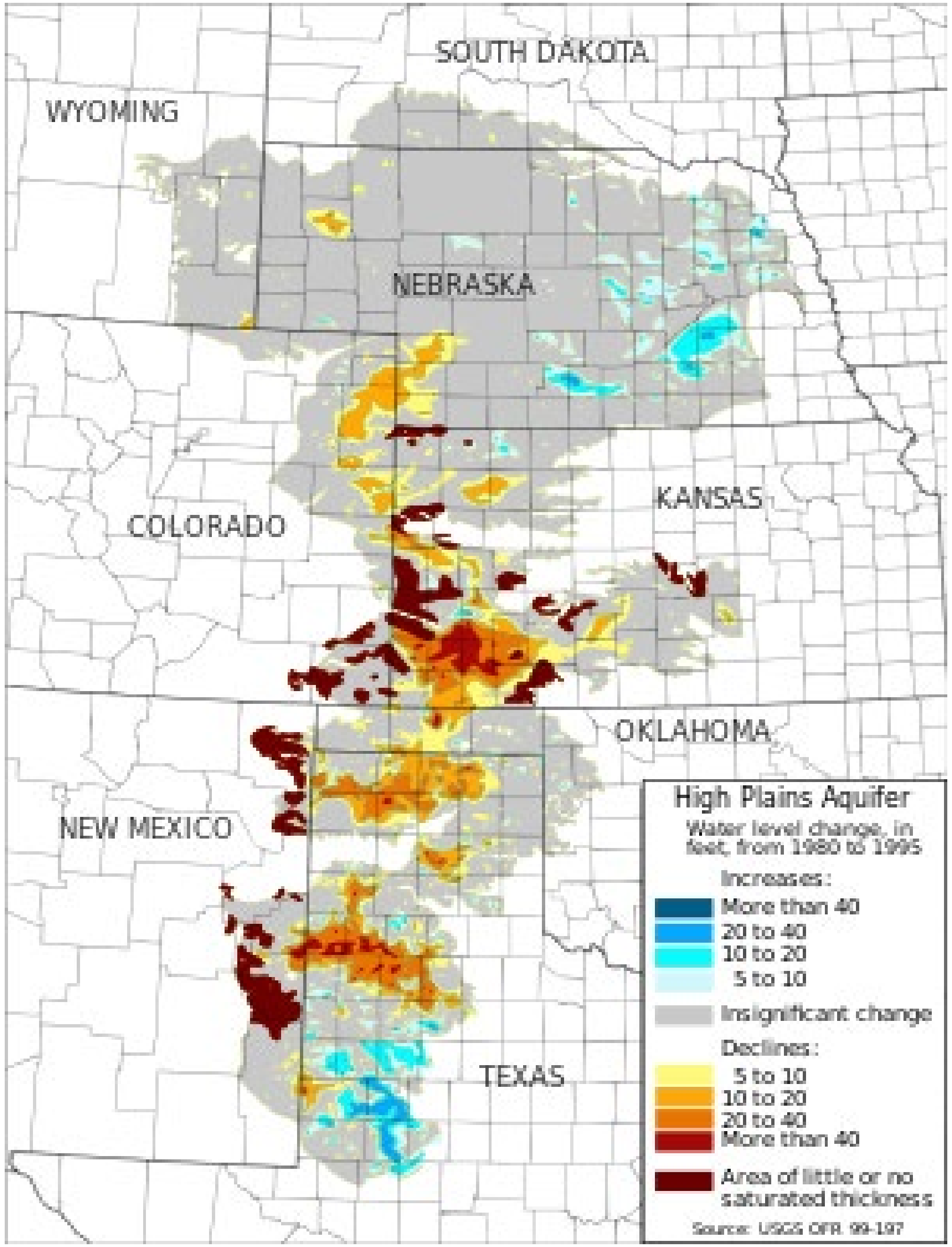


THP WATER RESOURCES

- Ogallala and Dockum Aquifers
- Rainfall
- Treated produced water



Texas Produced Water Consortium, 2024



THP WATER CHALLENGES

Declining groundwater resources

- Declining groundwater levels in the Ogallala Aquifer
- Limited aquifer recharge

Extreme weather

- Unpredictable rainfall and prolonged droughts
- Increased demand for irrigation water

Declining soil health

- Extreme soil erosion potential
- Conventional tillage practices have reduced soil organic matter
- Poor adoption of conservation practices

Declining water quality

- Transition from center pivot to subsurface drip irrigation
- Transition from irrigated to dryland acres
- Increasing salinity

RESEARCH INNOVATIONS

- Long-term research highlighted that cover crops increase rainfall interception, water infiltration, and soil water storage – Burke, Lewis, J.W. Keeling
- Cover crops terminated at 6-8 weeks before cotton planting did not limit early-season moisture or reduce lint yields – Lewis, Burke
- Cotton-wheat-fallow rotations increased cotton lint yield by 27% and gross margins by 54% - Lewis, Burke, Wright, W.S. Keeling, J.W. Keeling, Wheeler
- Treated produced water had minimal detrimental effects on plant development and mineral uptake, and enhanced soil carbon, pH, and micronutrient availability – Lewis, Burke
- Increased cotton, corn, peanut, and sorghum varieties screened for heat and water-stress tolerance – J.W. Keeling, Dever, Xu, Kelly, Burow, Wheeler
- 6.8% reduction in water requirements through data-informed irrigation scheduling, with no significant yield loss. This translates to an estimated annual savings of over 260,000 acre-feet of water and approximately $22 million in pumping costs. – Porter

ONGOING PROJECTS

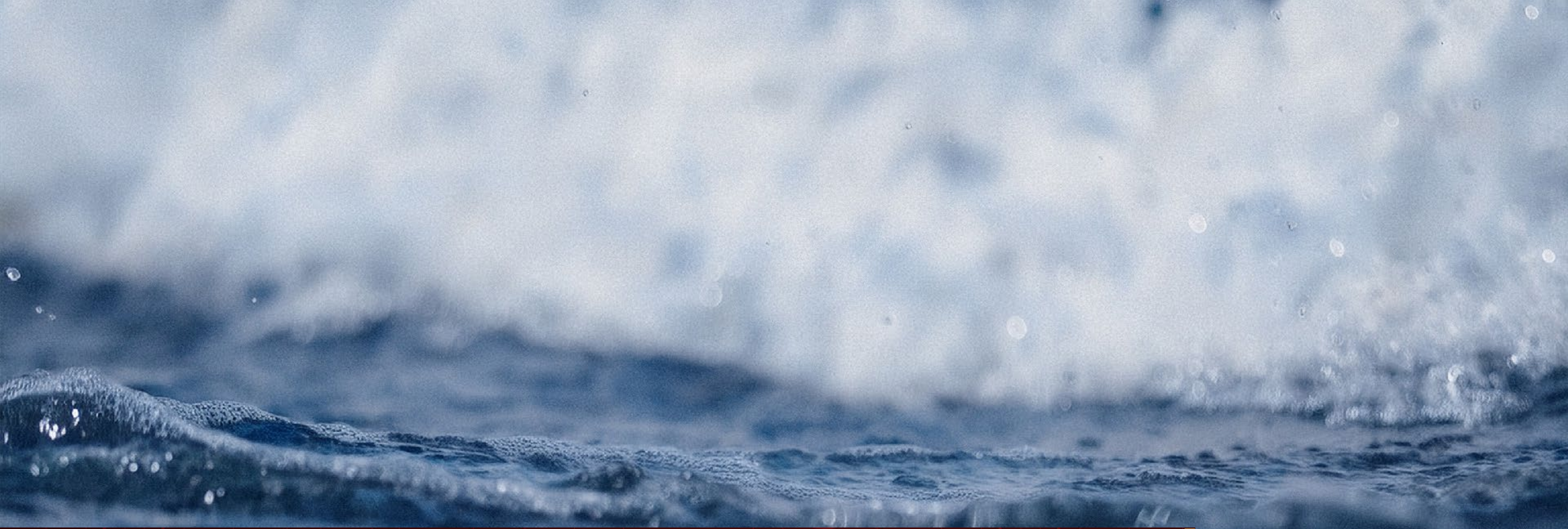
- Sustainable agricultural intensification and enhancement through the utilization of regenerative agricultural management practices – Lewis (PI), Burke, W.S. Keeling, Wright, J.W. Keeling, *et al.*; USDA-NIFA-SAS
- Soil health demonstrations to increase regenerative agricultural intensification in the Southern High Plains – Burke (PI), Lewis, W.S. Keeling, Wright, *et al.*; USDA-NRCS-CIG
- Impact of soil algae amendments on productivity, nutrition, and ecosystem regulating services of cropland – Lewis (PI), Burke, Nakabuye, *et al.*; MyLand
- Regenerative agriculture using treated produced water – Lewis (PI), Burke, Wright, W.S. Keeling, *et al.*; WaterBridge LLC
- Rows crops to perennial pastures: Feeding the world, conserving water, enhancing soil, and safeguarding the climate – Lewis (PI), Burke, Wright, *et al.*; FFAR
- Desalinated produced water as irrigation source for non-consumptive agriculture and adjacencies for ammonia mining and carbon sequestration field trials – Burke (PI), Lewis, Wright, W.S. Keeling; DOE

ONGOING PROJECTS

- Smart forage sorghum: precision sensing for optimized irrigation water management – Nakabuye (PI), Rudnick, Aguilar, *et al.*; Ogallala Aquifer Program
- Creating precision water management infrastructure for wine grape research and extension in the Texas High Plains, O'Brien (PI), Nakabuye, Montague; HPWD
- Master Irrigator and TAPS Education and Outreach – Auvermann (PI), Brandani, Bednarz, Nakabuye, Cason, Baughman; USDA-NRCS

COLLABORATION OPPORTUNITIES

Regenerative agriculture and soil health	Beneficial uses of treated produced water	Salinity management and remediation
Variety development	Forage production systems	Irrigation management



Texas A&M AgriLife Research and Extension Center-Stephenville

João Vendramini, Ph.D.- Center Director

Charles E. Simpson, Professor Emeritus, Peanut Pre-Breeding

- Introgression of genes
- Population development
- Germplasm maintenance

Dr. John Cason – Associate Professor
Peanut Breeding and Genetics

- High quality edible peanut variety development for growers of Texas and the Southwest U.S.
- Working to establish a low input sustainable drought tolerant high oil peanut market to address aquifer decline in the region
- Using wild species introgression to introduces related genes to cultivated peanut to expand the genetic base of peanut
- Development of new genotypic and phenotypic tools for use in breeding programs

Dr. Jeff Brady – Assistant Professor, Plant and Soil Microbiology

- Discovery/utilization of endophytic bacteria to increase peanut drought tolerance
- Biochar to mitigate the environmental impacts of dairies
- Discovery/utilization of microbes to decrease germination and persistence of invasive King Ranch Bluestem
- Detection/mitigation of pathogens and antibiotic resistance genes in the environment

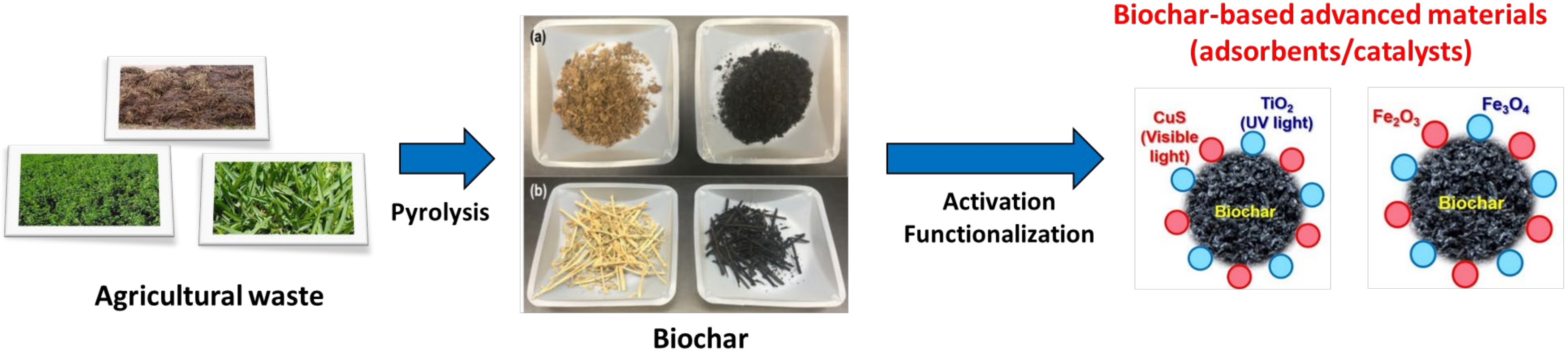
Microbe promoting peanut root growth

Microbe inhibiting invasive grass germination

Microbes promoting peanut drought tolerance

Dr. Eunsung Kan – Associate Professor, Environmental Engineering Lab

- Production of biochar-based advanced materials for wastewater and water treatment
- Removal of emerging contaminants (PFAS, antibiotics, cyanotoxins), ARG, and microbial pathogens in wastewater and water
- Recovery of valuable resources (nutrients, rare earth elements) from wastewater
- Addition of biochar (engineered biochar) to soil/forage systems for reduction of contaminants and greenhouse gas emissions



Dr. Jim Muir – Regents Professor, Grassland Ecology

- Native ornamental bunchgrasses for urban water savings.
- Dairy biochar for low-input forage production and ecosystems services.
- Native ornamental legumes for xeriscapes.

Dr. Eddie ‘Kyle’ Slusher – Assistant Professor

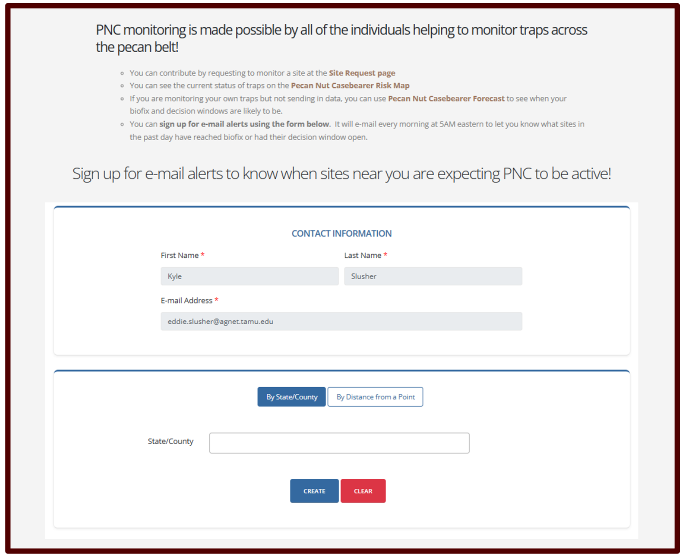
Extension Specialist Pecan, Viticulture and Fruit Entomology

- Educate growers in the pecan, viticulture, and fruit industry on principles of integrated pest management using workshops, one-on-one site visits, field days, and grower meetings.

- Design and execute monitoring programs for major fruit and tree nut pests including pecan nut casebearer and flatheaded borer.

- Enhance the grower toolbox through applied research involving field trials using insecticides, pheromone disruption, and trapping.

- Disseminate the above information using online tools and resources such as the Pecan Agpest Monitor website.



Dr. Jennifer Spencer – Associate Professor, Extension & Research Dairy Specialist

- **Heifer Reproductive Management & Stress Mitigation**: Optimize breeding efficiency through body condition scoring, puberty timing, synchronization protocols, and the use of precision monitoring tools to support reproductive success in dairy heifers
- **Cow Comfort & Environmental Technology Research**: Stress mitigation technologies, and real-time monitoring systems to enhance animal welfare, worker safety, and environmental sustainability
- **Bilingual Educational Programs**: Development and delivery of hands-on training programs in English and Spanish
- **Field Days & Extension Events**: Coordinates large-scale outreach events such as Southwest Dairy Day and Dairy Outreach Program Area (DOPA) credit trainings
- **Workforce Development & Industry Advancement**: Cultivating generational dairy professionals and enhancing the long-term sustainability of dairy workforce

Dr. Joao Vendramini – Professor Forage Management, Center Director

- Breeding, selection, and management of Crotalaria spp for forage and cover crop purposes
- Developing management practices to increase nutritive value and fermentation characteristics of forages for silage production
- Prescribed fire effects on soil, vegetation, and ecosystem services of rangelands grazed by beef cattle

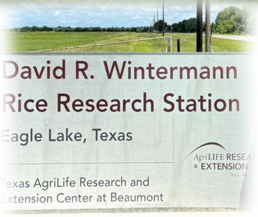



Texas A&M AgriLife Research and Extension Center-Beaumont

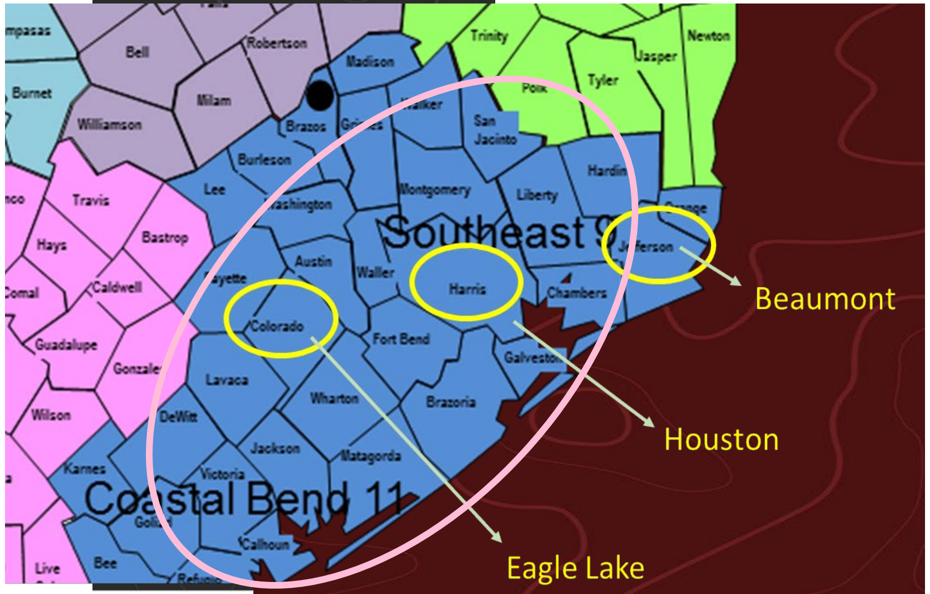
Mithila Jugulam, Ph.D., Center Director

Texas A&M AgriLife
Research and Extension Center-
Beaumont

BACKGROUND



- Rice Experimental Station was established in 1909
- Eagle Lake station was created in 1970
- 10 faculty
- Staff/students: ~50 to 60



FACULTY AND EXPERTISE: PRIMARY FOCUS- RICE IMPROVEMENT


Dr. Bernaola


Dr. Rustom


Dr. Samonte


Dr. Talukder


Dr. Dou

- Agroecosystems
- Crop Physiology
- Entomology
- Genetics
- Modelling
- Plant Breeding
- Plant Pathology
- Soil Science
- Weed Science


Dr. Zhou


Dr. Wilson

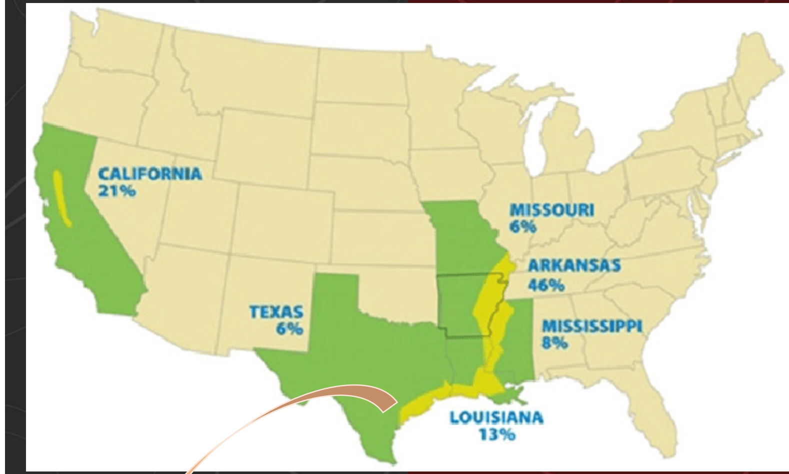

Dr. Yang

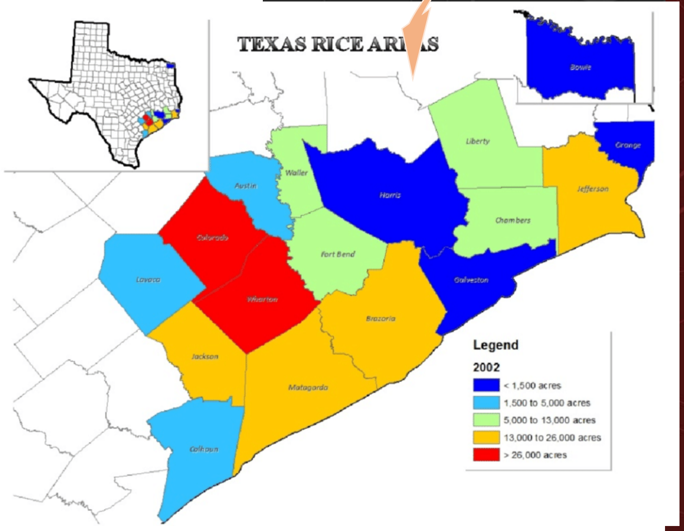
Dr. Tarpley


Dr. Jugulam

RICE CROP AND IMPORTANCE OF WATER

- Water is a crucial and expensive resource
- The majority is under wetland production
- Grown in flooded fields (paddies)
- ~3000 to 5000 L of water to produce 1 kg of rice
- Helps in weed management, enhances nutrient availability, regulate temperature



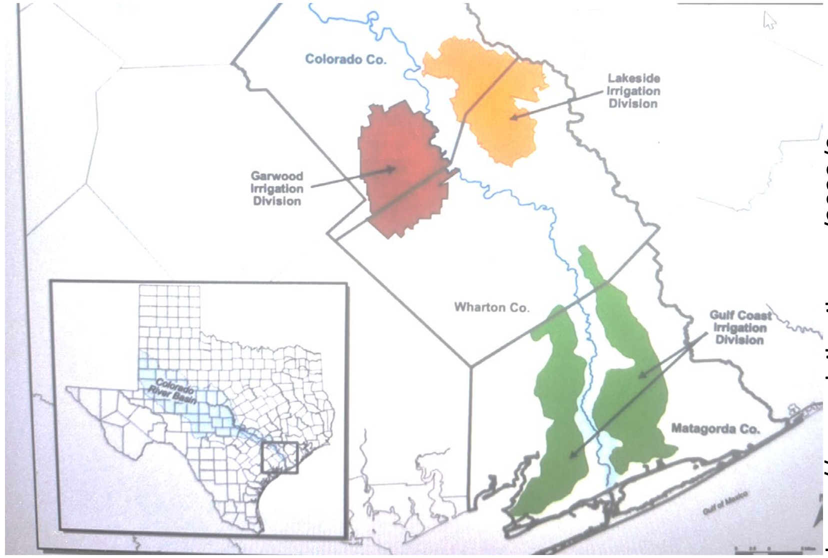


Texas A&M AgriLife Research and Extension Center-Beaumont

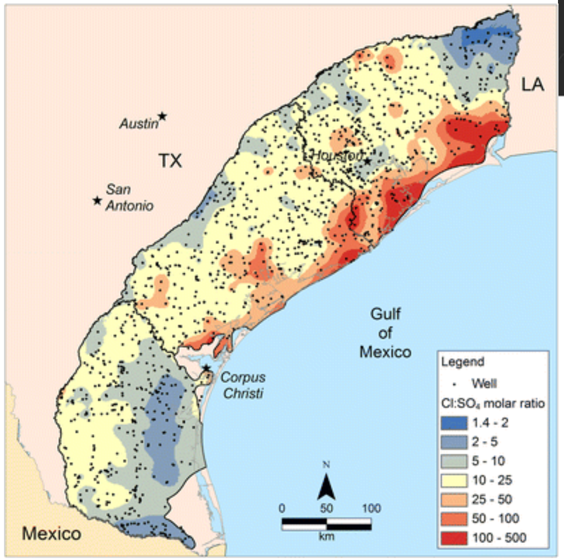
WATER-RELATED CONCERNS IN TX RICE BELT

- Water costs and water availability (decreased rice acreage by 26%)
- The cost of production has doubled since 2014
- Declining aquifer levels and salinity issues
- Drought and climate variability

Three large irrigation districts that purchase water from LCRA



https://www.dailytrib.com/2023/01/19/lcra-raises-rates-for-rice-farmers/

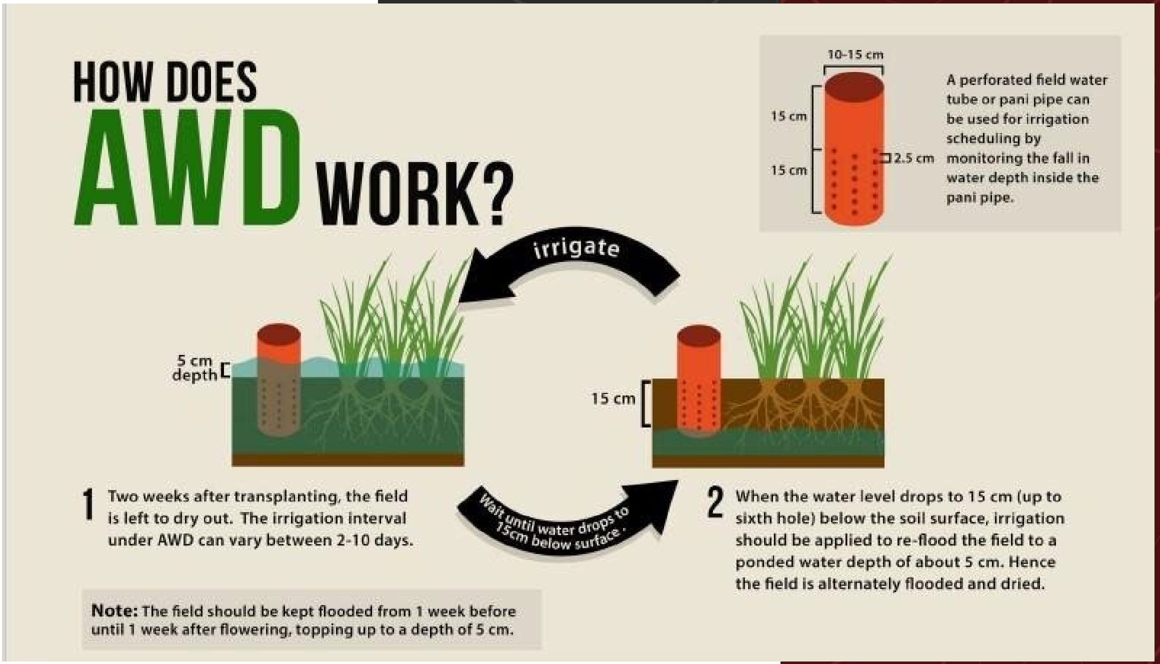


Chowdhury et al., 2018; DOI 10.1007/s10040-017-1619-8

MAJOR ADVANCES IN RICE WATER MANAGEMENT RESEARCH

1. Alternate wetting and drying (AWD)

- Reduces the water applied by 33 to 50%
- Requires extra N
- Additional herbicide costs
- Changes in soil texture



https://www.researchgate.net/profile/Hridesh-Harsha-Sarma/publication/382397006/figure/fig1/AS:11431281261283394@1721451542698/Working-principle-of-AWD-technique-Source.jpg

RESEARCH AREAS NEEDING ATTENTION

- Optimize water management for drought resilience
- More research in AWD
- Water quality monitoring and management (AI-based approaches)
- Zero grade rice farming
- Water conservation in organic rice production
- Changes in As and Cr uptake dynamics by rice under aerobic vs. anerobic conditions
- Rice-crawfish production systems (E of Houston)
- Upland rice varieties?

POSSIBLE COLLABORATION OPPORTUNITIES

Cross-disciplinary collaborations

- Water management and precision agriculture
- Crawfish or aquiculture specialists
- Molecular biologists (e.g., genes responsible for drought tolerance)
- Extension specialists for rice crawfish production systems

ON-GOING PROJECTS TO ADDRESS WATER

- AWD in progress
- Identification of high-performing
- genotypes under AWD
- Screening for drought tolerance in rice
- N use efficiency of rice cultivars
- Improve the water use efficiency of rice

TEXAS A&M AGRILIFE RESEARCH AND EXTENSION BEAUMONT AND EAGLE LAKE

- Dr. Wilson
- Dr. Dou
- Dr. Rustom
- Dr. Samonte

Texas A&M AgriLife Research and Extension Center- Dallas

Daniel Leskovar, Ph.D.- Center Director

MAJOR WATER-RELATED CONCERNS

Turfgrass

- Rapid urbanization and recurring drought are leading to higher water demand
- Existing infrastructure was not originally designed to support current population levels
- Many systems are outdated and struggling to meet growing needs
- Increased frequency of floods

Urban Water

- Stormwater management and (runoff) mitigation
- Long-term watershed planning, protection, and management
- Water conservation and outdoor water use management
- Water supply security given the economic development

MAJOR WATER-RELATED CONCERNS, CONTD

CEA Engineering

- Shrinking reservoirs and rising urban demand due to long-term climate trends are reducing water availability for urban agriculture, including CEA.
- Municipal water may contain chemicals (e.g., chlorine, calcium, magnesium) that disrupt nutrient uptake and plant health.
- CEA systems such as hydroponics are water-efficient (up to 90% less use) through nutrient solution recirculation but require filtration and monitoring, especially since open-loop systems can undermine those savings.

Ecological Engineering

- Flood Reduction
- Stormwater quality
- Nature-based solutions (NBS)
- Streambank stability

MAJOR ADVANCES IN RESEARCH

Turfgrass

- Stormwater management planning and rainwater harvesting
- Developing drought resistant cultivars of turfgrass species
- Developing salinity tolerant cultivars of turfgrass species to reduce dependency on freshwater resources
- Refining irrigation and N fertilizer recommendations for improved turfgrass cultivars
- Turfgrass end-user education on water conservation practices

Urban Water

- Improving the understanding of green stormwater infrastructure benefits and its ability to mitigate runoff volume and water pollutants to improve water quality
- Informing long-term flood and infrastructure planning through precipitation projections
- Use of integrative and holistic water conservation and environmental stewardship using citizen science and education

MAJOR ADVANCES IN RESEARCH, CONTD

CEA Engineering

- Optimal farm water management using AI-enabled crop water stress-based irrigation systems and soil moisture sensor driven smart irrigation. (Current NRCS project)
- Low-cost sensors and IoT systems are being developed to continuously monitor pH, EC, NPK, chlorine, and others in irrigation water. (On going work in collaboration with UT-Tyler)
- Liquid desiccant system to regulate greenhouse humidity while generating water for irrigation purposes (Submitted proposal)

Ecological Engineering

- Modeling impact of nature-based solutions at city-scale
- Developing criteria for nature-based solutions implementation in urbanizing areas
- Investigating incentives and barriers to adoption of nature-based solutions

RESEARCH GAPS AND LIMITATIONS

Turfgrass

- Adoption of new turfgrass cultivars or irrigation technology is slow: research on economic cost-benefit analysis and consumer behavior is much needed
- Limited use of recycled water for landscape irrigation, industrial processes, toilet flushing, etc.
- There is a poor understanding of how synthetic turf, as a landscape alternative, affects water quality.
- Inefficient production practices hinder the widespread adoption of native forbs as alternative lawn species.

Urban Water

- Wholistic and comprehensive research and outreach approaches on Green infrastructure and conservation technologies, including water smart technologies, for wide-scale acceptance and application
- Reliability of existing infrastructure to adapt and respond to the water-related natural disasters in the area
- Water-efficient landscape plant material adoption, and the choice of Natural turfgrass vs artificial turfgrass in residential neighborhoods
- Impacts of data centers on local water supply and ways to improve their water conservation practices/technology
- Understanding the psychological and motivational barriers and solutions to adopting water conservation practices at the household and community levels with measurable impacts.

RESEARCH GAPS AND LIMITATIONS, CONTD

CEA Engineering

- Advances in using atmospheric water generation (AWG) for CEA systems such as low-power compressors, solar-powered AWG, and thermoelectric cooling systems.
- Integration of crop evapotranspiration models with plant wearable sensors and AI based prediction to optimize irrigation scheduling for crops and microclimate control (greenhouse humidity).
- Research on advanced filtration (e.g., activated carbon, nanofiltration) and other treatments to remove chlorine, salts, and contaminants from municipal or recycled/rainwater in hydroponic systems.

Ecological Engineering

- Representation of NBS in models
- Performance of NBS at field scale with regard to new pollutants (e.g. PFAS)
- Increasing workforce literacy regarding NBS and NBS maintenance

FUTURE COLLABORATIONS

Turfgrass

- Collaboration on emerging contaminants
- Collaboration on the use of recycled water
- Collaboration with consumer scientists and economists
- Collaborations on mixed species lawns.
- Interdisciplinary collaboration to gain better knowledge of water infiltration, retention, and movement within urban soil systems

Urban Water

- Urban water team and faculties at AgriLife and A&M, including the Turfgrass team, on the applied technologies and management approaches to upscale and innovate adoption and behavior change.
- AgriLife, Dallas center, and regional partners, cities/ utilities/water districts, to meet and greet to explore collaborations.
- Urban water team and Parks and Recreation for Green stormwater infrastructure implementation.
- Urban water team and Texas Forest Service for urban landscape management, maintenance, and design.

FUTURE COLLABORATIONS, CONTD

CEA Engineering

- Collaboration to integrate solar energy and material sciences research to advance atmospheric water generation for CEA systems (e.g. high-performance desiccant materials, thermoelectric cooling etc.)
- Collaboration to develop new water filtration/desalination technologies for urban stormwater, rainwater, or hydroponic solution for water reuse.

Ecological Engineering

- Scientist working on emerging contaminants
- Modelers
- Soil Scientists

ON-GOING PROJECTS

Turfgrass

- Development of drought resistant turfgrass cultivars like ‘Cobalt’ St. Augustinegrass. USDA NIFA SCRI funded research has shown that under drought stress conditions, Cobalt exhibits 51.5% genetic gain in turfgrass quality over ‘Raleigh’ and 40.1% over ‘Palmetto’, which are the two most commonly used cultivars (doi:10.1002/csc2.21393)
- Development of salinity tolerant zoysiagrass varieties for golf course putting greens, fairways and home-lawns. doi: 10.48130/TIH-2022-0008
- Turfgrass breeding program has initiated a research effort to develop turf-type buffalograss, which is one of the most drought tolerant warm-season turfgrass species, and native to the great plains of North America. Germplasm collection is underway. Help us with our germplasm collection effort!
- We recently finalized a project focused on refining the crop coefficients for TifTuf bermudagrass and Cobalt St. Augustinegrass to take advantage of the reduced irrigation requirements of these improved turfgrass cultivars.
- The Sustainable Turfgrass Management program will assess the inclusion of legumes into lawns to take advantage of their nitrogen fixation capabilities and reduce the necessity of nitrogen fertilizers, which are linked to nutrient non-point source pollution.

ON-GOING PROJECTS, CONTD

Urban Water

- Green stormwater infrastructure planning and adoption – Dr. Jaber (and team); Dr. Heidari (and team)
- Multiple Watershed protection planning and implementation projects across DFW– Dr. Jaber (and team); Dr. Heidari (and team)
- Landscape water efficiency education and application – Minchillo; Dr. Boeri
- Projection of hydrologic intensity duration frequency parameters and their uncertainties up to 2100 for extreme precipitation – Dr. Heidari (and team); Dr. Jaber (and team)
- Landscape water-efficient plant material development and research– Dr. Chandra (and team); Dr. Boeri

CEA Engineering

- Title: Edge-IoT-enabled smart irrigation management system for urban and small farms
- Agency: USDA-NRCS
- Objectives: To develop an edge-IoT-driven smart irrigation system for high-value crops grown in urban and small farms. The key features of the system include an edge-IoT communication framework using LoRa and Bluetooth Low Energy (BLE) technologies for real-time monitoring and control and IoT node clustering to reduce energy consumption for an extended network lifetime.

CEA Horticulture

- Co-PI on a project (IHA), using treated municipal wastewater effluent to irrigate food crops “Safe and sustainable agriculture: Using reclaimed municipal wastewater for crop irrigation and managing emerging contaminants”.

ON-GOING PROJECTS, CONTD

Ecological Engineering

- Transportation Stormwater Infrastructure project (Funded by TWDB. GLO and FHWA)

- Several watershed Plan implementation projects (Arlington, Denton, Dallas) funded by TCEQ/EPA

- Developing Watershed Protection plan for Rowlett Creek (TCEQ/EPA)

- Watershed Characterization for White Rock Creek Watershed

Texas A&M AgriLife Research and Extension Center-Uvalde

Daniel Leskovar, Ph.D.- Center Director

MAJOR WATER-RELATED CONCERNS

- The Wintergarden region of southwest Texas has major water-related concerns.
- Extreme droughts, severe groundwater depletion and lower underground water table (triggered restrictions based on J-17 and J27 well levels; currently Stage 3 with 35% reduction in municipal water pumping in San Antonio and Stage 5 with 44% reduction).
- Reduced water availability for agriculture, including urban farming, due to water competition with rapid urban growth.
- Urgent requirement for improving crop water use efficiency and drought resistance in field and vegetable crops, especially in high-water demand crops (onions, watermelons).
- Testing alternative drought-tolerant crops (guayule, foxtail millet, proso millet, sesame).

MAJOR ADVANCES IN RESEARCH

Agronomy

- The Uvalde agronomy group has tested, developed and applied efficient methods for crop drought resistance screening, including the application of ground penetrating radar for plant root mass detection (wheat and energy cane), leaf wax carbon isotopes as proxies for water use efficiency (wheat), leaf water relations traits for drought tolerance screening (cotton, onion), leading to estimated water savings of $3.3 million in the Wintergarden region.

- The group developed novel strategies, such as a Bayesian statistics-based root water uptake modeling tool (cotton) and irrigation timing (corn) to improve transpiration quantification and increase crop use efficiency.

MAJOR ADVANCES IN RESEARCH, CONTD

Horticulture

- Breeding and trialing of drought-resistant crop varieties.

- Use of grafting as alternative production method for novel high-value tomato and sweet-hot pepper types for conventional and organic fields.

- Adoption of horticulture crop production systems in controlled environments (e.g. high tunnels, hydroponics).

- Demonstrated that silicon application enhances WUE in hydroponically grown lettuce.

- Evaluating how different hydroponic system designs (NFT, DWC, and Vertical) impact WUE. We found that vertical hydroponic systems significantly improved WUE compared to NFT and DWC, though they require greater maintenance.

- Solid humic substance increased heat stress tolerance by increasing shoot growth, WUE, and transpiration of spinach.

MAJOR ADVANCES IN RESEARCH, CONTD

Molecular Physiology

- Identified molecular markers and candidate genes linked to natural variation in transpiration efficiency in spinach through Genome Wide Association Studies (GWAS) and parental lines with higher water use efficiency (WUE).

- Transcriptomic studies have identified genes and regulatory networks involved in the drought stress response in onion and sesame roots, facilitating the development of more resilient crops.

- The functional characterization of citrulline, a strong osmolyte and hydroxyl radical scavenger in watermelons, plays a crucial role in maintaining water balance and protecting against drought-induced oxidative stress. Understanding its molecular mechanism suggests its potential translatability to other crops, enhancing drought tolerance.

RESEARCH GAPS AND LIMITATIONS

- Accuracy of plant water use and independent measurements of crop evapotranspiration requires using in-ground lysimeters. Currently we are using certain indirect methods and simplified models for water use estimation, but do not have functional lysimeters at the Uvalde Center.

- Optimizing irrigation scheduling by developing precise controlled and automatic drip systems.

- Studies to evaluate the long-term sustainability or economic feasibility of high-efficiency urban farming systems under real municipal restrictions.

- Research on nutrient cycling, energy use, and multi-crop systems in vertical or recirculating hydroponic systems, particularly in water-limited settings.

- Adoption barriers (cost, maintenance, technical knowledge) in small-scale or community-based urban farms must be addressed to support broader implementation.

- Advances in multi-source data acquisition and processing to inform irrigation management decisions, and the quantification of real water use savings from various management and cultivation practices.

- Promoting the adoption of water saving advancements to growers requires collaborative efforts with Extension and other public institutions.

FUTURE COLLABORATIONS

- Multi-collaborations together with other Centers/Institutions to garner sufficient resources for building field lysimeters capacity for water balance studies in a water limited region and for more accurate water use quantification required in crop physiological research.

- Precision irrigation: Collaborating on data capture, processing, and implementation to improve irrigation systems and decision making.

- Partnerships with utility/regional water agencies (e.g., SAWS, EAA) to align urban agriculture practices with city drought management plans.

- Interdisciplinary projects linking breeders, agronomists, horticulturists, engineers, soil scientists, and urban planners to co-develop scalable urban farming solutions.

- Extension networks and local organizations to promote adoption of WUE practices among community gardens, schools, and commercial local farms.

- Collaborating with industry partners to trial various material innovations, including controlled environments (e.g. high tunnels, container farming), biostimulants, soil amendments, drip technologies, smart controllers, sensors and imaging devices.

ON-GOING PROJECTS

- Texas A&M AgriLife Uvalde is pursuing multiple research routes to address water-related issues.
- We are conducting water use-related crop physiology studies at Uvalde Center using Seed grants from Texas A&M Vegetable and Fruit Improvement Initiative and Cotton Incorporated, as well as partnering with Texas A&M Extension Service, Department of Statistics, and international institutions such as Federal University of Rondonópolis, Brazil and University of Palermo, Italy and University of Catania, Italy.
- Dr. Xuejun Dong (Crop Physiology) and Dr. Subas Malla (Vegetable Breeding/Genetics) are working collaboratively on onion drought tolerance and irrigation management research to understand the water requirement and optimize irrigation scheduling in onion cultivars - yellow, red, and white types.
- Dong is also collaborating with Dr. Ben McKnight and Dale Mott (AgriLife Extension College Station) and Dr. Quan Zhou (TAMU-Statistics) in cotton drought tolerance screening and water use studies.
- Dong is collaborating with Dr. Thiago Duarte (professor and visiting scholar, Federal University of Rondonópolis, Brazil) to estimate cotton transpiration and develop crop water stress index (CWSI) using energy balance based biophysical models.
- Dong's program has recently hosted visiting PhD student Giuseppe Vitale (Univ. of Catania, Italy) and is currently hosting PhD student Noemi Tortorici (Univ. of Palermo, Italy) in conducting cotton drought tolerance study at the Uvalde Center.

ON-GOING PROJECTS, CONTD

- Leskovar's Vegetable Physiology team is evaluating system-level impacts of NFT, DWC, and vertical hydroponic setups on WUE and horticulture crop performance.

- Exploring different types of biostimulants for their capacity to reduce water loss and operational demands in vertical (leafy greens) and high tunnel for specialty peppers and cucumbers in organic systems.

- Investigated the role of partial root drying (PRD) on grafted tomato. Overall, PRD showed promise as a water-saving strategy, maintaining yield and improving fruit sweetness in tomato.

- Trialing novel, drought-resistant crop varieties and assessing the impacts of specialty crop grafting with drought-resistant rootstocks (collaboration with HORT-TAMU, USDA-SCMP and KAUST University) .

- We recently hosted a visiting Fulbright scholar Dr. Goitse Malambane, University of Botswana, who conducted research evaluating the role of biostimulants under deficit irrigation of seedless (3x) watermelon.

Texas A&M AgriLife Research and Extension Center-Weslaco

Beth Racine, Dr.PH.- Center Director

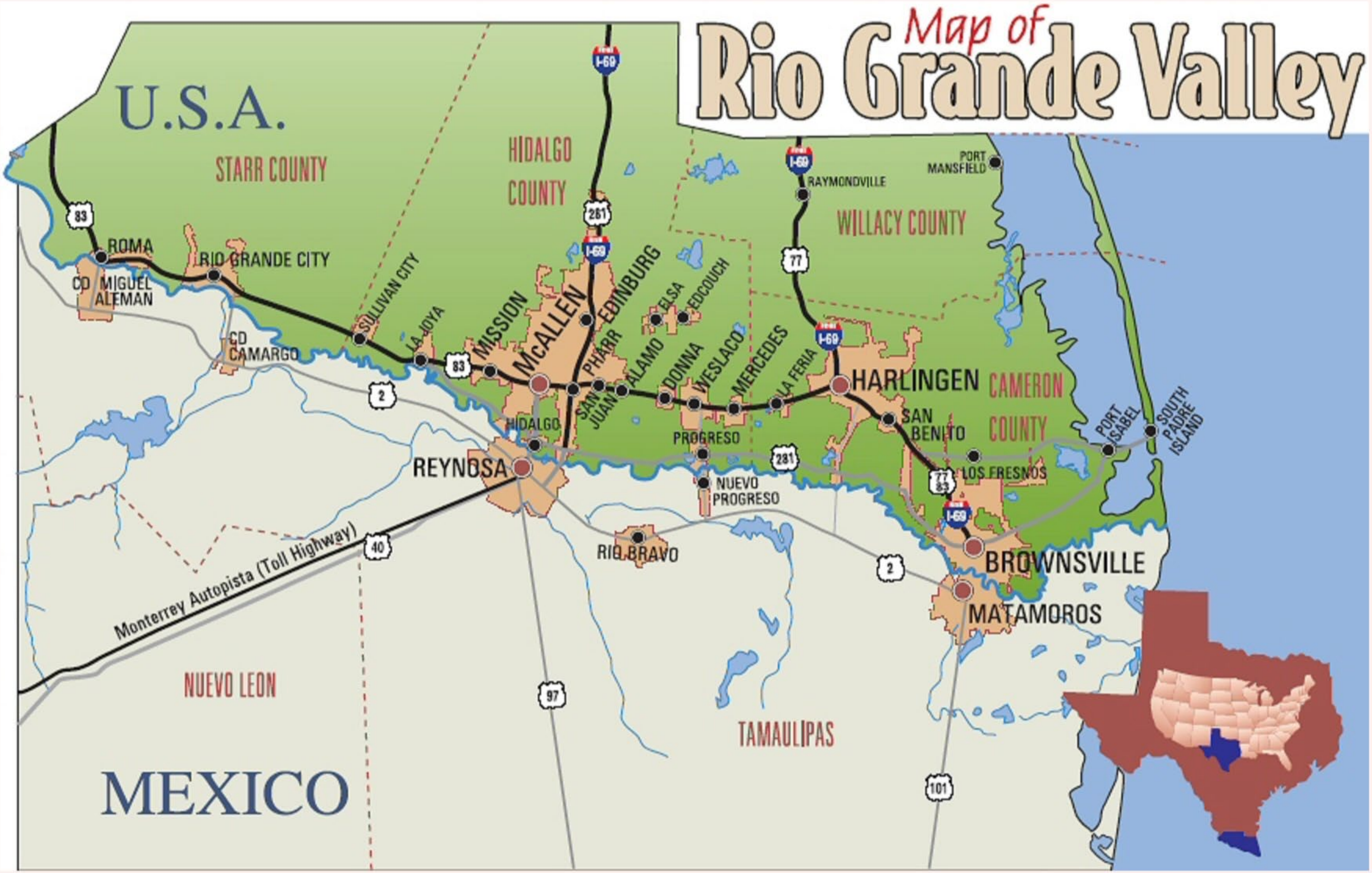
AgriLife Research Center at Weslaco

Beth Racine, DrPH, RD

Texas A&M AgriLife Research Center at El Paso, Director

Texas A&M AgriLife Research | Texas A&M University Nutrition | Texas A&M AgriLife Extension | USDA Regional Food Business Centers Rio Grande Colonias

agriliferesearch.tamu.edu



Map of
Rio Grande Valley
U.S.A.
STARR COUNTY
HIDALGO COUNTY
WILLACY COUNTY
CAMERON COUNTY
ROMA
RIO GRANDE CITY
CD MIGUEL ALEMAN
CD CAMARGO
SULLIVAN CITY
LA JOYA
MISSION
McALLEN
EDINBURG
PHARR
SAN JUAN
ALAMO
ELSA
EDCOUCH
DONNA
WESLACO
MERCEDES
LA FERIA
HARLINGEN
SAN BENITO
RAYMONDVILLE
PORT MANSFIELD
PORT ISABEL
SOUTH PADRE ISLAND
LOS FRESNOS
BROWNSVILLE
MATAMOROS
HIDALGO
REYNOSA
PROGRESO
NUEVO PROGRESO
RIO BRAVO
Monterrey Autopista (Toll Highway)
NUEVO LEON
TAMAULIPAS
MEXICO
I-69
83
281
77
2
40
97
101

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Rio Grand Valley Water News

RUNNING OUT: TEXAS' WATER CRISIS

U.S., Mexico agree to new deal that sends water to South Texas

The latest development in a years-long push by South Texas farmers and officials to get Mexico to fulfill a 1944 treaty would still fall short of what is owed.

BY BERENICE GARCIA APRIL 29, 2025 3 PM CENTRAL

2025-04-29 15:03 CDT

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USDA Announces $280 Million Grant Agreement to Support Rio Grande Valley Agricultural Producers Amid Severe Water Shortages

PRESS RELEASE

USDA Announces $280 Million Grant Agreement to Support Rio Grande Valley Agricultural Producers Amid Severe Water Shortages

PUBLISHED: March 19, 2025

SHARE:

What are the major water-related concerns in your Center's region

Water use efficiency- To develop cropping systems (planting geometry, and row spacing configurations)., and irrigation strategies (deficit irrigation, the use of plastic mulches, drip irrigation) to maximize production per unit of water

Irrigation Scheduling- use of soil water sensors, and crop evapotranspiration data to conserve water.

Salinity Management

Using high-throughput phenotyping to select the most drought and salinity-tolerant varieties.

Using imagery data and drone-derived data to manage the crop

TEXAS STANDARD™
THE NATIONAL DAILY NEWS SHOW OF TEXAS

ALL OUR STORIES TOPICS FIND A SHOW

Texas' only sugar mill closes after 50 years in the Rio Grande Valley

Drought and inadequate water supplies devastated sugar cane harvests.

Texas' citrus industry — once an agricultural powerhouse — is on the brink of disaster

A hurricane and winter freeze devastated the South Texas industry. A lack of water is preventing a full recovery.

BY BERENICE GARCIA DEC. 19, 2024 1 PM CENTRAL SHARE REPUBLISH ↗

TEXAS A&M AGRILIFE

https://weslaco.tamu.edu

Texas A&M AgriLife

What are the major advances in research being conducted?

- Through imagery analysis, we can estimate canopy cover, height, volume, and relate this to water use.
- We can develop incremental water need estimates based on crop traits.
- We can develop more precise crop production estimates for different crop varieties.

What collaboration would you like to see moving forward regarding these issues?

We'd like to work with

- physicists to develop additional soil water sensors.
- Extension economists to develop irrigation strategies.

What are some on-going projects addressing these issues/what faculty member at your Center are addressing these issues

Development of Germplasm Resources and Molecular Breeding Tools To Combat Endemic diseases in US spinach production -funded by USDA-NIFA

Water Conservation Strategies for Producing Specialty Crops in the Lower Rio Grande Valley- TWDB

Advising in Irrigation Technology to La Feria Irrigation District- La Feria Irrigation District

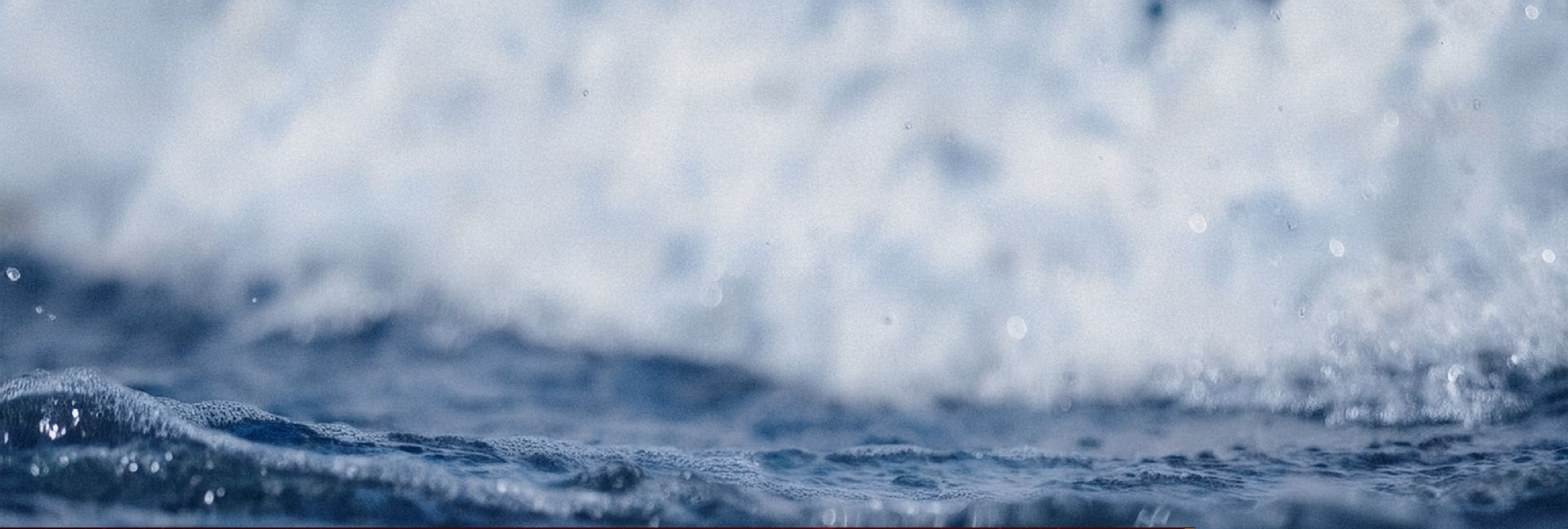
Irrigation Strategies for Water Conservation in Citrus Orchards. Submitted to TWDB

Irrigation of biodiesel and energy crops. Funded by Shell Co. The project was recently completed.

What are areas where current research may be lacking?

We need low-cost and more accurate soil water sensors. The soil water sensors available on the market are not very reliable and are expensive.

There is a need to work as a team, including engineers, sociologists, and economists, to develop incentives for water conservation strategies.



Texas A&M AgriLife Research and Extension Center- El Paso

Beth Racine, Dr.PH.- Center Director

Water In El Paso

Beth Racine, DrPH, RD

Texas A&M AgriLife Research Center at El Paso, Director

What are the major water-related concerns in your Center's region

Water scarcity and frequent drought

Groundwater pumping and depletion

Shared transboundary water sources (New Mexico, Texas, Mexico)

Traditional Flood Irrigation Practice

High salinity in soils and of marginal water sources

Support El Paso Water Management Goals

EL PASO MATTERS

FREE NEWSLETTER DONATE

Latest News · Special Projects · Events · Fact Checks · Podcast · Book Club · Commentary

ENVIRONMENT

As drought, climate change pressure El Paso water supply, farmers innovate to sustain orchards in one of nation's biggest pecan-growing hubs

From lab-developed soil treatments to cover crops, farmers explore new technologies, techniques to protect pecan orchards in a hotter, drier future.

RUNNING OUT: TEXAS' WATER CRISIS

To avoid a water crisis, Texas may bet big on desalination. Here's how it works in El Paso.

Desalination can create millions of gallons of fresh water a day. But it is expensive and there are many environmental concerns.

BY ALEJANDRA MARTINEZ, GRAPHICS BY CARLA ASTUDILLO APRIL 11, 2025 5 AM CENTRAL SHARE REPUBLISH

RUNNING OUT: TEXAS' WATER CRISIS

Toilet to tap: El Paso is about to embark on a whole new way to save its limited water supply

El Paso's dry climate — it rains just 9 inches annually — is one of the reasons the city has taken water management so seriously.

BY ALEJANDRA MARTINEZ APRIL 10, 2025 1 PM CENTRAL SHARE REPUBLISH

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ENVIRONMENT

As it seeks to drought-proof El Paso, city's water utility breaks ground on first-of-its-kind water recycling plant

by Diego Mendoza-Moyers March 9, 2025

Facebook X

What are the major advances in research being conducted?

Using multiple data collection methods to predict water availability

- El Paso
- Crossing Boundaries—New Mexico, Texas, Mexico

Precision arid water management in rural and urban areas

Reuse and treatment of marginal water sources

Resilient management strategies

https://elpaso.tamu.edu

What collaboration would you like to see moving forward regarding these issues?

Regional and Binational Partnerships:
International Boundary and Water Commission (IBWC)
North American Development Bank
Texas Water Development Board
US Geological Survey
Texas Water Research Institute

Multi-Institutional Research Programs

State Policy and Planning Agencies: Coordinating research outputs with Texas Water Development Board (TWDB), Texas Commission on Environmental Quality (TCEQ), and Far-West Texas regional water planning group (Region E) to ensure findings translate into actionable water management policies and water infrastructure investments.

What are some on-going projects addressing these issues/what faculty member at your Center are addressing these issues

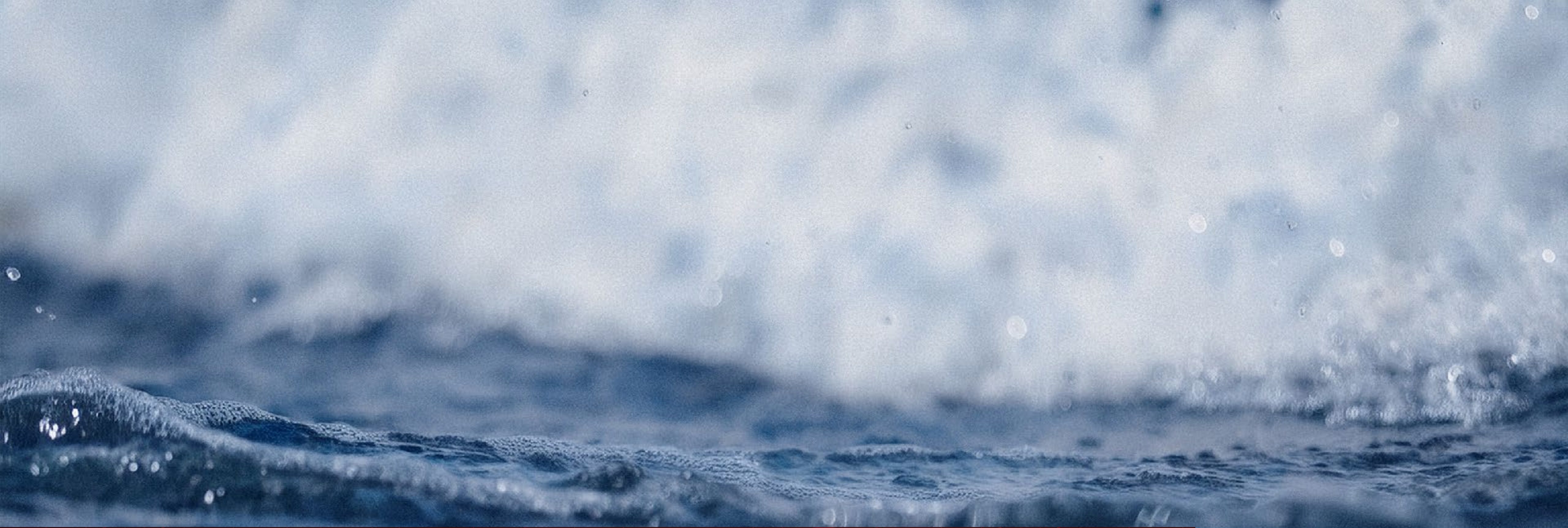
- Alternative crop research
  - Canola
  - Quinoa
- Alternative irrigation research (e.g. drip irrigation, recycled water)
- Water modeling using a variety of data sources
- Funding from El Paso Water, Texas Water Board, USDA, National Science Foundation

What are areas where current research may be lacking?

Transbounday community and research engagement and policy translation

Socio-economic barriers to technology adoption

Contaminant accumulation long-term impacts



Texas A&M AgriLife Research and Extension Center-Overton

Vanessa Olsen, Ph.D.

OUR MAJOR WATER CONCERN

Drought

MAJOR ADVANCES IN RESEARCH

- Evaluation of rooting and water use of cowpea (**Gerald Smith and Monte Rouquette**)
- **Prem Woli and Dr. Attia** have publications that are related to Drought and effects on Cropping Systems (listed below).

- *The El-Nino-Southern Oscillation Effects on Cowpea and Winter Wheat Yields in the Semi-Arid Region of the Southern US*
- *Estimating the yield loss of winter wheat from drought in the US Southern Plains Region as influenced by El Nino-Southern Oscillation (ENSO)*
- *Exploring the potential of Cowpea-wheat double cropping in the semi-arid region of the southern US using the DSSAT crop model*
- *Predicting the drought induced yield loss of cotton in the Southern Plains Region of the US Using a drought index*
- *Unlocking climate resilience by exploring the mitigation potential of improved rotation with cover cropping.*

RESEARCH LIMITATIONS

- Lacking research??
- Limitations include **money**, **faculty** and **interest/support** of faculty and clientele.
- In a high rainfall area, the assumption is that there are no water issues (except for drought)

ON-GOING PROJECTS

Prem Woli and **Dr. Ahmed Attia** are open to work with others on modeling of cropping systems, drought etc.

Texas A&M AgriLife Research and Extension Center-Temple

Jaehak Jeong, Ph.D.

Temple Programs Overview
- From field to globe

Texas A&M AgriLife Research

Current Programs and Activities

Temple Center: 6 research & extension faculty, 7 research scientists, 30 postdoc/students/associates, 3 admin staff

Keywords: Watershed modeling, digital agriculture, water reuse, data-driven research

Funding Agencies

- Local/State – TWRI, **TX-GLO**, TCEQ, TSSWCB, TWDB, **Water districts**, EAA, Producer boards, OCC, Various State NRCS'
- Industry: **IBM**, Chevron
- Federal – USDA NIFA-AFRI, **NRCS**, **EPA**, ARS, ERS, NASA, **BLM**
- International – FAO, NASA, TNC, **RDA**-South Korea, CRS

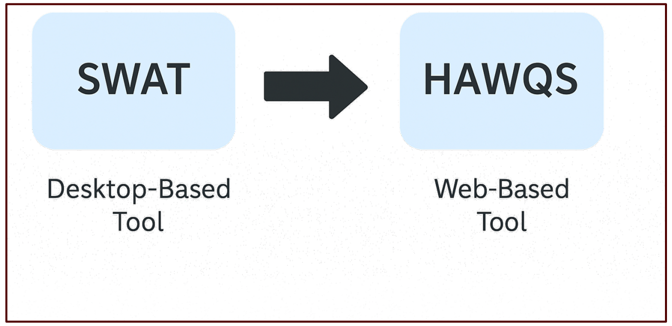
TEXAS A&M AGRILIFE RESEARCH

Raghavan Srinivasan

Professor & Director
Texas A&M AgriLife Research
Blackland Research and Extension Center

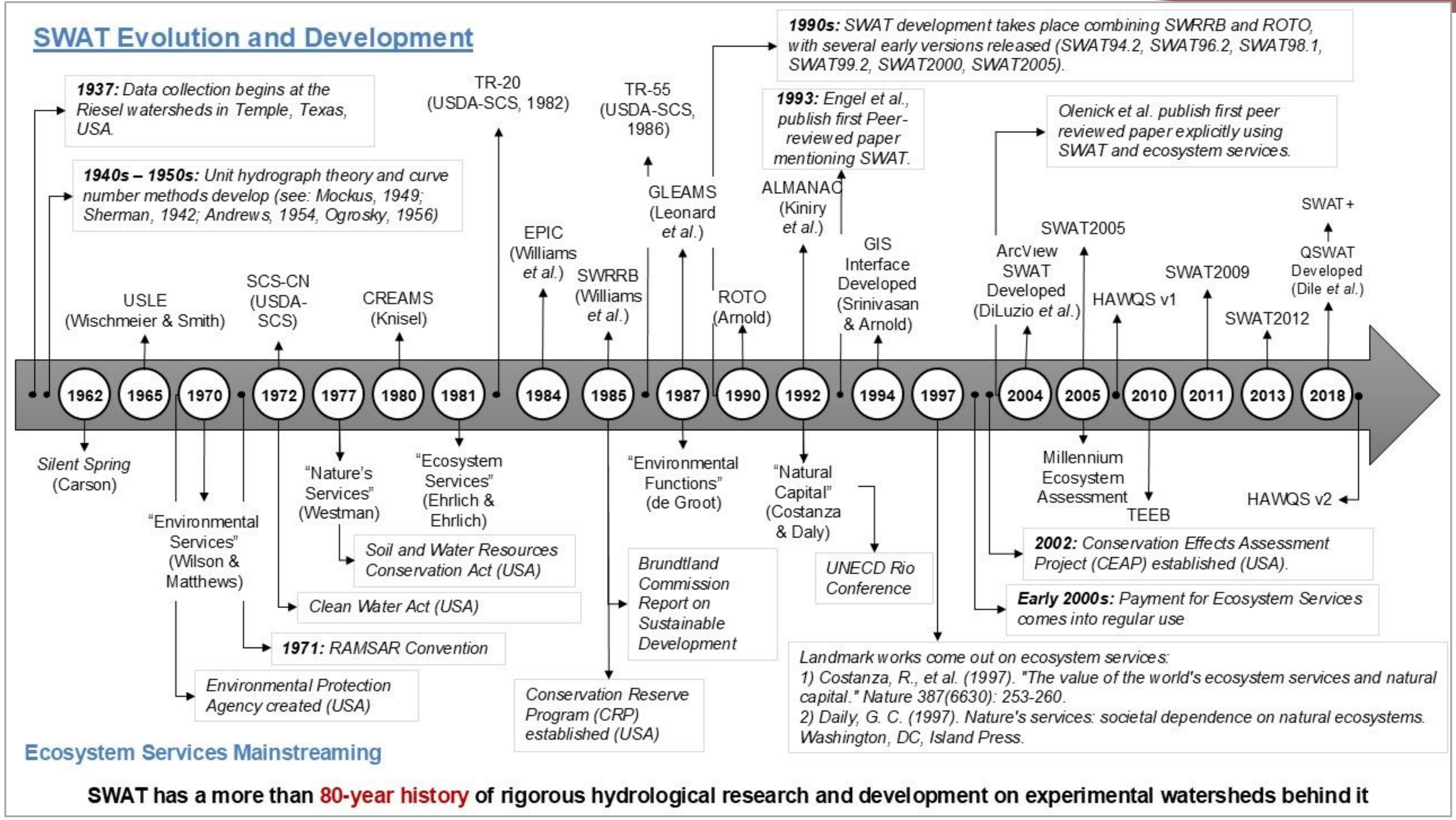
Program objective: water resource management

Research Interests: Ecosystem Sustainability



World renown scientist- one of the SWAT model developers

TEXAS A&M AGRILIFE RESEARCH



Desktop based tools to web-based decision support Systems

Anish Jantrania

Professor and Extension Specialist
Texas A&M AgriLife
Blackland Research and Extension Center
Biological and Agricultural Engineering

Registered Professional Engineer in TX and VA

Research Objective: Evaluate and demonstrate cost-effective and sustainable **onsite** water and wastewater infrastructure options

Research Interests: environmental monitoring, wastewater treatment and reuse

TEXAS A&M AGRILIFE RESEARCH

TAMU's OSSF Research Center

https://ossf.tamu.edu/

2-Acre facility on RELLIS with access to water and sewer lines, **wastewater treatment and reuse technologies, POU drinking water treatment technologies, and a field laboratory!**

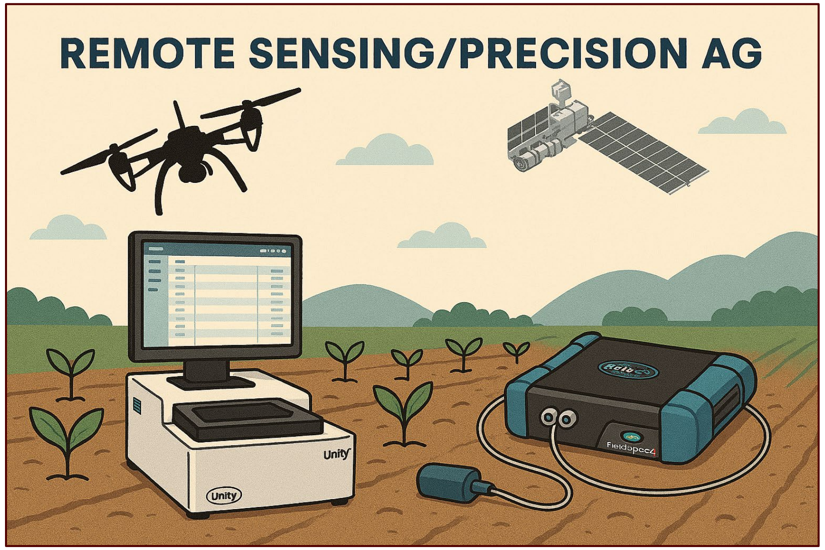
TEXAS A&M AGRILIFE RESEARCH

Gurjinder Baath

Assistant Professor- Digital Agriculture
Texas A&M AgriLife Research
Blackland Research and Extension Center
Soil and Crop Sciences

Program objective: Data-driven field research to support Texas producers and beyond

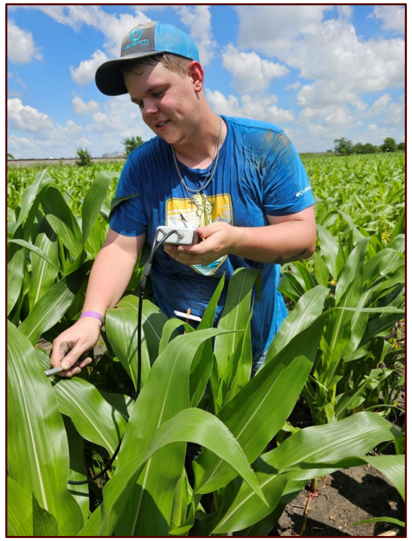
Research Interests: Cropping systems' research & modeling, Remote sensing, and precision agriculture



TEXAS A&M AGRILIFE RESEARCH

Digitalization for Sustainable Agricultural Systems

Field plots in Temple



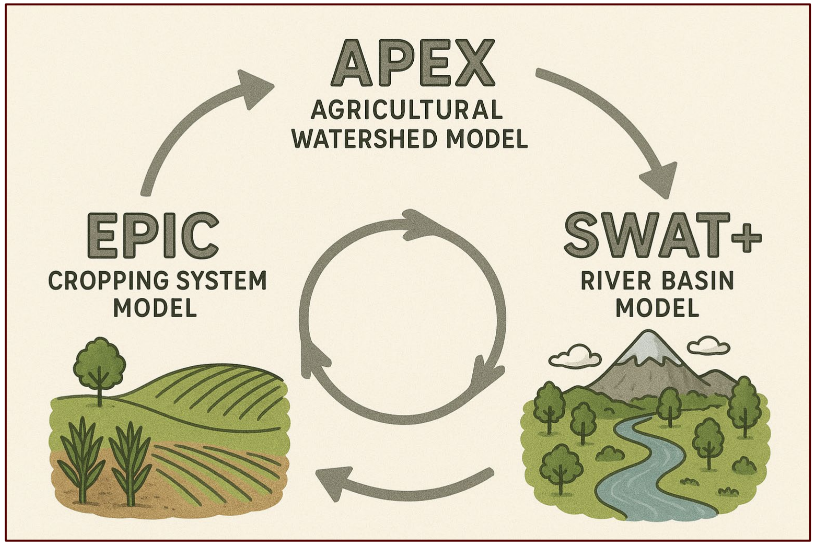
Texas A&M AgriLife Research

Jaehak Jeong

Regents Fellow Professor- Soil & Water Modeling
Jimmy Williams Chair in Natural Resources Modeling
Texas A&M AgriLife Research
Biological and Agricultural Engineering
Water Management and Hydrological Science

Program objective: Computer modeling for agricultural sustainability and natural resources conservation

Research Interests: APEX, EPIC, SWAT+ development and application for simulating soil and water



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Watershed Modeling System

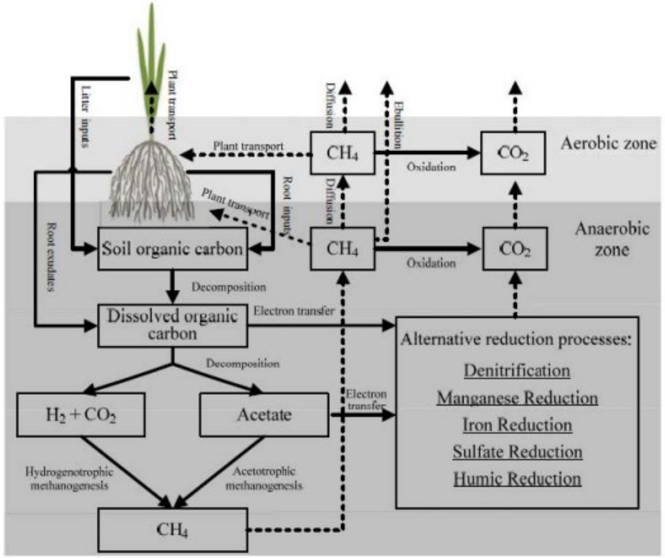
APEX
Agricultural Policy Environmental eXtender model

Agricultural Watershed & Land Management Simulation Model

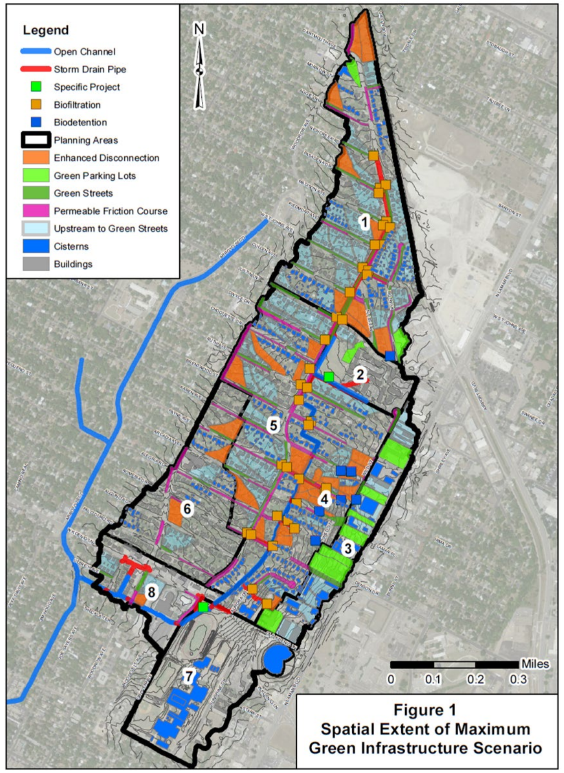
EPIC
Environmental Policy Integrated Climate model

A Crop & Soil Productivity Simulation Model

SWAT+
SOIL & WATER ASSESSMENT TOOL



Rice Paddy Agroecosystem Modules



Urban Flooding & WQ

TEXAS A&M AGRILIFE RESEARCH

Javier Osorio Leyton

Assistant Professor
Allan Jones Agroecosystem Modeling Scientist
Texas A&M AgriLife Research
Blackland Research and Extension Center
Rangeland, Wildlife, and Fisheries Management

javier.osorio@ag.tamu.edu

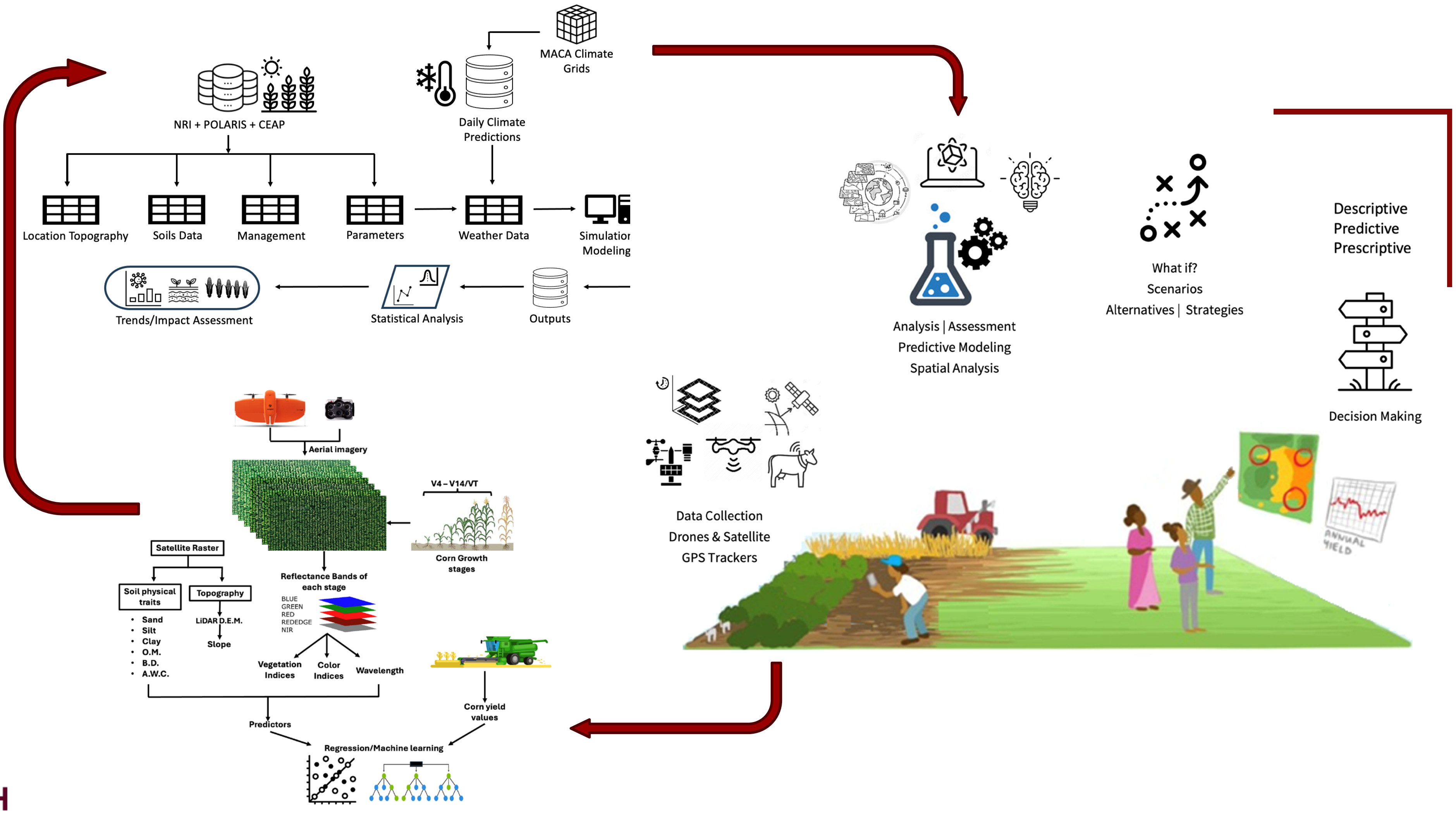
720 East Blackland Rd.
Temple, TX - 76502

Program objective: To lead research in spatial ecology powered by data to understand ecological processes across working lands.

Research Interests: Predictive Modeling and Decision Making.

TEXAS A&M AGRILIFE RESEARCH

Spatial Ecology for Working Lands and Natural Resources



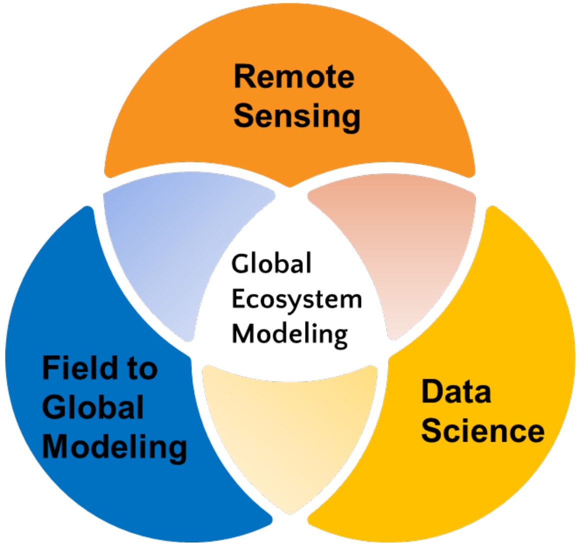
TEXAS A&M AGRILIFE RESEARCH

Arun Bawa

Assistant Professor- Global Ecosystem Modeling
Texas A&M AgriLife Research
Blackland Research and Extension Center
Biological and Agricultural Engineering

Program objective: Integrating data, models, and insights to guide global sustainability

Research Interests: Process based Modeling, Data Science, Remote Sensing



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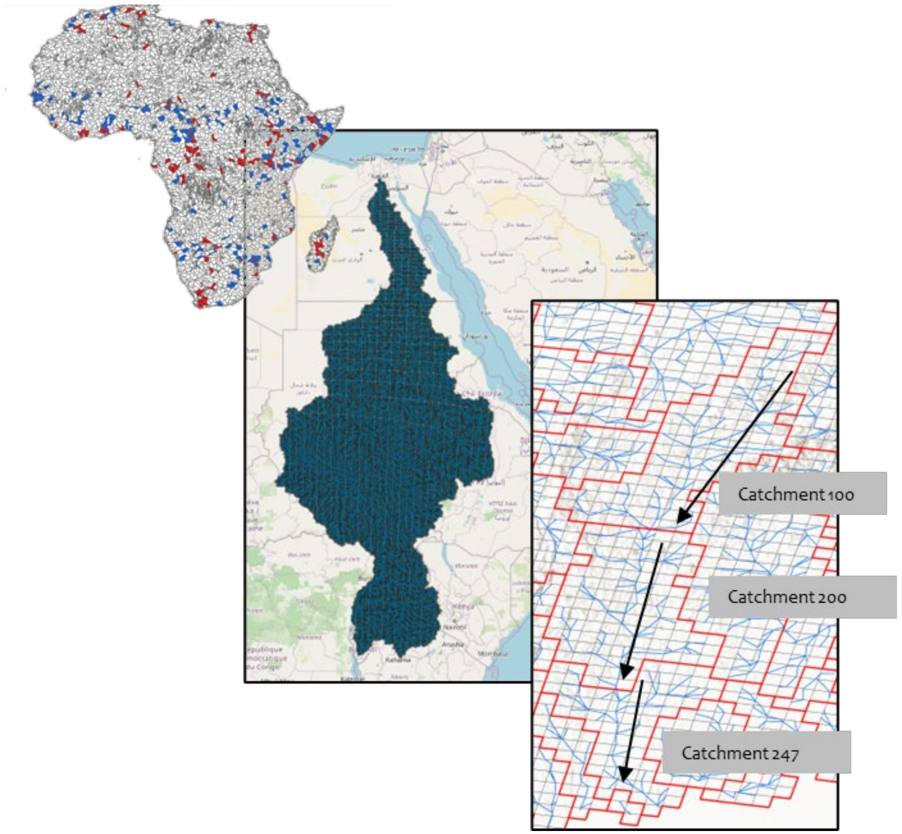
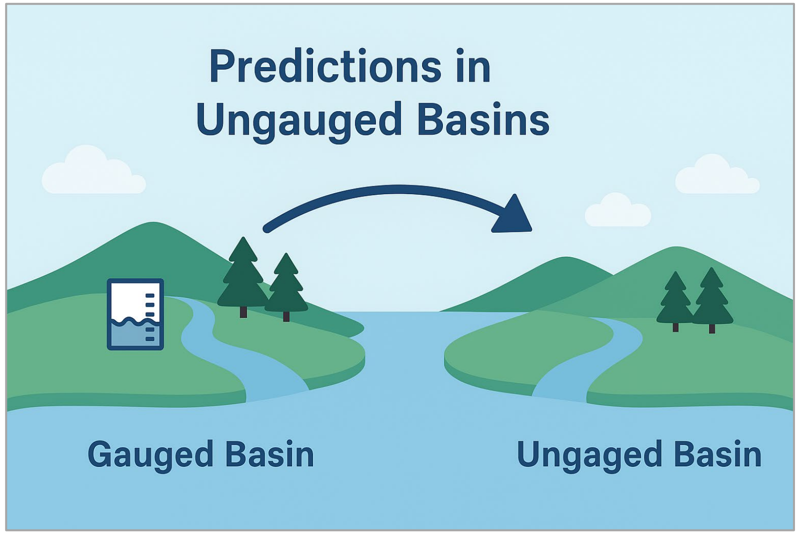
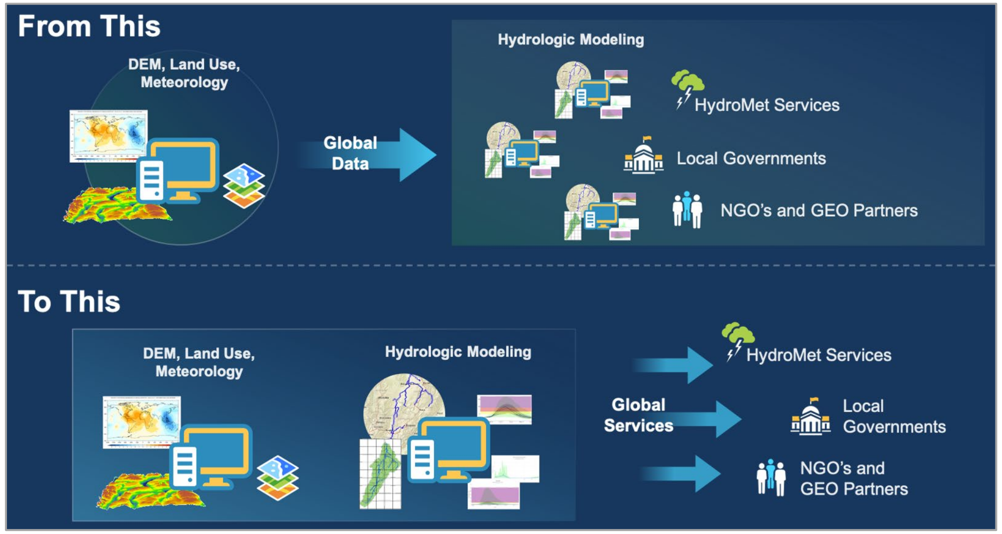
Global Ecosystem Modeling







TEXAS A&M AGRILIFE RESEARCH

June Wolfe III

Research Scientist
Texas A&M AgriLife Research
Blackland Research and Extension Center
Water Science Laboratory

Program objective: water resource management

Research Interests: environmental monitoring, wastewater treatment and reuse, flood mitigation

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Field Hydrology

- Instrumentation
  - Stormwater runoff
  - Sample collection
- Water quality
  - Nutrients
  - Sediment
  - Pesticides
- Watershed processes
  - Constituent export
  - Fate and transport

Wastewater Reuse

- On Site Sewage Facilities (OSSF)
  - RELLIS Water Reuse Lab
  - High strength and dosing
  - Aerobic treatment units
- RV park / Commercial OSSF
  - Usage characterization
  - Water quantity and quality
- Sensor development
  - Chlorine measurement
  - PFAS detection

Flood Mitigation

- Nolan Creek Flood Alert System
  - Assessment and recommendations
- Fort Hood Flood Warning Program
  - Management, planning, and education
  - Alert system expansion (gauge network)
- Leon Flood Mitigation Program
  - Flood forecasting models (e.g., SWAT)
  - Community engagement and education
  - Pilot alert system (gauge network)

Texas A&M AgriLife Research

Active projects (selected)

Local

- TX-GLO: Multipurpose flood mitigation toolset for two watersheds in *central Texas* flood forecasting-SWAT & HEC-RAS integration
- NRCS- Sustainable manure in agriculture (Temple-Stephenville-Vernon)
- EPA-319/TCEQ/TXGLO: funded OSSF research, wastewater quality data collection, continuation of coastal water impact assessment projects

National

- NRCS-CEAP: National assessment of conservation programs on croplands, rangelands, wildlife, and watersheds
- NRCS- Multi-Scale EPIC/APEX/SWAT Agroecosystem Modeling for Conservation Assessment

Global

- NASA- Satellite-based Crop Monitoring and Forecasting System- *Hindu Kush Himalayan* Region
- RDA-WISE: Global scale DSS for Predicting and Adapting to Drought and Flood Risks in Agriculture

Thanks!

720 East Blackland Rd
Temple, Texas

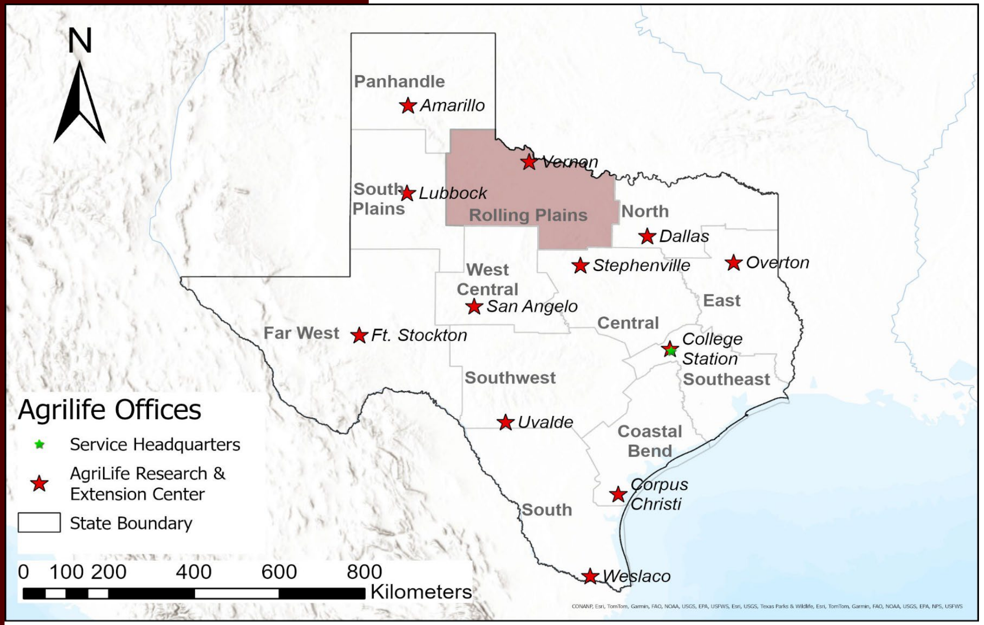
Texas A&M AgriLife Research and Extension Center- Vernon

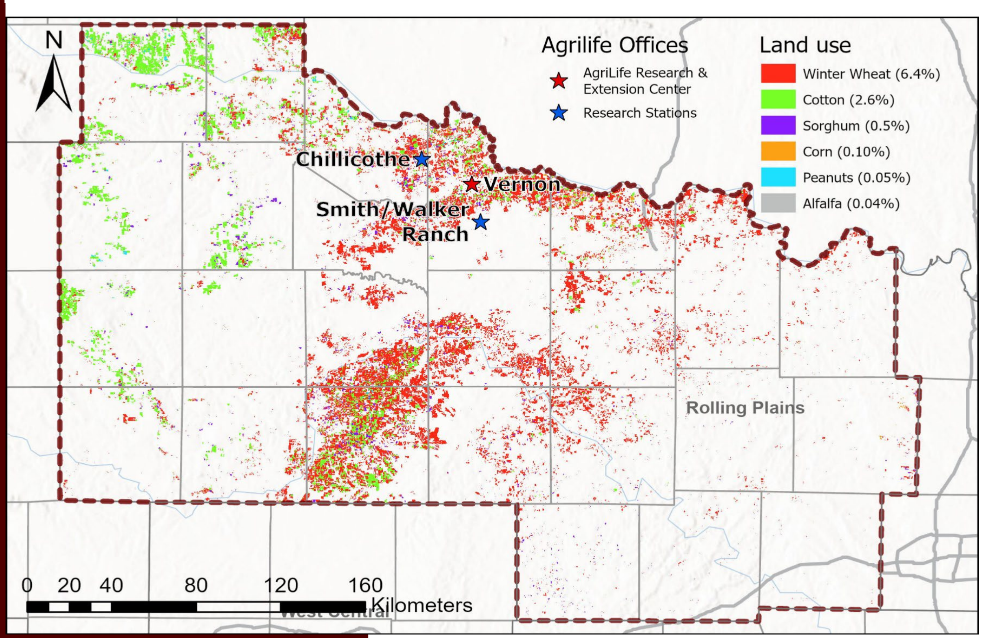
Srinivasulu Ale, Ph.D.

Water-related Challenges, Research Needs and Opportunities in the Texas Rolling Plains

Richard Vierling, Ph.D.
Center Director
Srinivasulu Ale, Ph.D.
Professor of Agrohydrology

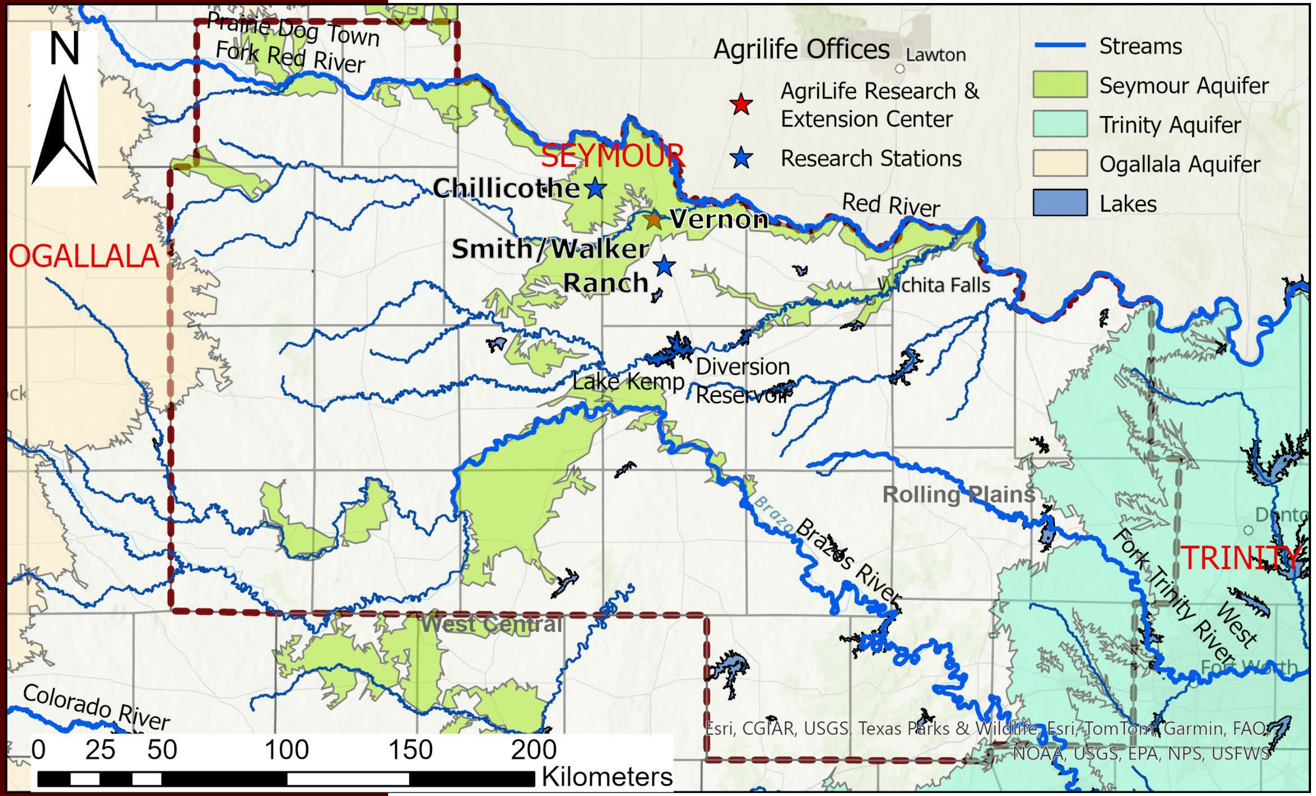
Texas Rolling Plains – Climate and Land Use





- Semi-arid region
  - Annual rainfall: 550 to 750 mm (22 to 30 in)
  - Hot summers and cool to mild winters
  - Low humidity and high evaporation rate
  - Occasional severe weather: thunderstorms, hail, tornadoes
- Land use
  - Shrubland: 38% (in the west)
  - Grasslands/pastures: 40% (in the east)
  - Major crops: winter wheat (6.4%), cotton (2.6%), sorghum, corn, peanuts, alfalfa, etc.
  - About 15% of cropland is irrigated
- Ideal location for conducting research on marginal crop production systems

Water Sources



- Major Aquifers
  - Seymour Aquifer is the primary groundwater source of irrigation and drinking water.
  - Ogallala Aquifer and Trinity Aquifer
- Major Rivers
  - Brazos River
  - Red River
  - Wichita River
  - Pease River
- Lakes
  - Lake Kemp
  - Lake Diversion

Water-related Challenges in the Rolling Plains

Declining Groundwater Resources and Limited Surface Water

- Declining groundwater levels in the Seymour, Ogallala and Trinity Aquifers
- Limited recharge rates
- Small reservoirs
- Sedimentation

Recurring Droughts and Extreme Weather Impacts

- Frequent and prolonged droughts
- Unpredictable rainfall patterns
- Increased temperature and longer heatwaves
- Increased evaporation and reduced soil moisture

Increasing Agricultural Water Demand

- High irrigation needs in the summer due to dry climate
- Inefficiencies in water use

Declining Soil Health and Degraded Agro-ecosystems

- Conventional tillage and monoculture
- Overgrazing
- Excessive soil erosion and loss of organic matter and nutrients
- Lower adoption rates of conservation practices

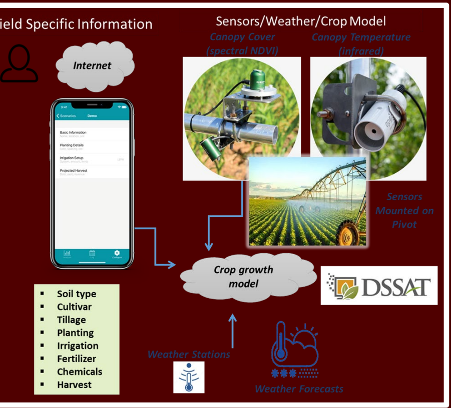
Water Quality Issues

- High salinity and contaminants (e.g., nitrates, pesticides)
- Naturally occurring arsenic, fluoride, etc.

Infrastructure and Management Challenges

- Aging water systems
- Inefficient water treatment plants
- Reliance on state and federal grants for repairs and improvements

Major Advances in Research



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- Long-term research on regenerative practices demonstrated potential of cover crops and conservation/no-tillage to reduce soil degradation while maintaining soil moisture for the subsequent cash crops – Paul DeLaune, Srini Ale, Emi Kimura, Bill Pinchak
- Introduced summer-dormant cool-season grasses to the Southern Great Plains to take advantage of cool season precipitation – Darius Malinowski
    - Developed and commercialized Yonatan tall fescue and Chillicothe orchard grass cultivars
- Long-term research on adaptive multi-paddock grazing showed potential to enhance water catchment functions and ecosystem services of rangelands – Richard Teague, Bill Pinchak, Srini Ale, Nuria Gomez-Casanovas
- Developed and evaluated water-use-efficient irrigation strategies and irrigation decision support tools – Srini Ale, Paul DeLaune, Curtis Adams
    - A prototype of a mobile app for irrigation decision support, idCROP was developed
- Alternative drought tolerant summer crops including guar and cowpea are being developed – Waltram Ravelombola
- Long-term research on bioenergy crops assessed the impact of a bioenergy landscapes on the water cycle and water quality in the Southern US – Nuria Gomez-Casanovas, Srini Ale
- Studies evaluating the impact of biofertilizers on water regulating ecosystem services in cotton production systems are in progress – Paul DeLaune, Nuria Gomez-Casanovas
- Studies assessing the influence of agrivoltaics deployment on soil health and soil moisture are in progress – Nuria Gomez-Casanovas

New Research Areas and Major Limitations

- Intelligent cropping systems and irrigation decision support tools
- Use of sensors, UAV data and AI models in irrigation and crop management
- Development of alternative crops and forages resilient to drought and heat stresses, and extreme weather
- Drought phenotyping – developing tools to reliably and cost-effectively phenotype for drought tolerance
- Summer-dormant cool-season grasses – more alternatives to wheat; more extension activities to share information and overcome barriers for adoption
- Regenerative/water-smart strategies for enhancing water conservation on crop and rangelands and protecting water quality
- Selection of cattle phenotypes adapted to increasing weather variability and forage conditions in the Southern Great Plains
- Managed aquifer recharge and use of alternative sources of water
- Interaction and synergies among water regulation and other ecosystem services for integrated assessments
- Coupled land-water-climate modeling at multiple scales to better understand feedbacks under different land-use/climate scenarios that are crucial for developing effective policies
- Major limitation for modeling is a lack of adequate short- and long-term monitoring data for model evaluation

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Potential Areas of Collaboration

- Need for interdisciplinary collaborations to develop holistic approaches that address both biophysical processes and socio-economic dimensions of land and water management on crop and rangelands
- Intelligent cropping systems, irrigation decision support tools – agronomists, irrigation engineers, physiologists, computer engineers and data scientists
- Regenerative agriculture and climate-smart practices – soil scientists, agronomists, hydrologists, ecologists, cattle nutritionists, animal scientists, and economists
- Alternative sources of water for irrigation, livestock and domestic uses – agronomists, hydrologists, chemical engineers, ecologists, animal scientists
- Water-food-energy-environment nexus – hydrologists, crop scientists, ecologists, social scientists
- High throughput phenotyping and gene-editing – breeders, plant physiologists, agricultural engineers
- Mechanisms of summer-dormancy in cool-season grasses – breeders, soil scientists, ecosystem modelers

Texas A&M AgriLife

Ongoing Projects and Faculty Expertise

- Enhancing corn water use efficiency through integration of sensor, crop model, and machine learning-based approaches (PI: Srini Ale; Co-PIs: Qingwu Xue, Thomas Marek, Jourdan Bell, Chukwuzubelu Ufodike); Funding: Water Exceptional Item
- Enhancing soil ecosystem health and resilience through pasture cropping (PI: Srini Ale; Co-PIs: Paul DeLaune, Nuria Gomez-Casanovas); Funding: USDA-NIFA
- Assessing the impacts of broader adoption of deficit irrigation practices on groundwater conservation in an agricultural watershed (PI: Srini Ale; Co-PIs: Jourdan Bell and others) Funding: USDA-ARS Ogallala Aquifer program
- Identification of climate resilient alternative field and forage crops for the Southern Great Plains (PI: Srini Ale; Co-PIs: Jourdan Bell and others) Funding: USDA-ARS Ogallala Aquifer program
- Breeding perennial cool-season forage grasses for a warming climate (PI: Dariusz Malinowski; Co-PIs: Bill Pinchak, John Ford, Alan Stewart, Derek Woodfield); Funding: Grasslands Innovation, New Zealand
- Utility-scale photovoltaics on rangelands: Influence on provisioning and supporting services and soil organic carbon dynamics (PI: Nuria Gomez-Casanovas); Funding: AgriLife Research/COALS
- Impact of soil algae amendments on productivity, nutrition and ecosystem regulating services of cropland. (PI: Paul DeLaune/Katie Lewis, Co-PIs Nuria Gomez-Casanovas and others); Funding: MyLand

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Ongoing Projects and Faculty Expertise

- Active participation of Center Faculty on projects led by other PIs:
  - Sustainable agricultural intensification and enhancement through the utilization of regenerative agricultural management practices (Paul DeLaune, Emi Kimura, Srini Ale, Bill Pinchak; PI: Katie Lewis)
  - Regenerative agriculture using treated produced water (Paul DeLaune, Srini Ale; PI: Katie Lewis)
  - Row Crops to Perennial Pasture: Feeding the World, Conserving Water, Enhancing Soil, and Safeguarding the Climate (Srini Ale; PI: Katie Lewis)
  - Strategies for sustaining the productivity of alfalfa under water limited environments of the Intermountain West (Srini Ale, Francisco Abello; PI: Srinivasa Pinamaneni, CSU)
  - Collaborative research on cotton production in thermo-limited regions of the High Plains (Srini Ale; PIs: Bridget Guerrero, West Texas A&M; Jourdan Bell, Dana Porter and others)
  - Ecological Impact of varying vegetation management strategies employed on solar farms. (Nuria Gomez-Casanovas; PI: Stacy Hines)
  - Department of Energy – Bioenergy Research Centers. Center for Advanced Bioenergy and Bioproducts Innovation (CABBI). (Nuria Gomez-Casanovas; PI: Leakey, A.)
  - Use of woody encroachment biochar to enhance soil health of restored grasslands (Nuria Gomez-Casanovas; PI: Kramm, M.)
  - Adaptive Multi-Paddock (AMP) grazing research in the Northern Great Plains. (Nuria Gomez-Casanovas; PI: Peter Byck)

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Texas A&M AgriLife Research and Extension Center- Corpus Christi

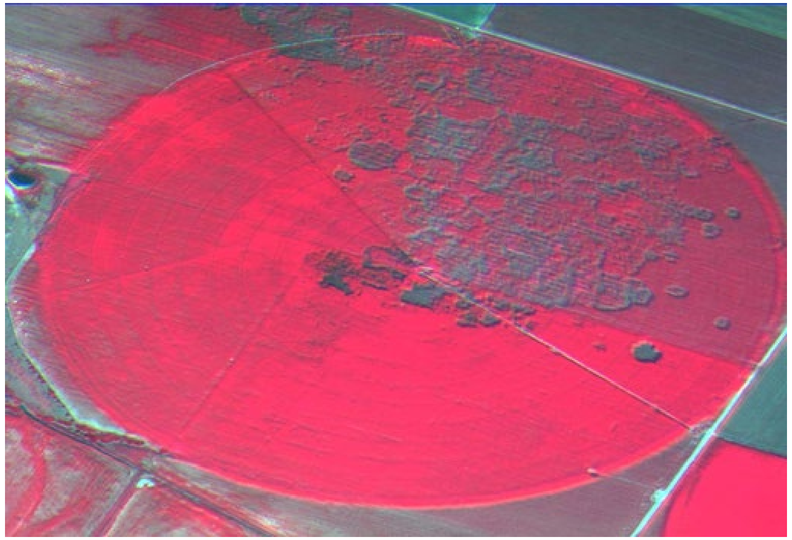
Juan Landivar, Ph.D.- Center Director

Juan Landivar
Center Director

Established in 1974 to serve the South Texas Region's agricultural research and development needs

Boll Weevil

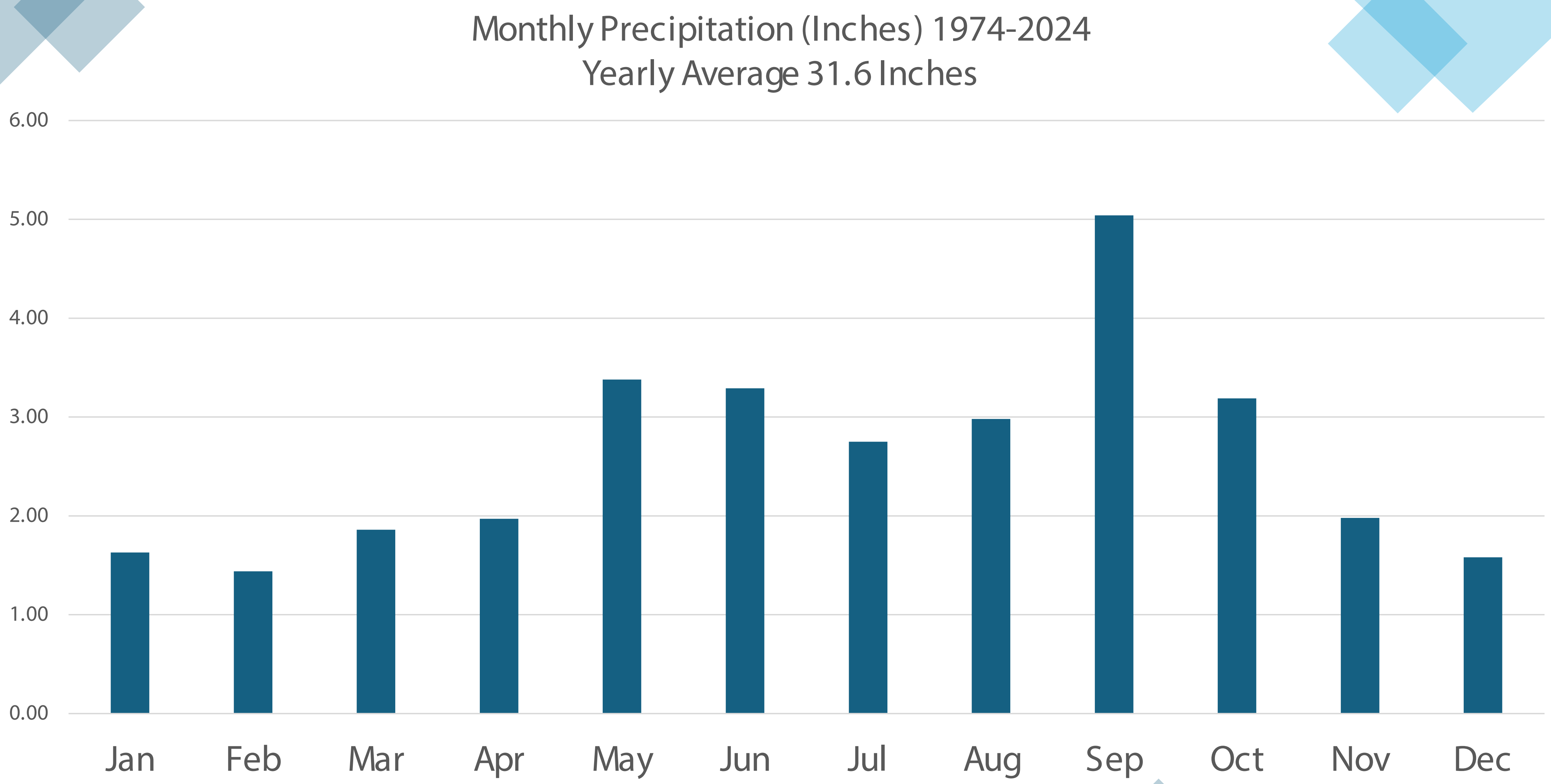
Texas Root Rot



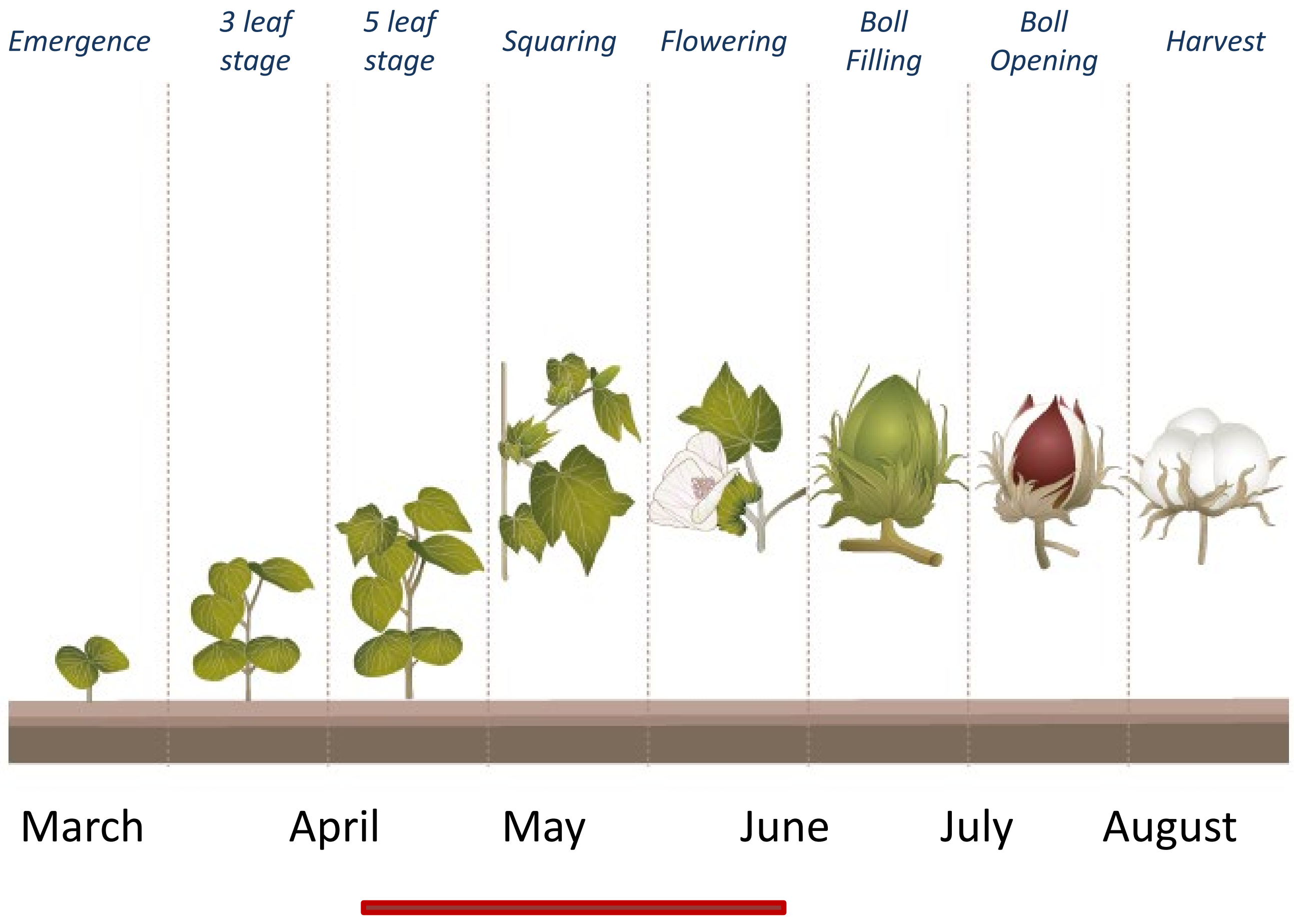
Water Stress

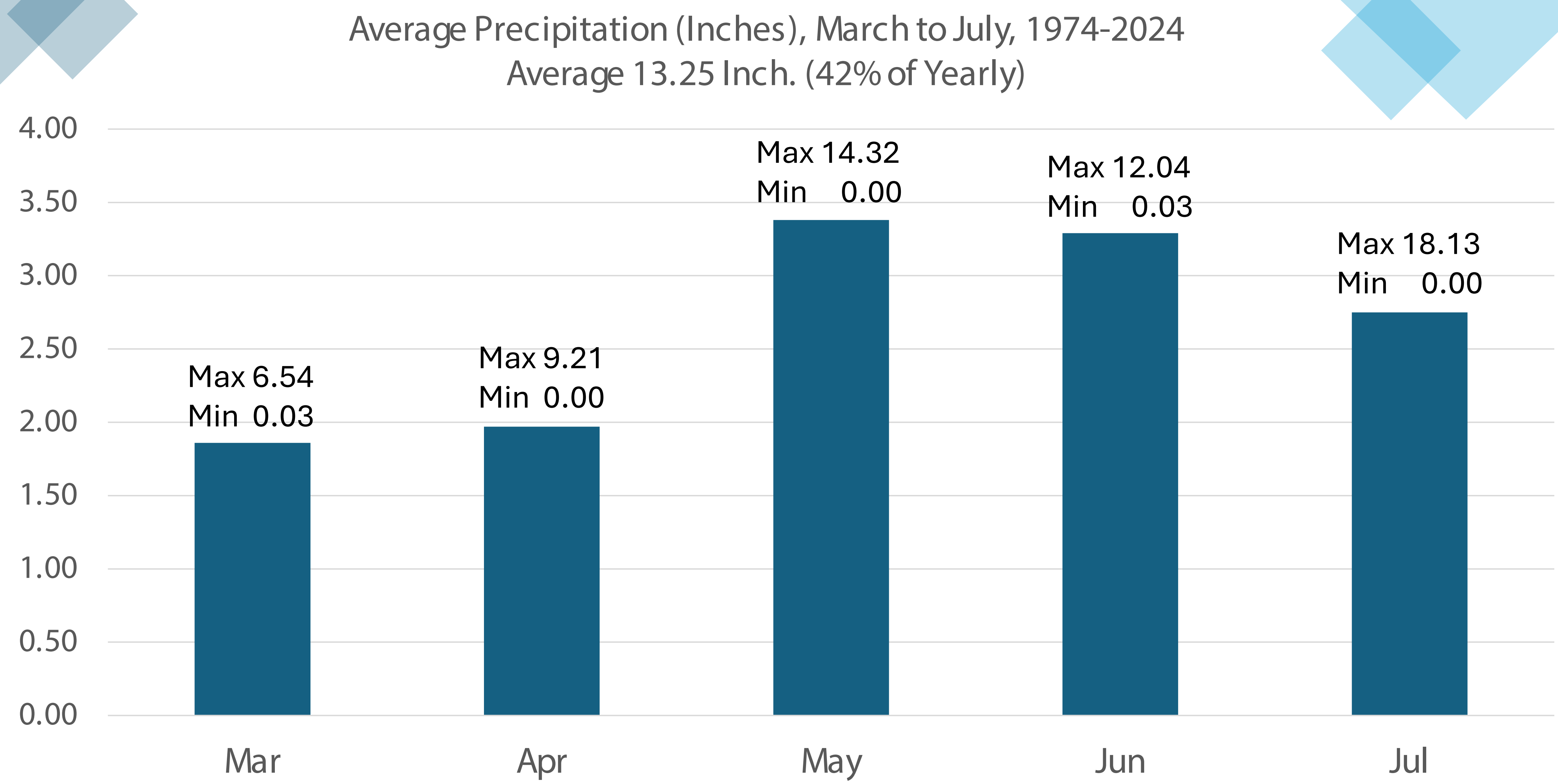
Initial Mission of Texas A&M AgriLife

Corpus Christi


Monthly Precipitation (Inches) 1974-2024
Yearly Average 31.6 Inches
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Cotton Development
Drought susceptible period: Mid April to June




Average Precipitation (Inches), March to July, 1974-2024
Average 13.25 Inch. (42% of Yearly)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Max 6.54
Min 0.03
Max 9.21
Min 0.00
Max 14.32
Min 0.00
Max 12.04
Min 0.03
Max 18.13
Min 0.00
Mar
Apr
May
Jun
Jul

Total Precipitation (Inch), March to July, 1974-2024 and Lint Yield (lb. /Acre)

Range (Inch)	%	Yield (lbs. / Acre)
< 10	35	300 to 600
10-20	50	800 to 1200
>20	15	1200 to 1600

Approximately 50-60 lbs. of lint per Inch of Precipitation

Water Management Strategies for the Lower Coastal Bend Region of Texas

Cropping Systems
Conservation Tillage, Cover Crops, Crop Rotation, Residues Management

Genetics

High Throughput Phenotyping

Crop Management

Digital Twin Models

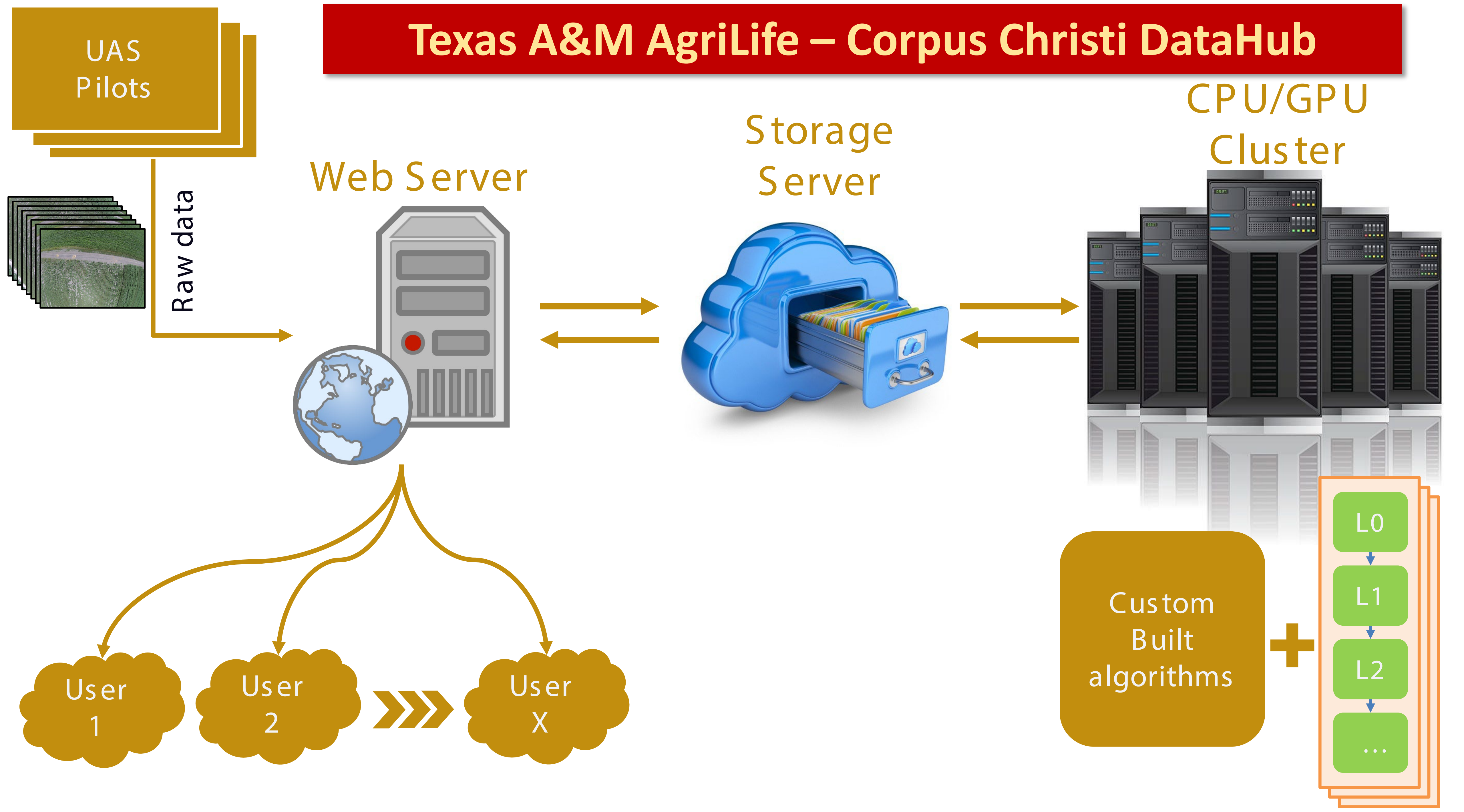
Sensors and Platforms
(Big Data)

Drones

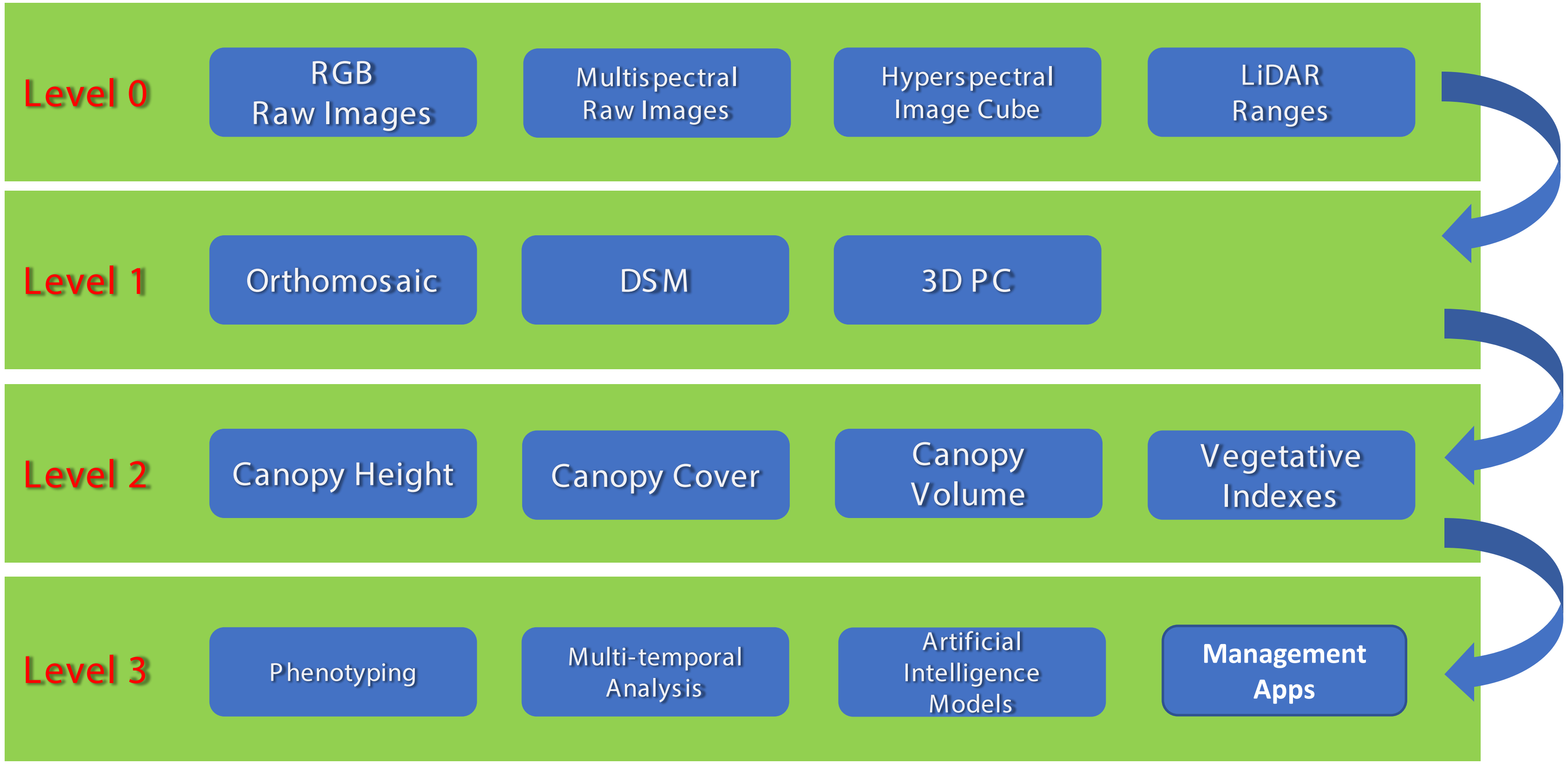
Robots

Satellites

Sensors

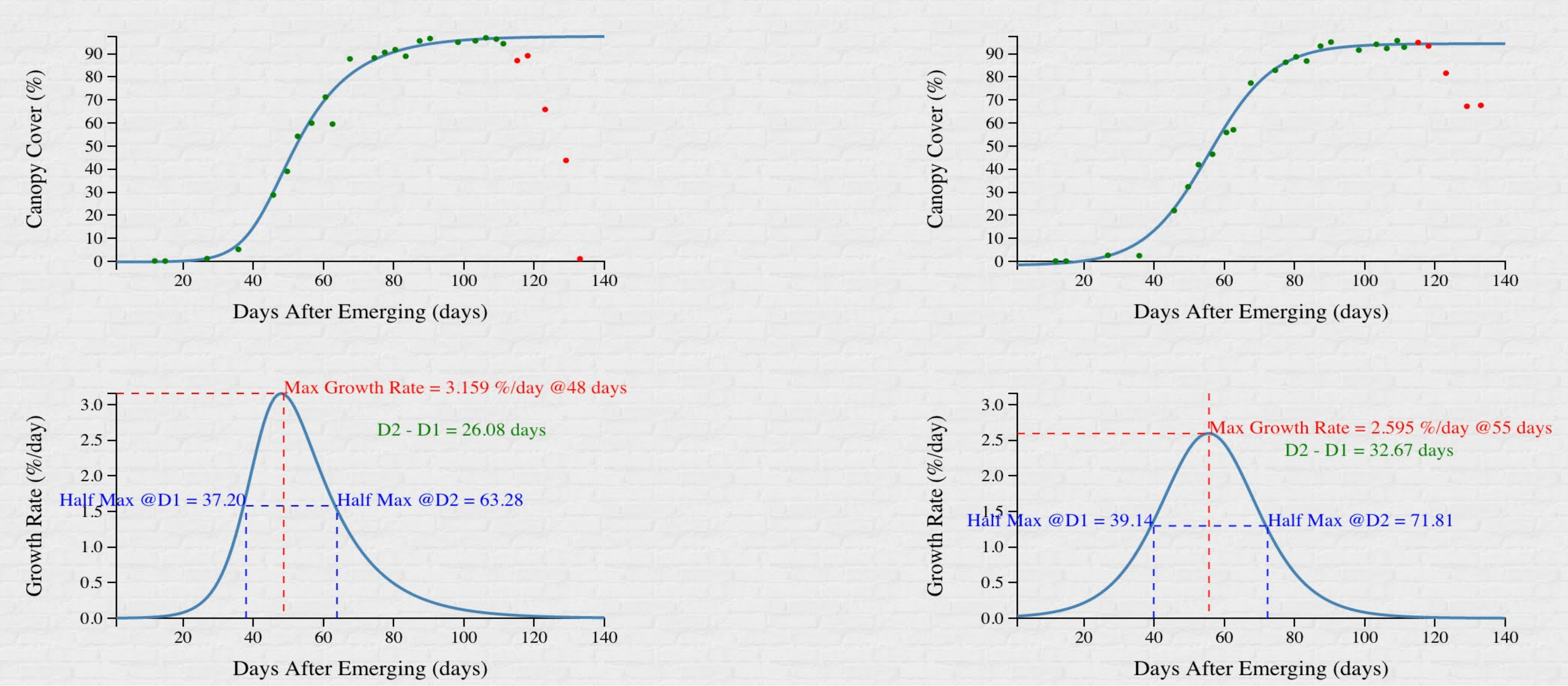

Texas A&M AgriLife – Corpus Christi DataHub
UAS Pilots
Raw data
Web Server
Storage Server
CPU/GPU Cluster
User 1
User 2
User X
Custom Built algorithms
L0
L1
L2
...

Texas A&M AgriLife – Corpus Christi DataHub
Data products and workflow

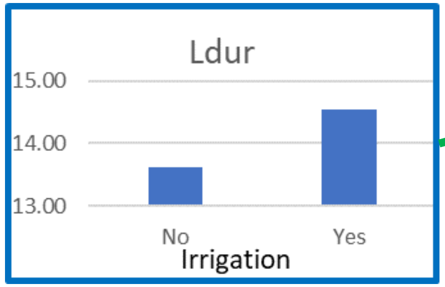


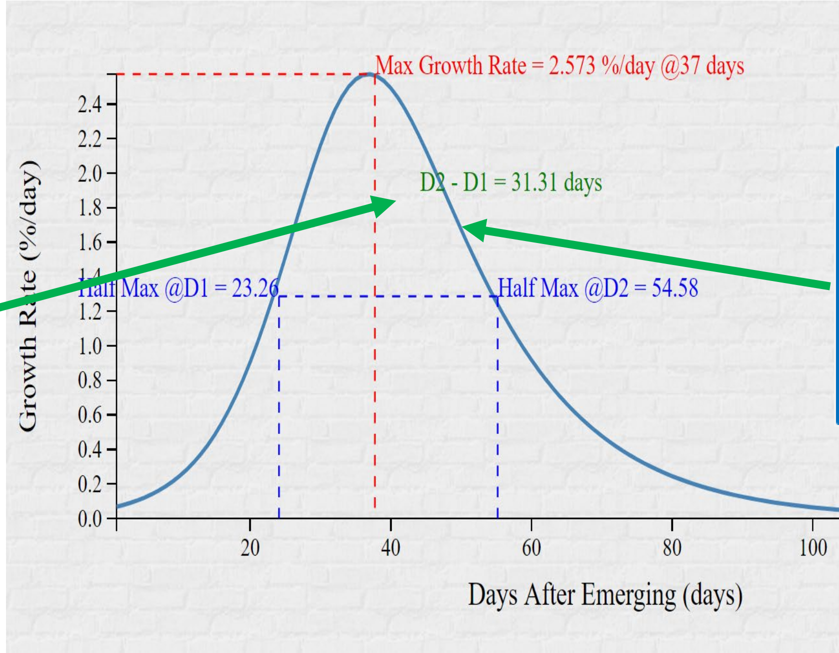
Growth Analysis (L2) Canopy Cover (dryland vs irrigated)

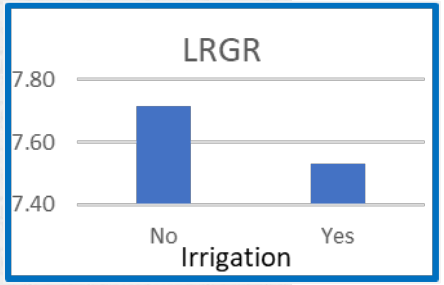
Juan Landivar, Wayne Smith, David Stelly, Mahendra Bhandari, Jose Landivar, Josh McGinty

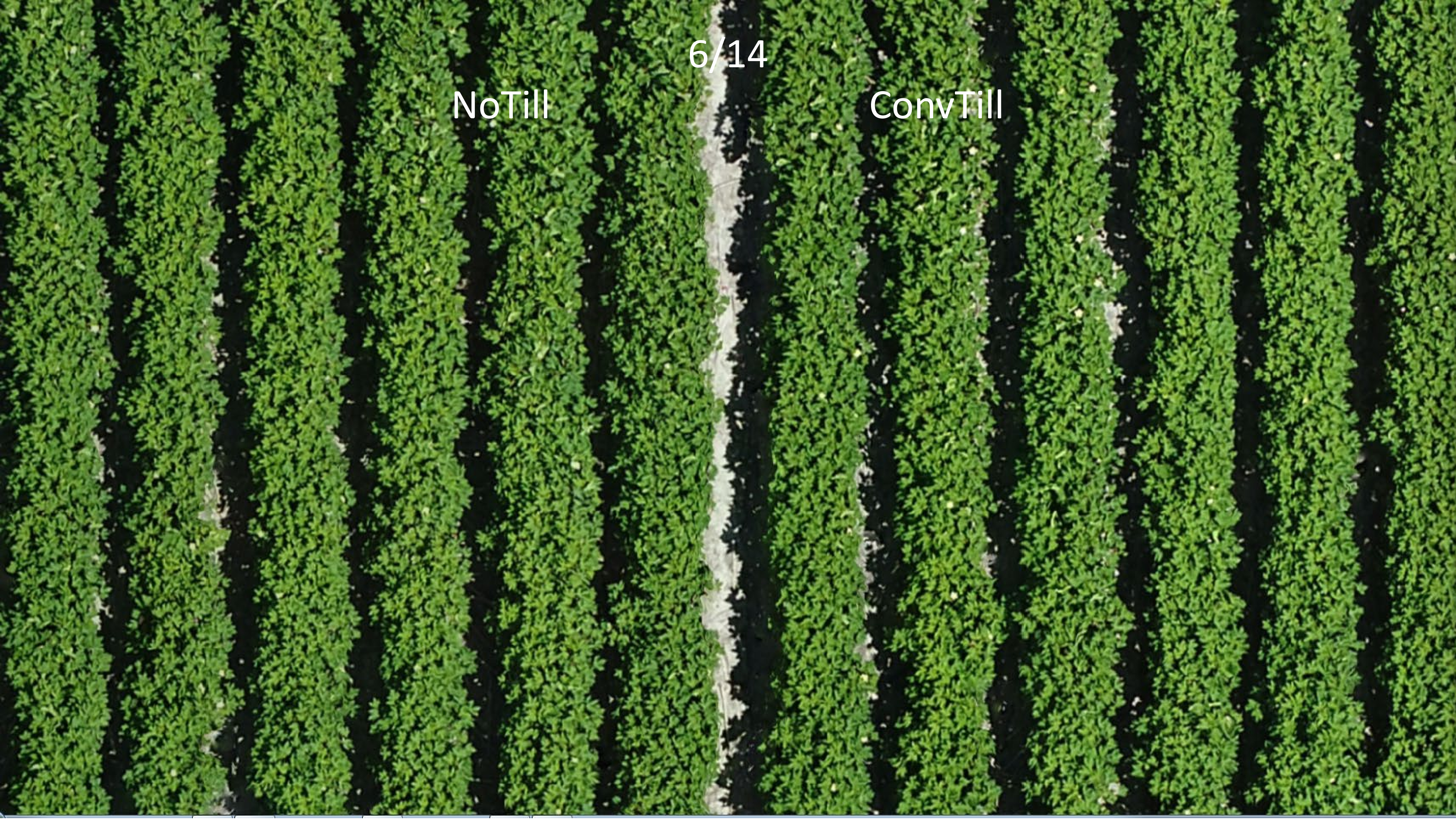


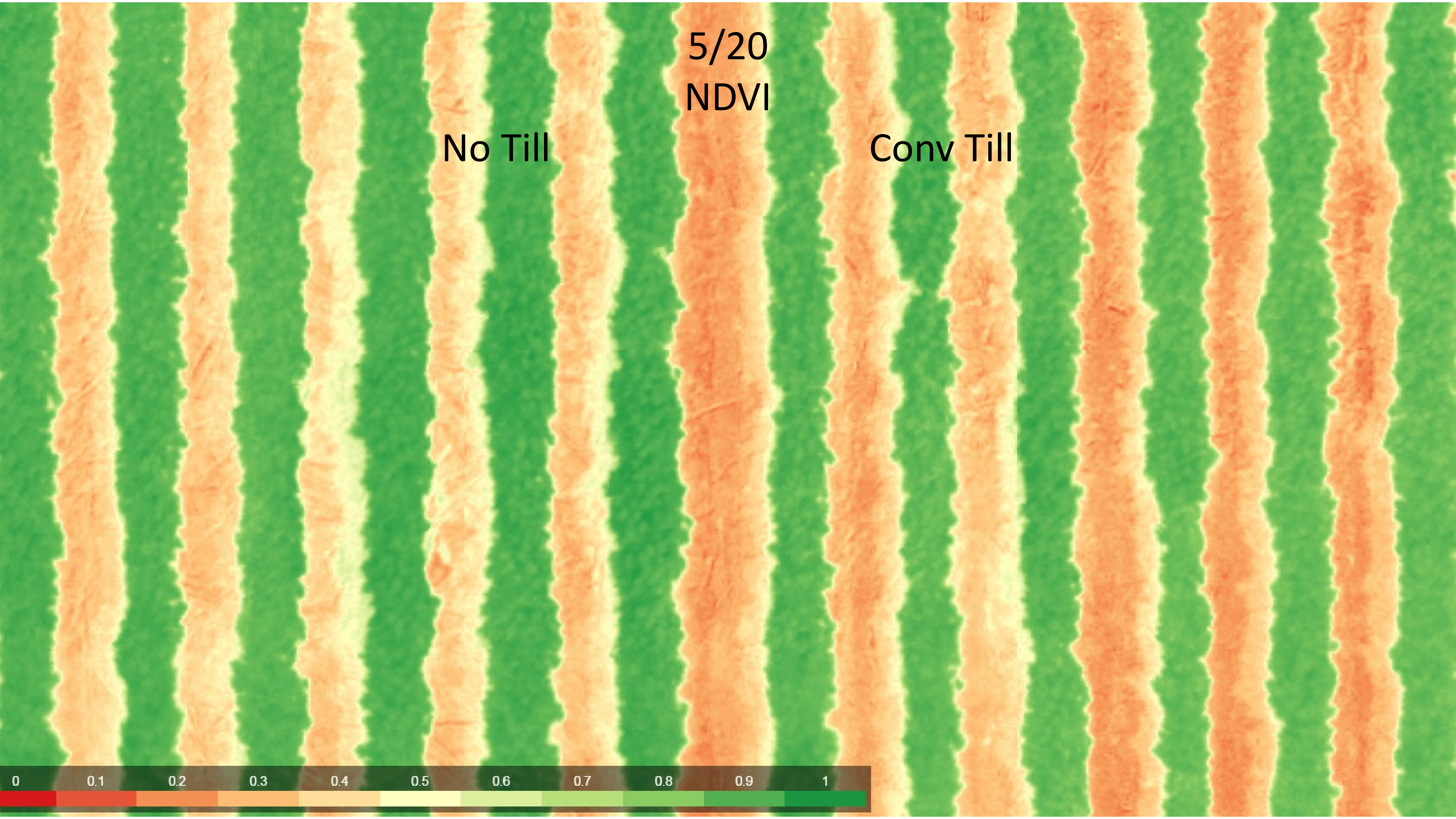
Effects of Irrigation on Growth Parameters
Canopy Cover, Corpus Christi, Texas



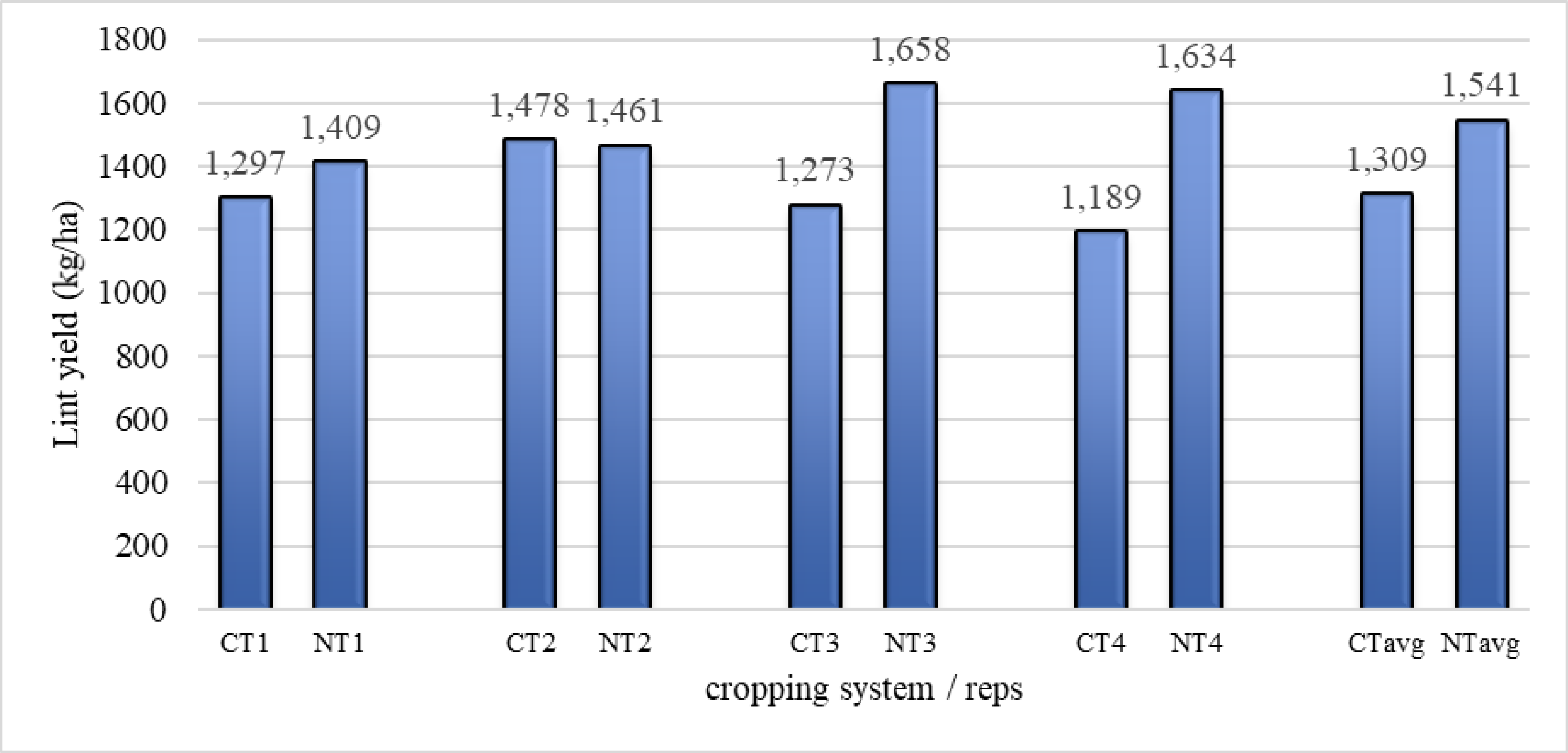





6/14
NoTill
ConvTill


5/20
NDVI
No Till
Conv Till
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Cotton Lint Yield (Kg/ha)

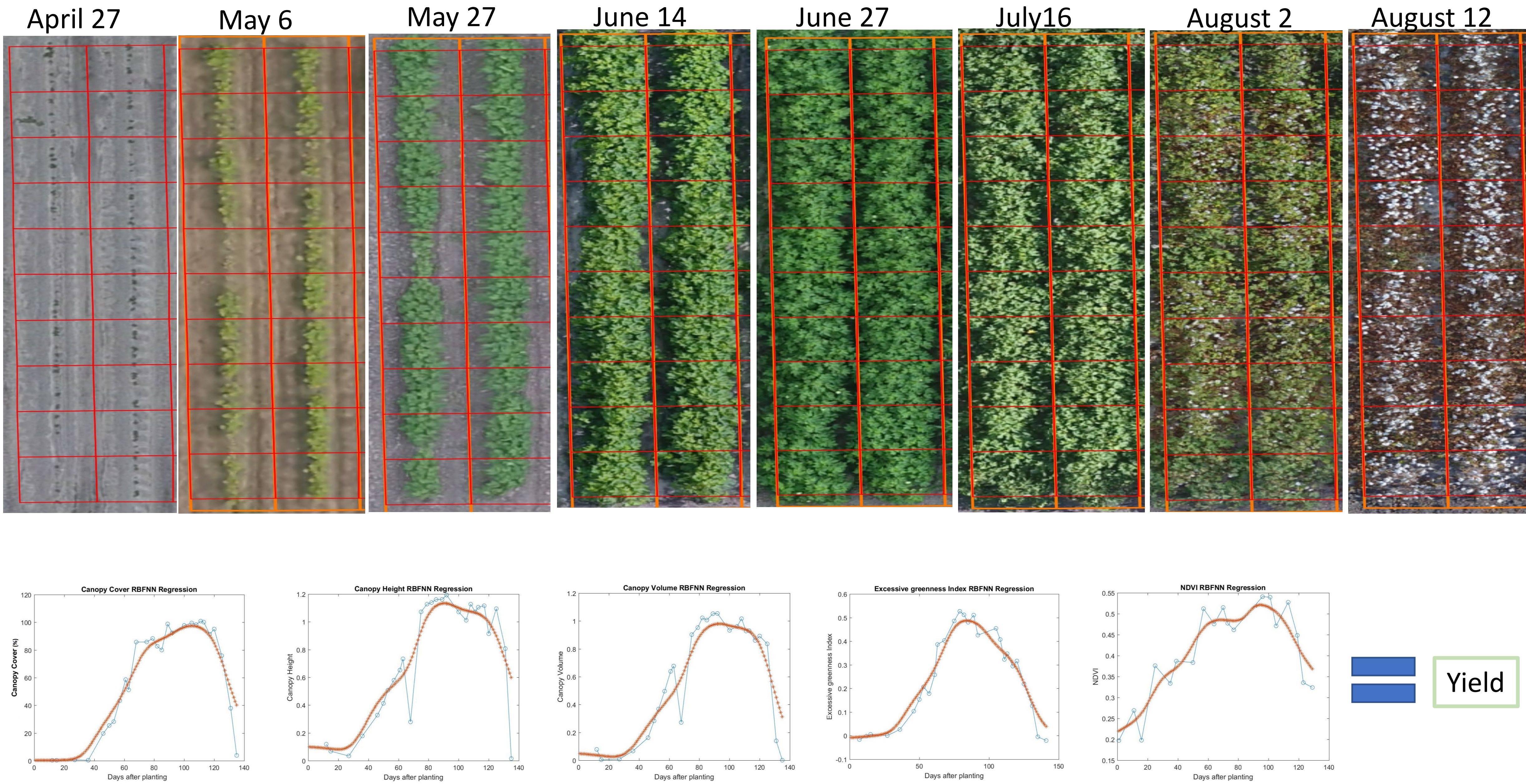


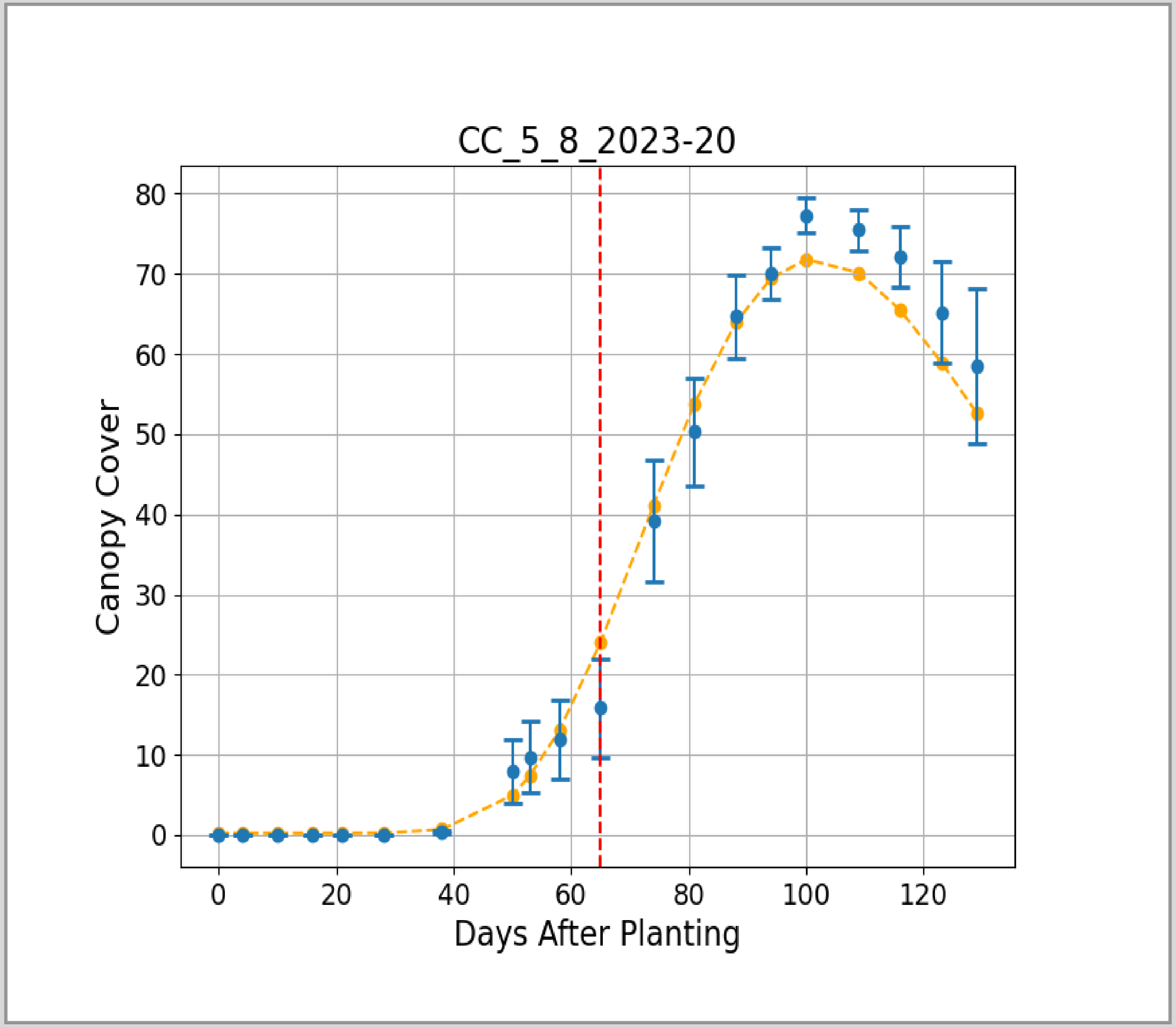
Subplot-wise and overall yield (kg/ha) for CT and NT cropping systems

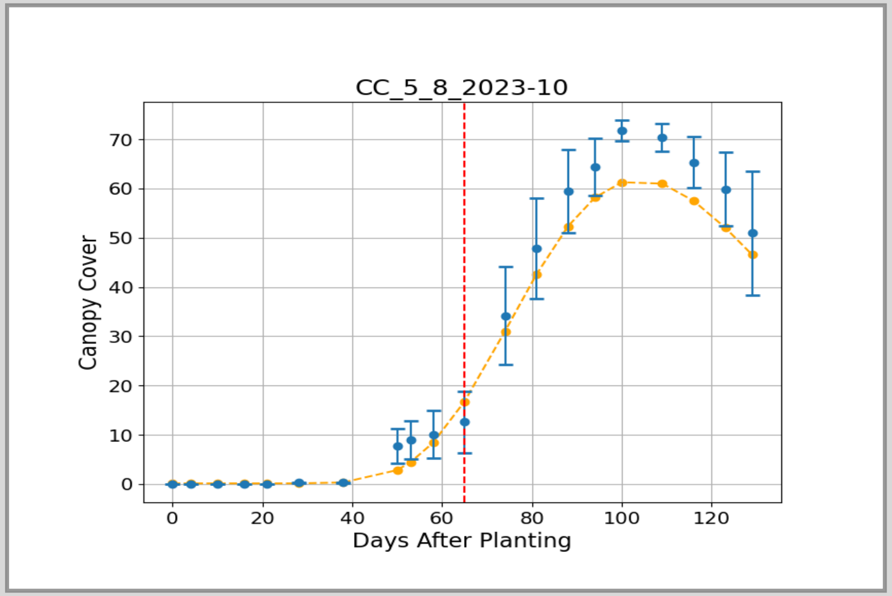
Digital Twin Models for Agriculture

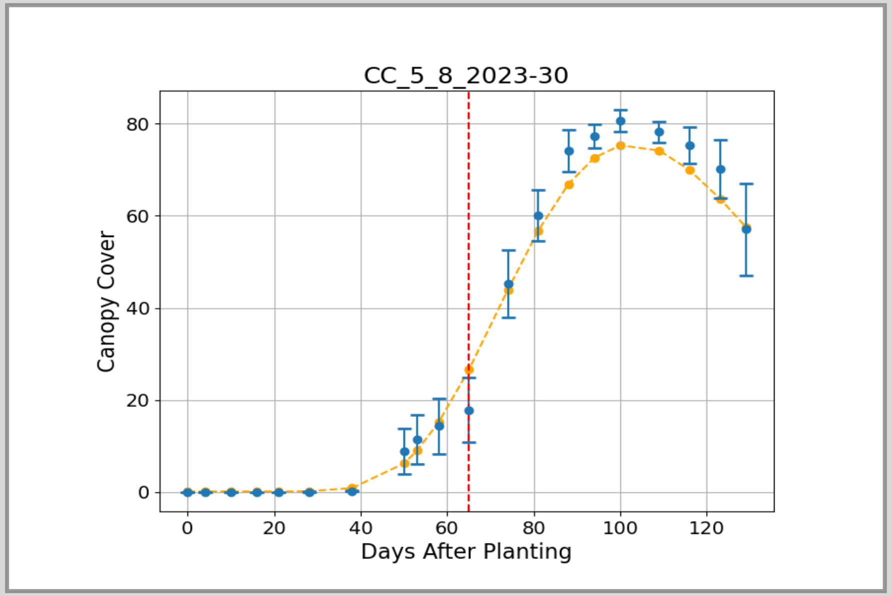
"A Digital Twin is a real time digital replica of a physical device"

Bacchiega (2017)

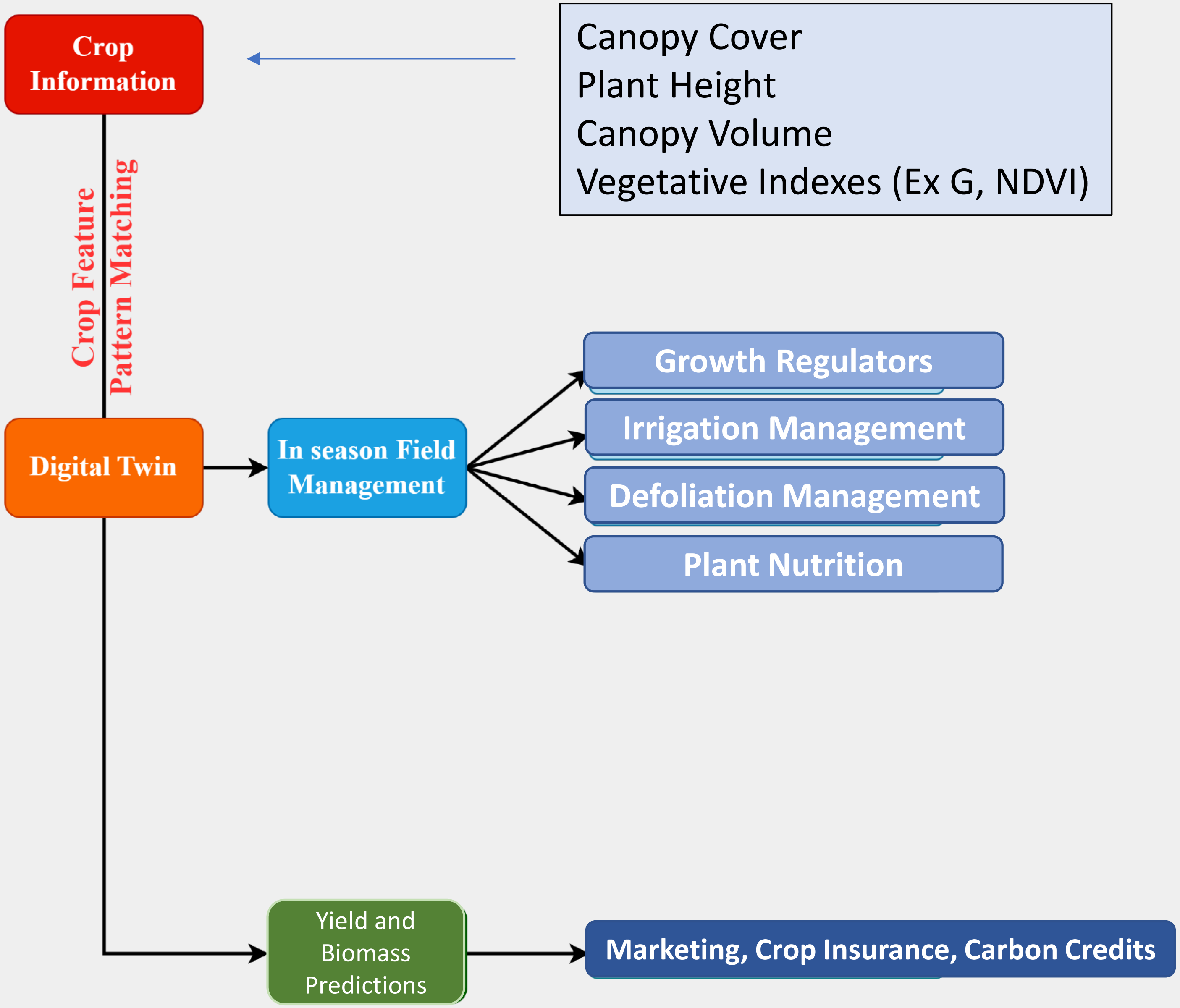

April 27
May 6
May 27
June 14
June 27
July16
August 2
August 12
Canopy Cover RBFNN Regression
Canopy Cover (%)
Days after planting
Canopy Height RBFNN Regression
Canopy Height
Days after planting
Canopy Volume RBFNN Regression
Canopy Volume
Days after planting
Excessive greenness Index RBFNN Regression
Excessive greenness Index
Days after planting
NDVI RBFNN Regression
NDVI
Days after planting
Yield


CC_5_8_2023-20
Canopy Cover
Days After Planting
0
10
20
30
40
50
60
70
80
0
20
40
60
80
100
120

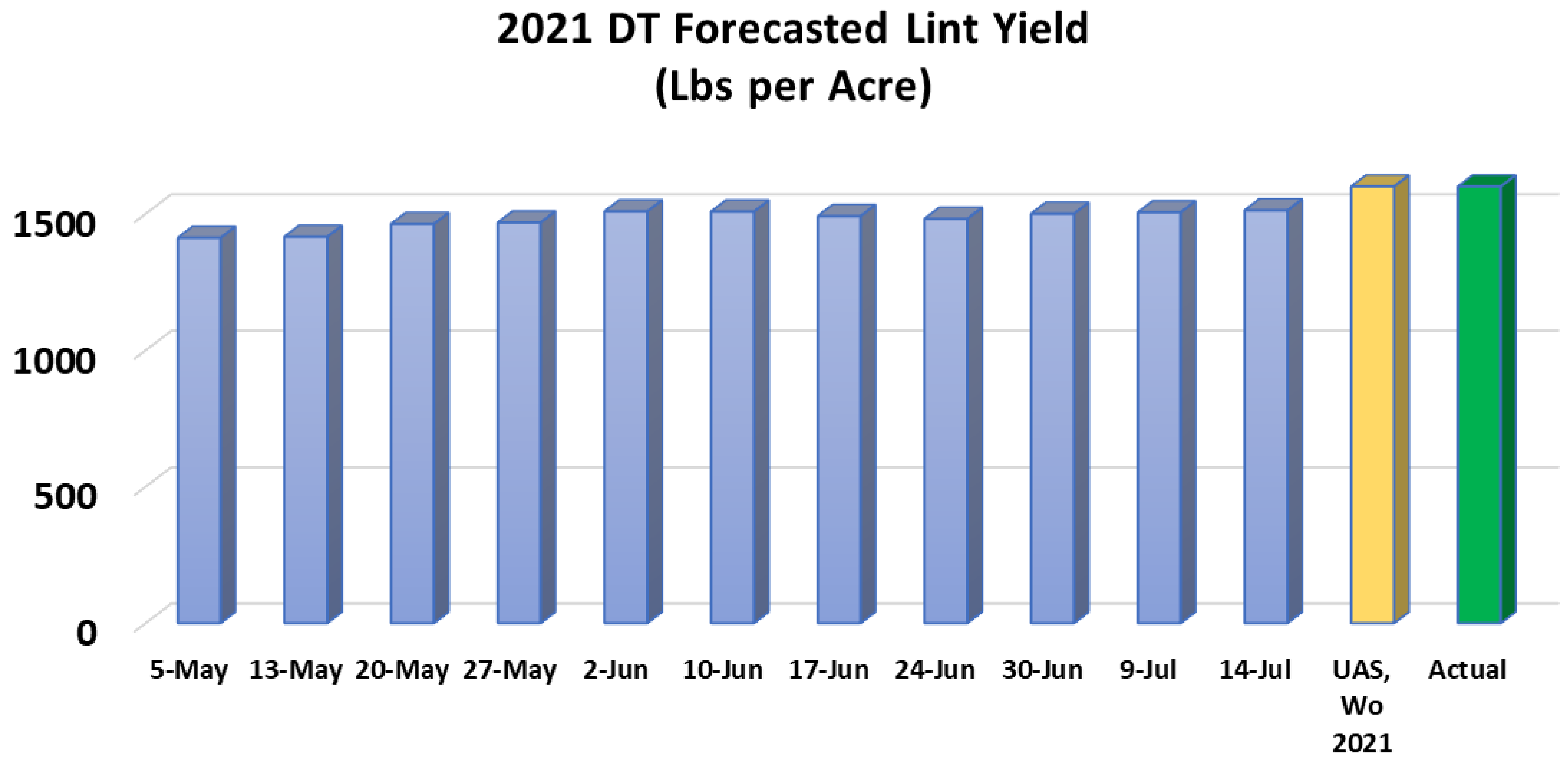

CC_5_8_2023-10
Canopy Cover
Days After Planting
0
10
20
30
40
50
60
70
0
20
40
60
80
100
120

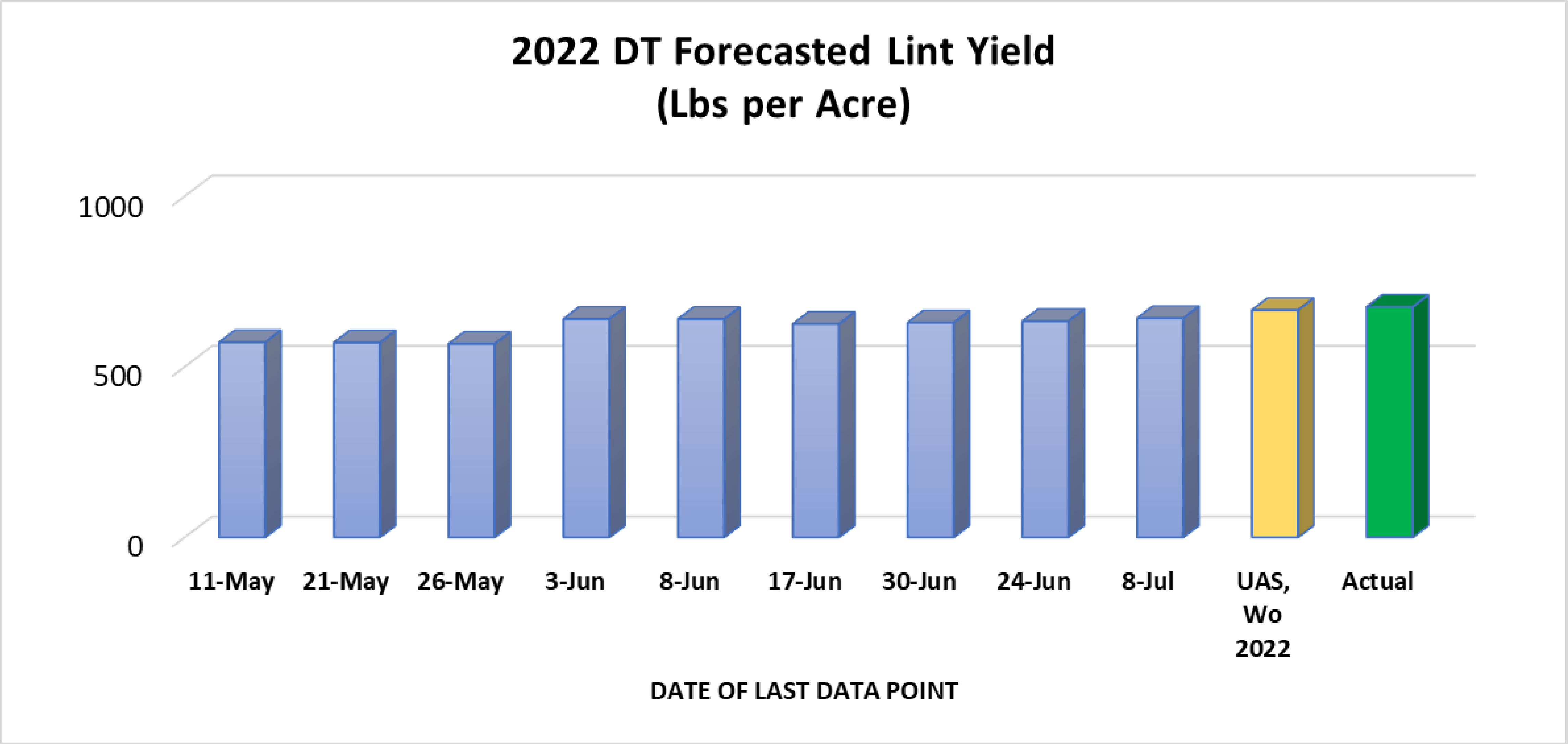

CC_5_8_2023-30
Canopy Cover
Days After Planting
0
20
40
60
80
0
20
40
60
80
100
120

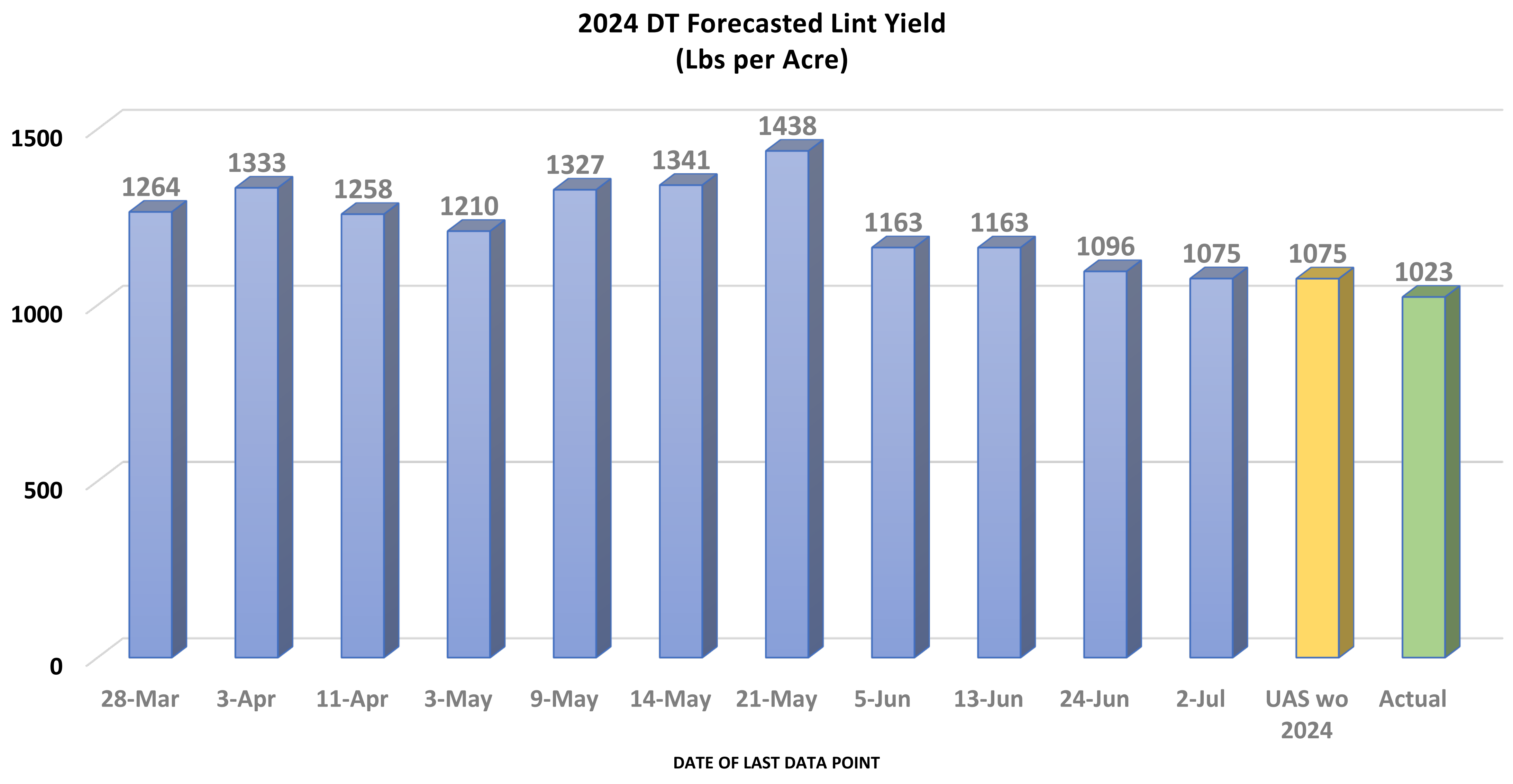
Objective

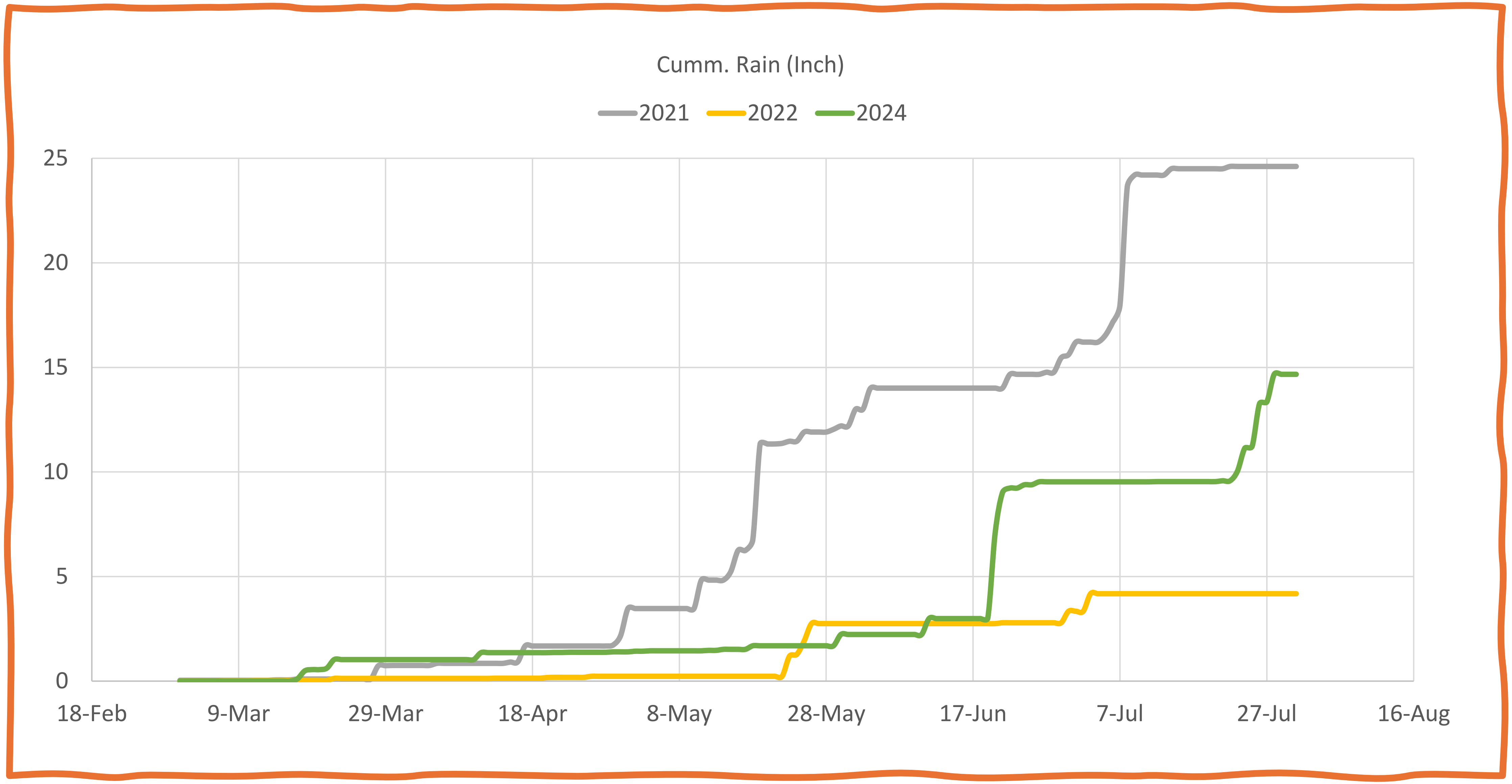


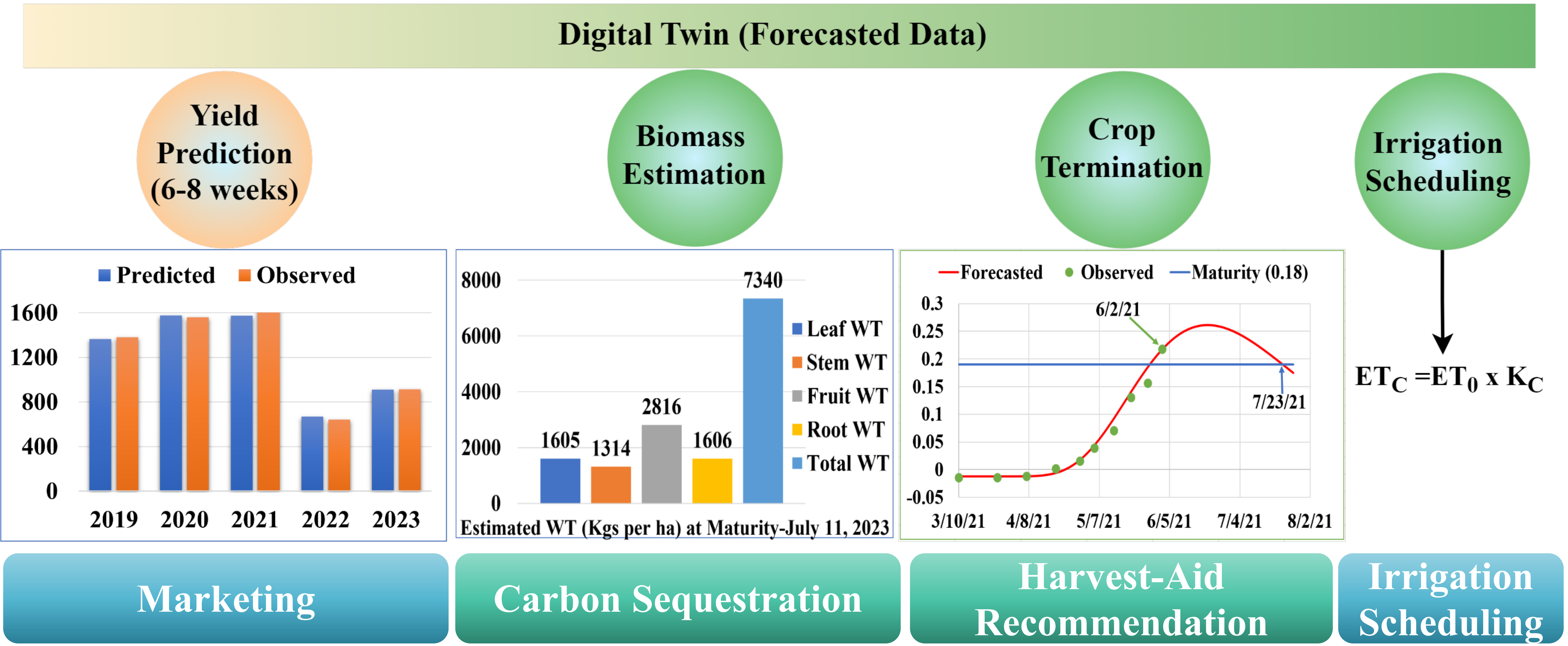
Crop Information
Canopy Cover
Plant Height
Canopy Volume
Vegetative Indexes (Ex G, NDVI)
Crop Feature
Pattern Matching
Digital Twin
In season Field Management
Growth Regulators
Irrigation Management
Defoliation Management
Plant Nutrition
Yield and Biomass Predictions
Marketing, Crop Insurance, Carbon Credits


2021 DT Forecasted Lint Yield
(Lbs per Acre)
1500
1000
500
0
5-May
13-May
20-May
27-May
2-Jun
10-Jun
17-Jun
24-Jun
30-Jun
9-Jul
14-Jul
UAS, Wo 2021
Actual


2022 DT Forecasted Lint Yield
(Lbs per Acre)
1000
500
0
11-May
21-May
26-May
3-Jun
8-Jun
17-Jun
30-Jun
24-Jun
8-Jul
UAS, Wo 2022
Actual
DATE OF LAST DATA POINT


2024 DT Forecasted Lint Yield
(Lbs per Acre)
1500
1000
500
0
1264
1333
1258
1210
1327
1341
1438
1163
1163
1096
1075
1075
1023
28-Mar
3-Apr
11-Apr
3-May
9-May
14-May
21-May
5-Jun
13-Jun
24-Jun
2-Jul
UAS wo 2024
Actual
DATE OF LAST DATA POINT


Cumm. Rain (Inch)
2021
2022
2024
25
20
15
10
5
0
18-Feb
9-Mar
29-Mar
18-Apr
8-May
28-May
17-Jun
7-Jul
27-Jul
16-Aug

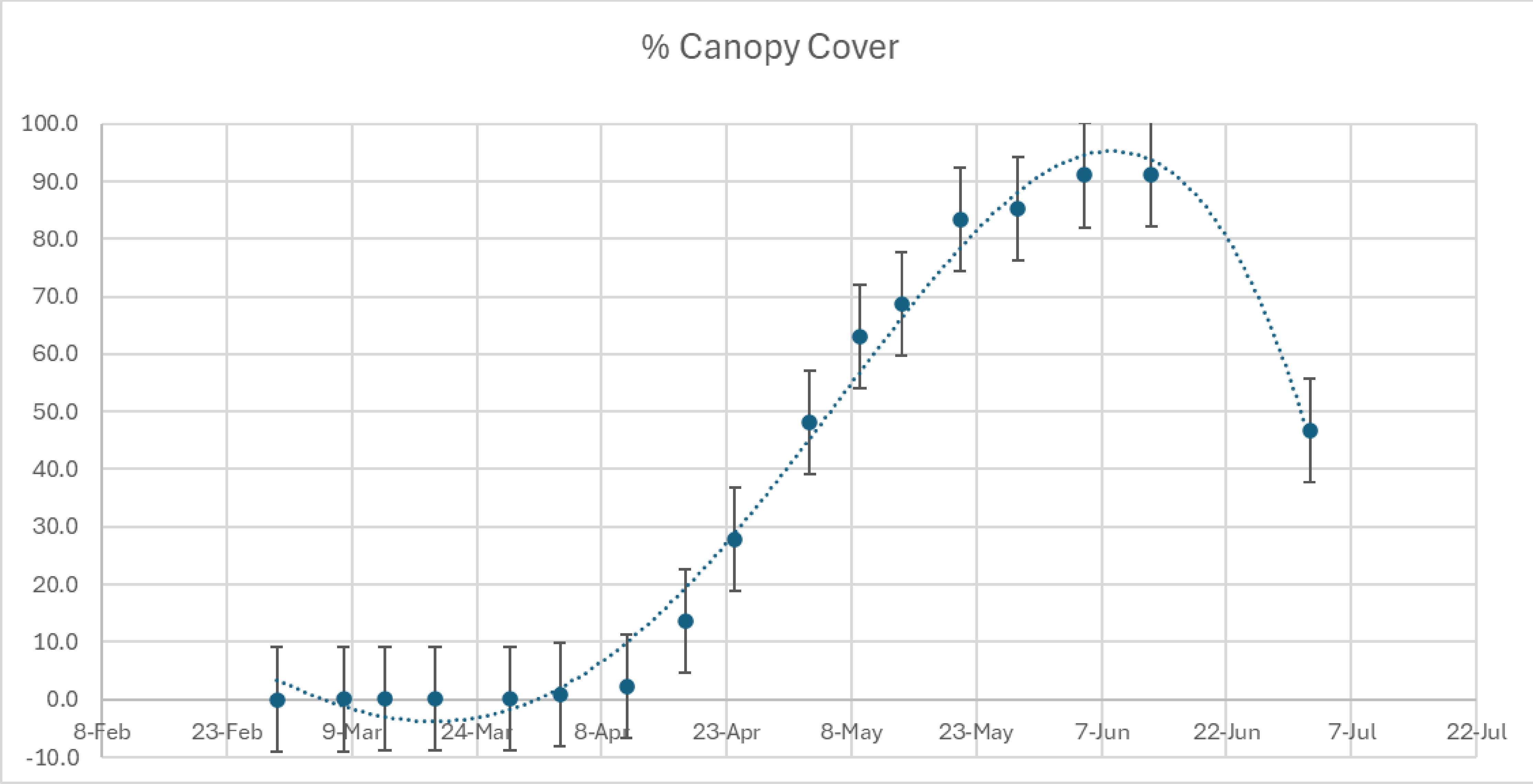

Digital Twin (Forecasted Data)
Yield Prediction (6-8 weeks)
Biomass Estimation
Crop Termination
Irrigation Scheduling
Predicted
Observed
1600
1200
800
400
0
2019
2020
2021
2022
2023
8000
6000
4000
2000
0
1605
1314
2816
1606
7340
Leaf WT
Stem WT
Fruit WT
Root WT
Total WT
Estimated WT (Kgs per ha) at Maturity-July 11, 2023
Forecasted
Observed
Maturity (0.18)
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
6/2/21
7/23/21
3/10/21
4/8/21
5/7/21
6/5/21
7/4/21
8/2/21
$ET_C = ET_0 \times K_C$
Marketing
Carbon Sequestration
Harvest-Aid Recommendation
Irrigation Scheduling

Summary

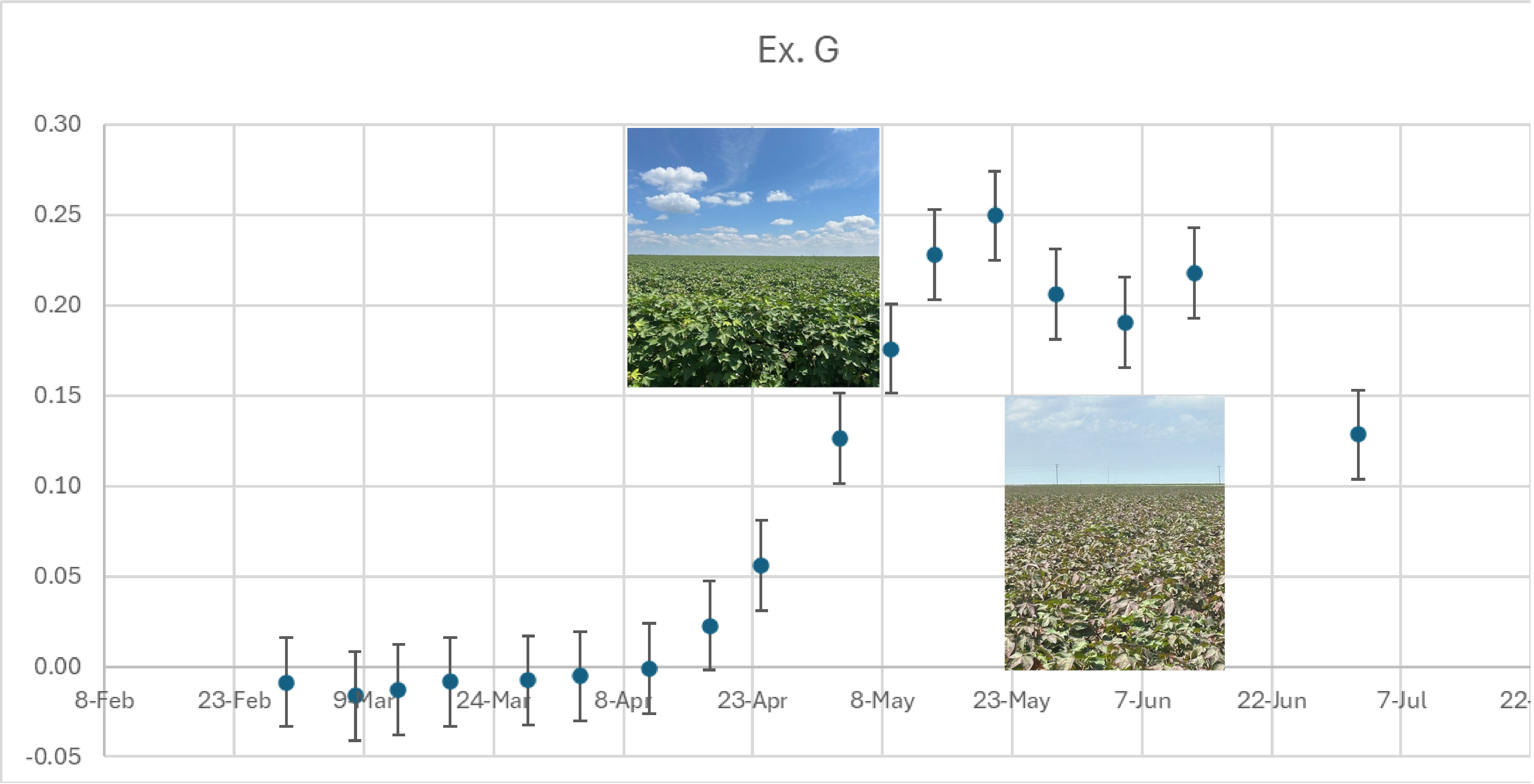
- Dryland production system
- Genetics improvement
- Conservation tillage practices are effective
- Digital Agriculture – Digital Twin Models are Key technologies

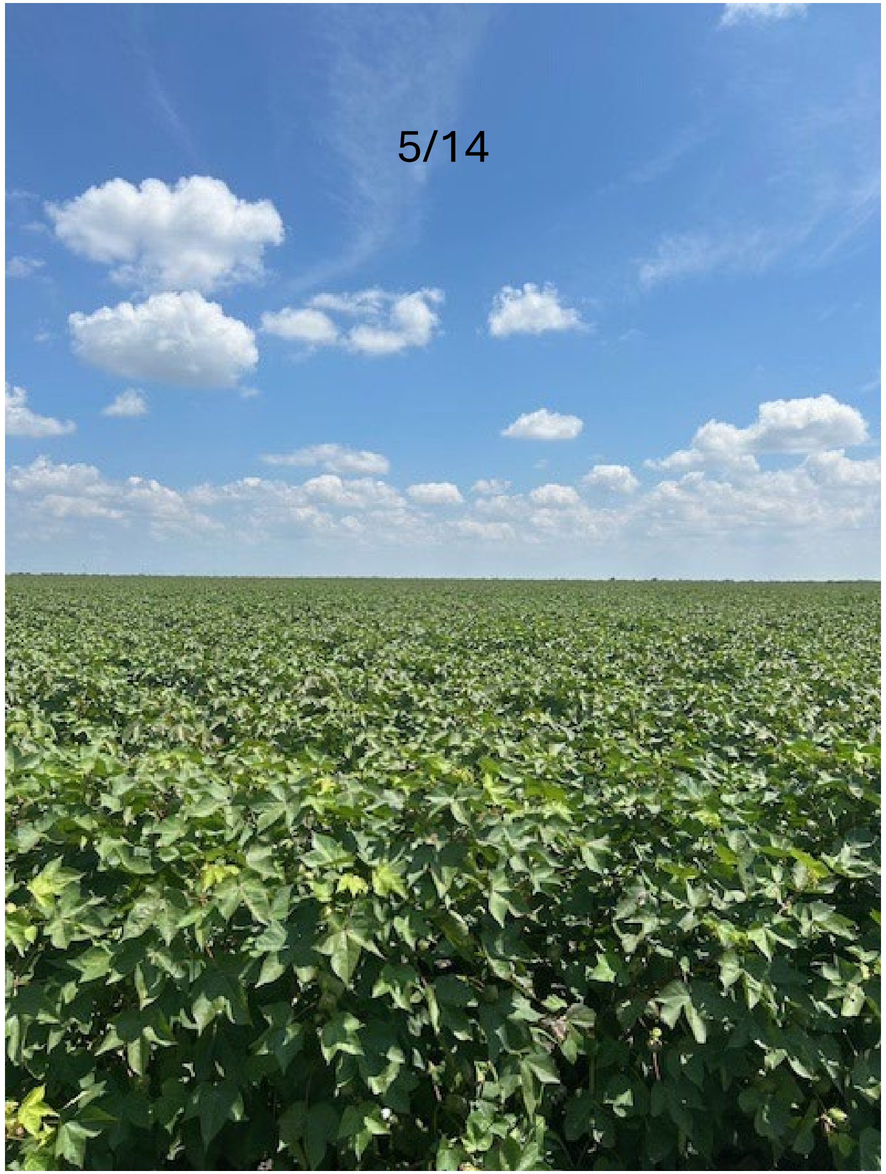
Thank you

Driscoll Texas, 2024

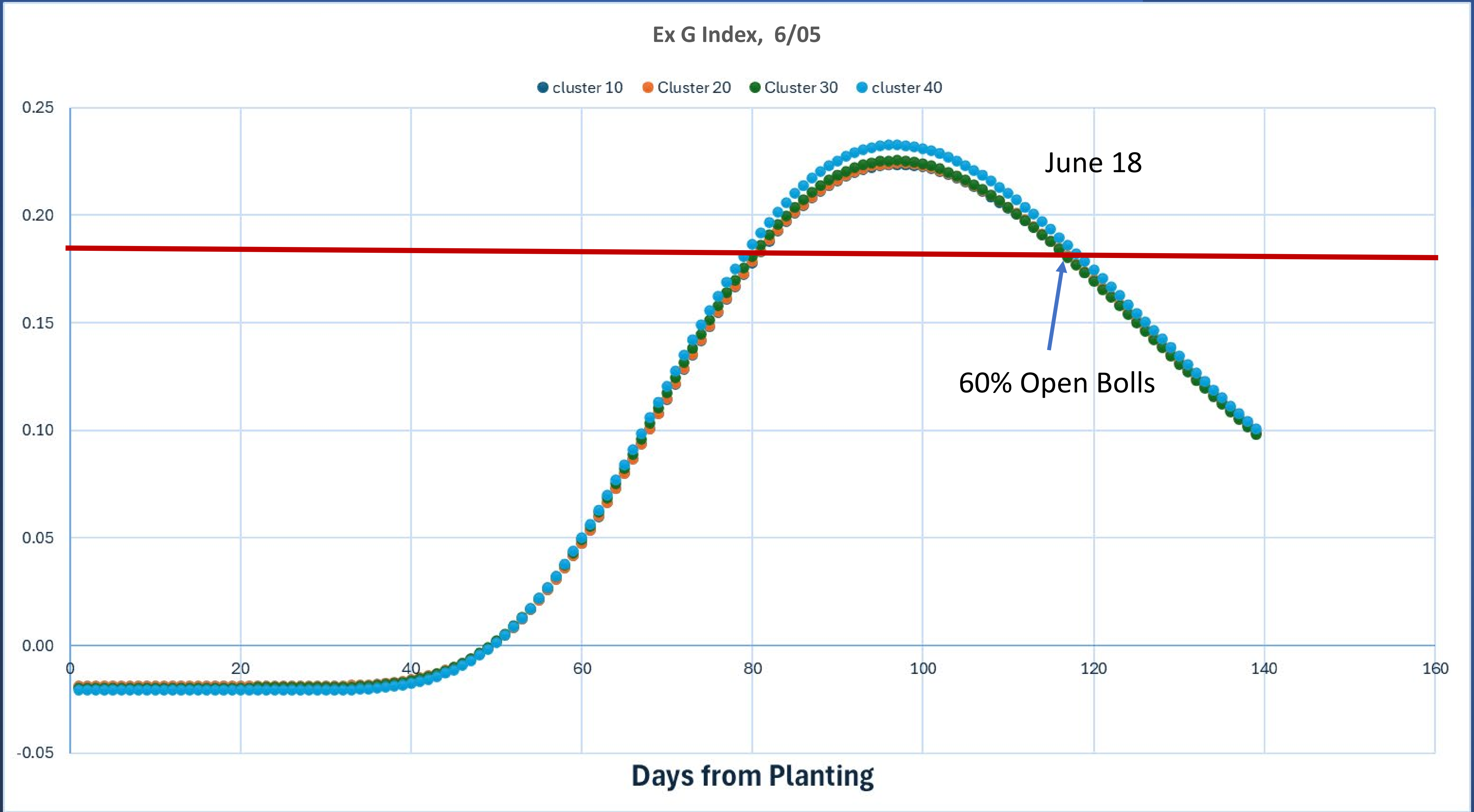


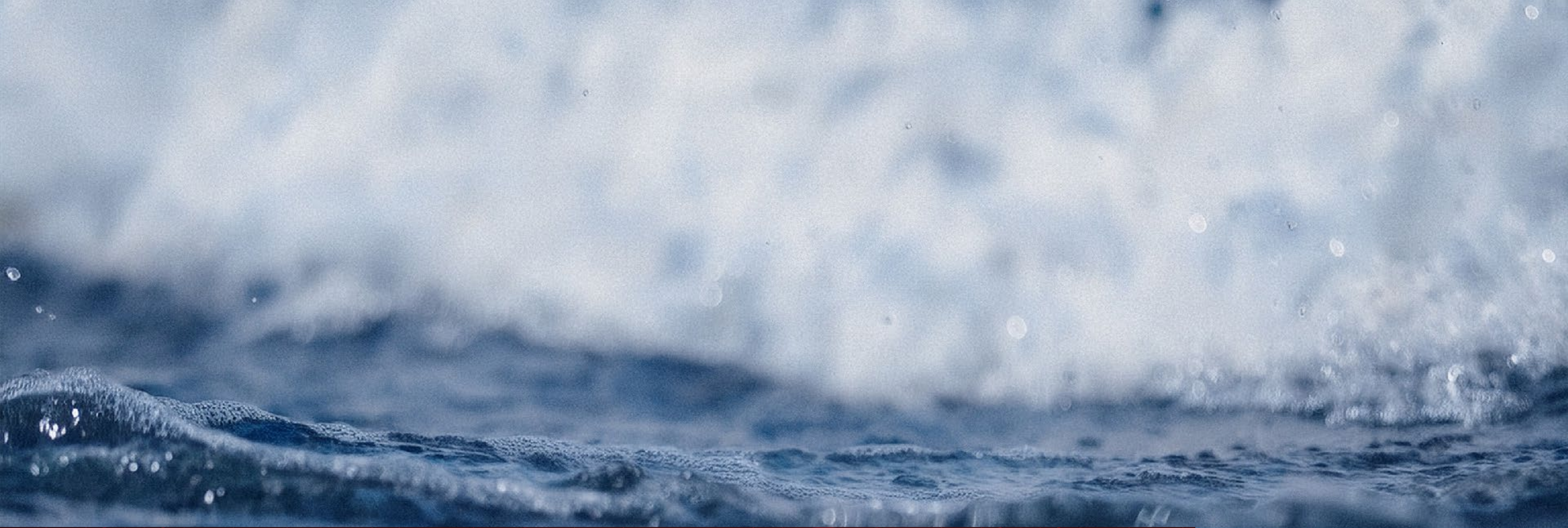
Driscoll Texas, 2024




5/14


6/05


Ex G Index, 6/05
cluster 10
Cluster 20
Cluster 30
cluster 40
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
0
20
40
60
80
100
120
140
160
June 18
60% Open Bolls
Days from Planting



Texas A&M AgriLife Research Keynote Speaker- Dr. Cliff Lamb

Director, Texas A&M AgriLife Research

TEXAS A&M AGRILIFE RESEARCH

INNOVATE TODAY, HARVEST TOMORROW

Texas Water Symposium • August 2025

G. Cliff Lamb, Ph.D.
Director

AGRILIFE RESEARCH **LEADERSHIP**

G. Cliff Lamb, Ph.D.
Director

Stephen Cisneros
Executive Associate Director

Angela Bailey
Executive Assistant to the Director

Amir Ibrahim, Ph.D.
Associate Director and Chief Scientific Officer

Rachel Tydlacka
Executive Assistant

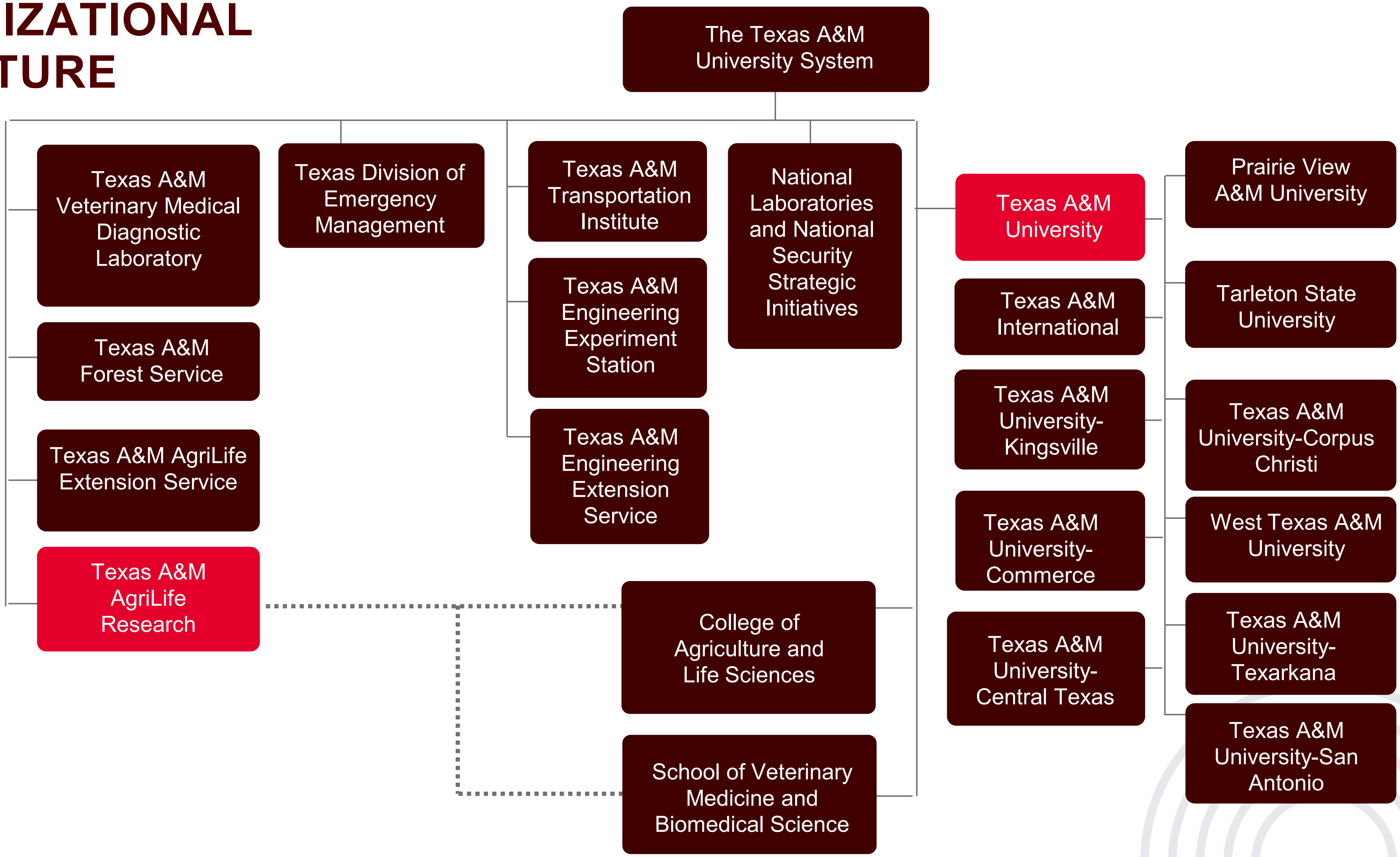
Kelly Essler
Director of Research Employee Experience

Debbie Cummings
Chief Financial Officer

- 13 Center Directors
- 15 Department Heads: College of Agriculture and Life Sciences
- 5 Department Heads: School of Veterinary Medicine and Biomedical Sciences
- 6 Institute Directors

Texas A&M AgriLife Research

AGRILIFE RESEARCH
ORGANIZATIONAL STRUCTURE



Texas A&M AgriLife Research

AGRILIFE RESEARCH **BY THE NUMBERS**

600+ Ph.D.-level scientists across all affiliated Texas A&M entities

13 Texas A&M AgriLife Research and Extension Centers across Texas

7 Regional Texas A&M University System institutions with AgriLife Research joint appointments

5 Academic departments within the School of Veterinary Medicine and Biomedical Sciences integrated with AgriLife Research in 2022

15 Academic departments in the Texas A&M University College of Agriculture and Life Sciences

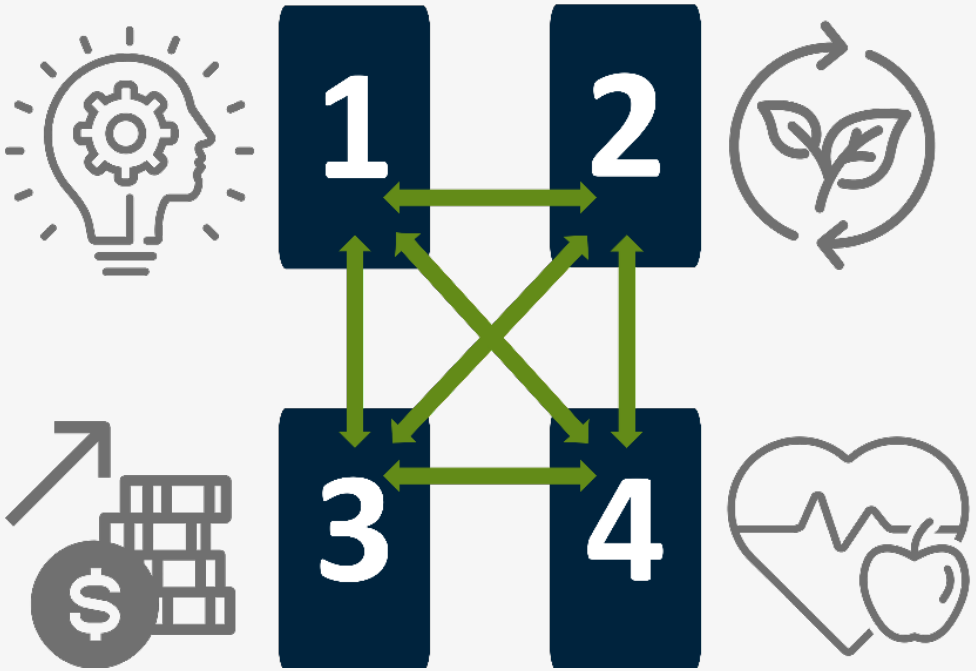
>$319 Million FY24 research expenditures, a 12% increase over FY23

>$157 Million Competitive grants and contracts awarded in FY24

AGRILIFE RESEARCH **STRATEGIC PRIORITIES**

Leading-edge research and innovation

Sustainable Production Systems



Economic Strength

Healthy Living

FIND OUR FULL STRATEGIC PLAN ONLINE

THE IMPORTANCE OF WATER
ACROSS COMMODITIES

>$3.2 Million

FY 24 commodity awards leveraged to address water-related issues

- Limited or excess water
- Produced, brackish, and salt water
- Increasing production, decreasing water
- PFAS in water
- Efficient crops and irrigation systems
- Dryland science
  - Soil and plant interactions with water
  - water retention

Texas A&M AgriLife Research

Texas Water Resources Institute
make every drop count

THE IMPORTANCE OF WATER **ACROSS COMMODITIES**

Major collaborations across commodities

PLAINS COTTON GROWERS

Potatoes USA

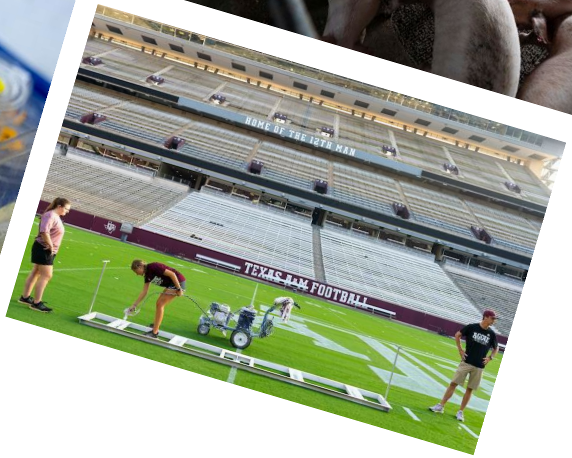
CRDF

NCBA National Cattlemen's Beef Association

National Peanut Board

pork

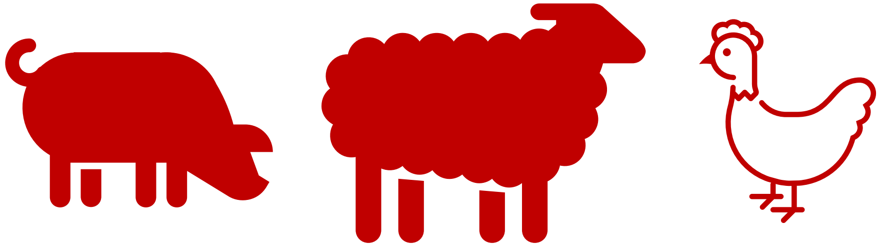
- American Dorper Sheep Breeders Society
- American Quarter Horse Foundation
- Citrus Research and Development Foundation
- Cotton Incorporated
- National Cattlemen's Beef Association
- National Peanut Board
- National Pork Board
- National Turfgrass Evaluation Program
- Plains Cotton Growers, Inc.
- Potatoes USA
- Project Apis m.
- Many others

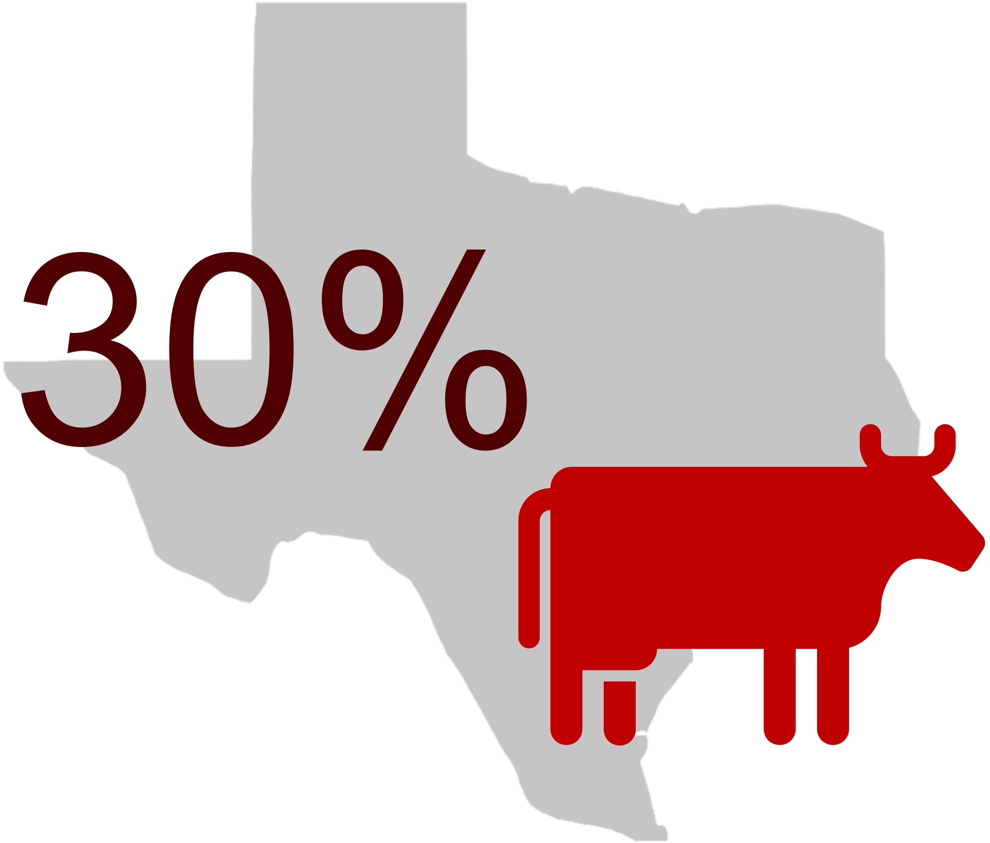


TEXAS A&M AGRILIFE RESEARCH

Texas Water Resources Institute
make every drop count

LIVESTOCK
ANIMALS IN TEXAS





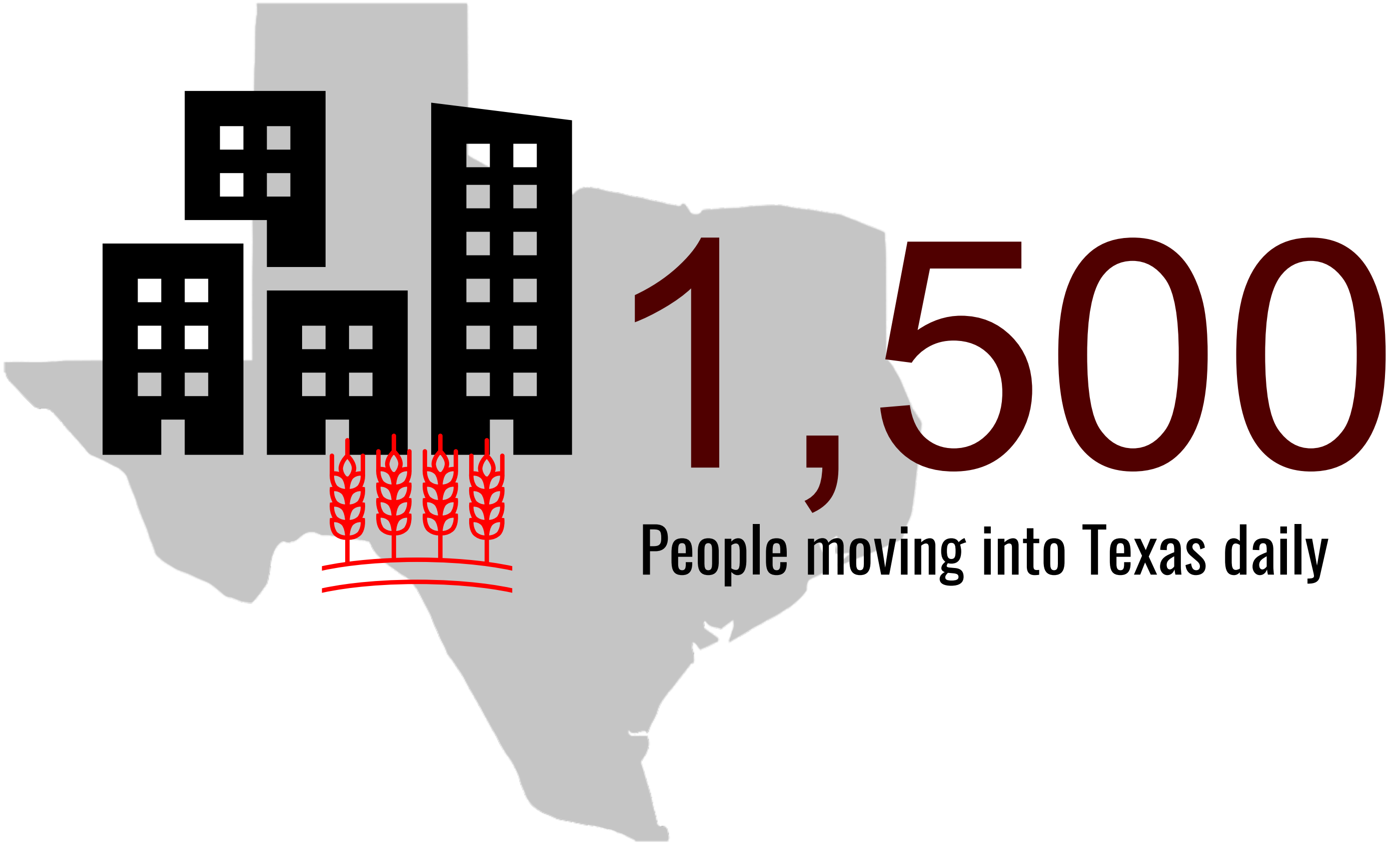
How can we be better stewards of water resources?

Texas A&M AgriLife Research

Texas Water Resources Institute
make every drop count

THE RURAL-URBAN **INTERFACE**

- Arable land is shrinking.
- Producing on marginal land where water is a bigger issues.
- Urban competition for water higher than ever before.



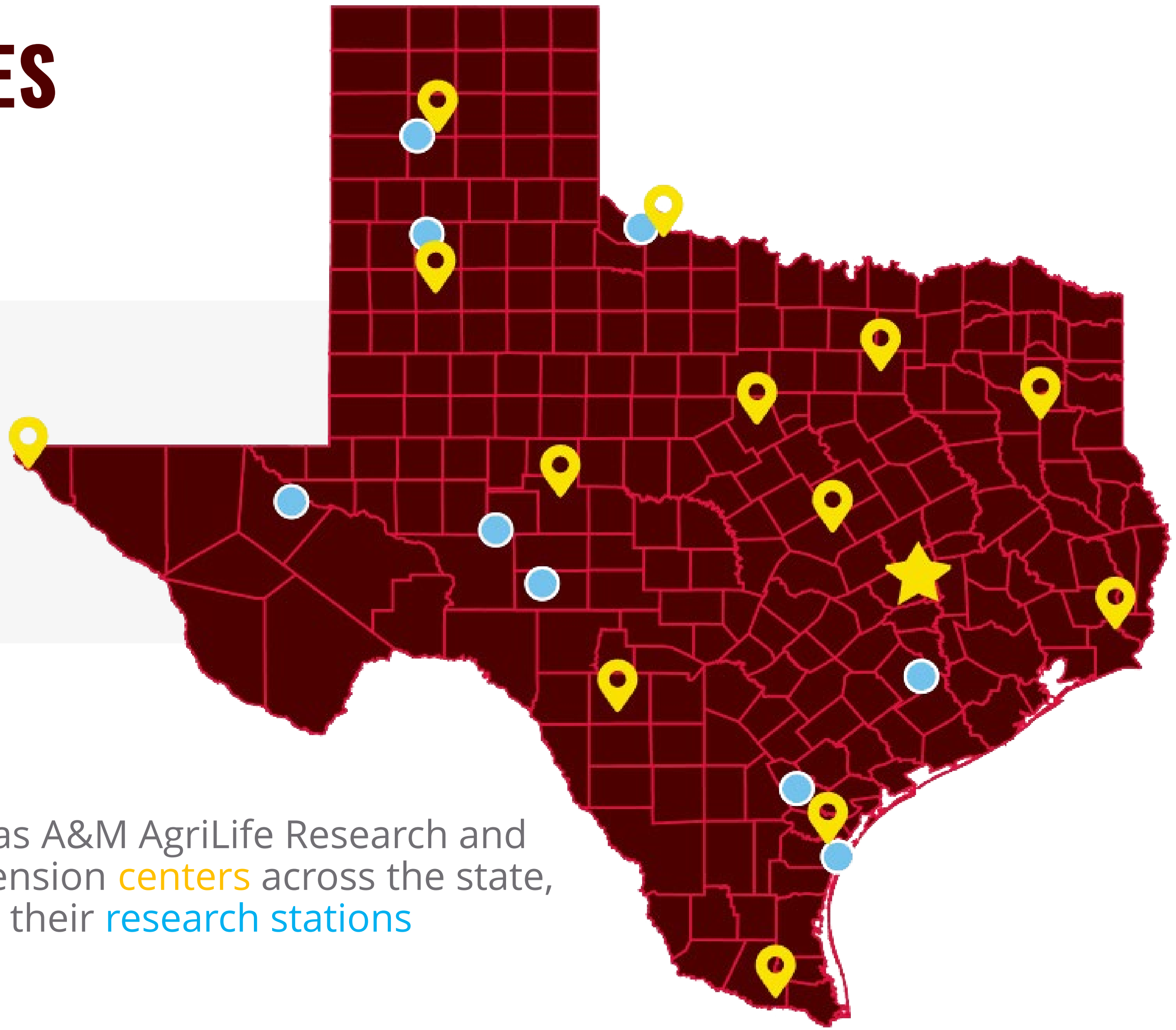
Texas A&M AgriLife Research

Texas Water Resources Institute
make every drop count

TEXAS A&M AGRILIFE
STRATEGIC ADVANTAGES

Positioned to lead

Local // Federal // State



Texas A&M AgriLife Research and Extension centers across the state, and their research stations

Texas A&M AgriLife Research

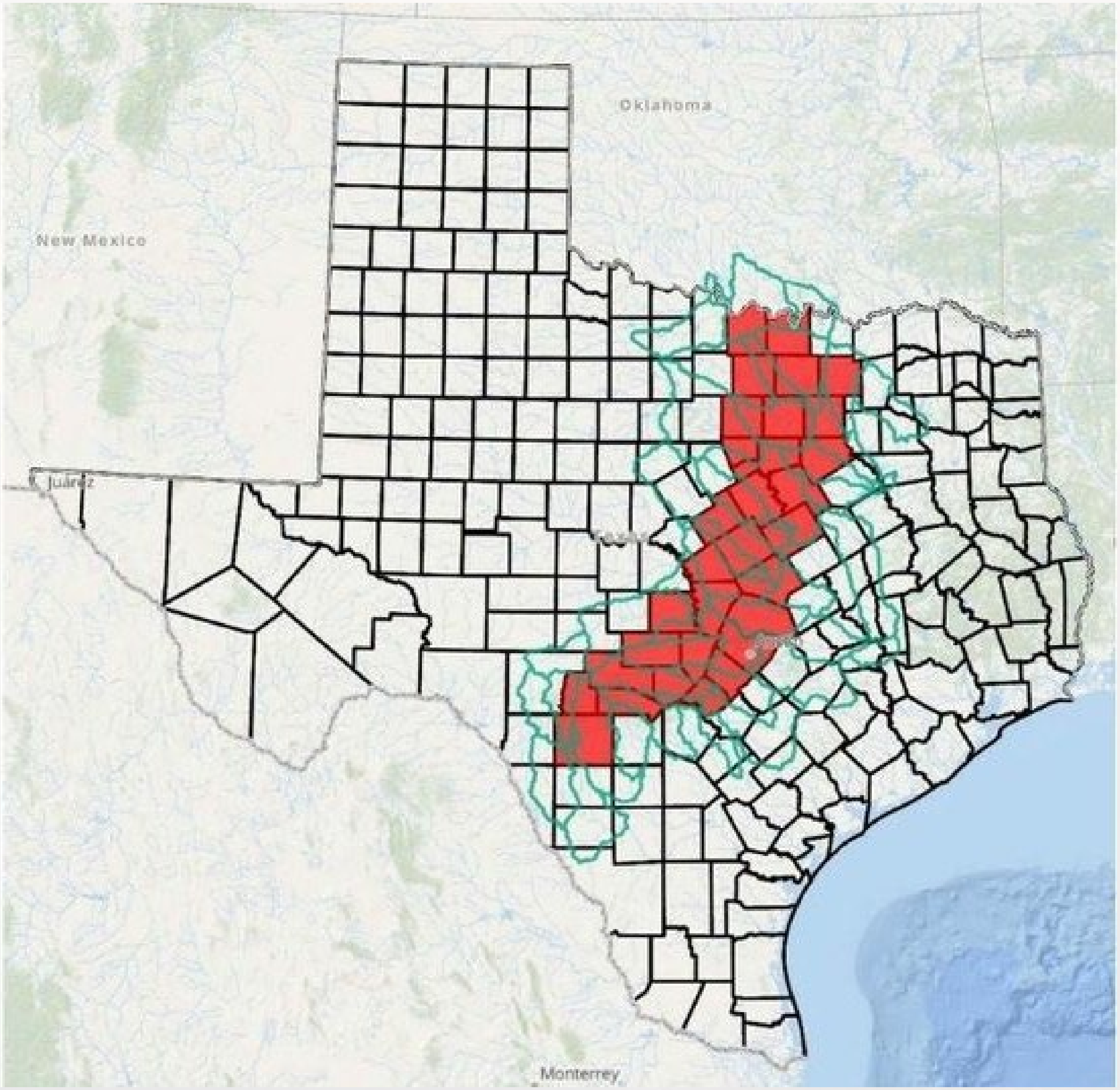
Texas Water Resources Institute
make every drop count

Texas A&M AgriLife Research

FLOOD PREDICTION MODELING and COMMUNITY RESILIENCE

"Flash Flood Alley"

- Flood alert information infrastructure
- Stream gauge network
- Predictive flood models
- System integration and analytics
- Data-based community preparedness and response



SECURING FUNDING
KEYS TO SUCCESS

BEYOND THE INDIVIDUAL: THINKING HOLLISTICALLY

- Multidisciplinary,
- Multi-institutions,
- Multi-PIs.
- Industry

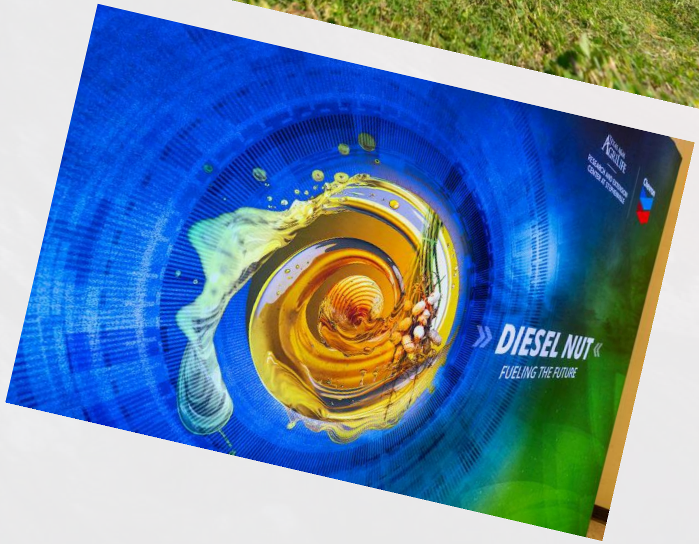
Ogallala: multiple states involved.

Texas A&M AgriLife Research

THE FUTURE

Intelligent Systems

- Real-time remote sensing data analysis
- Specialized expertise to develop technologies
- Upgraded laboratories
- Satellite-based data and precision farming integrations
- Training of next generation



Texas A&M AgriLife Research

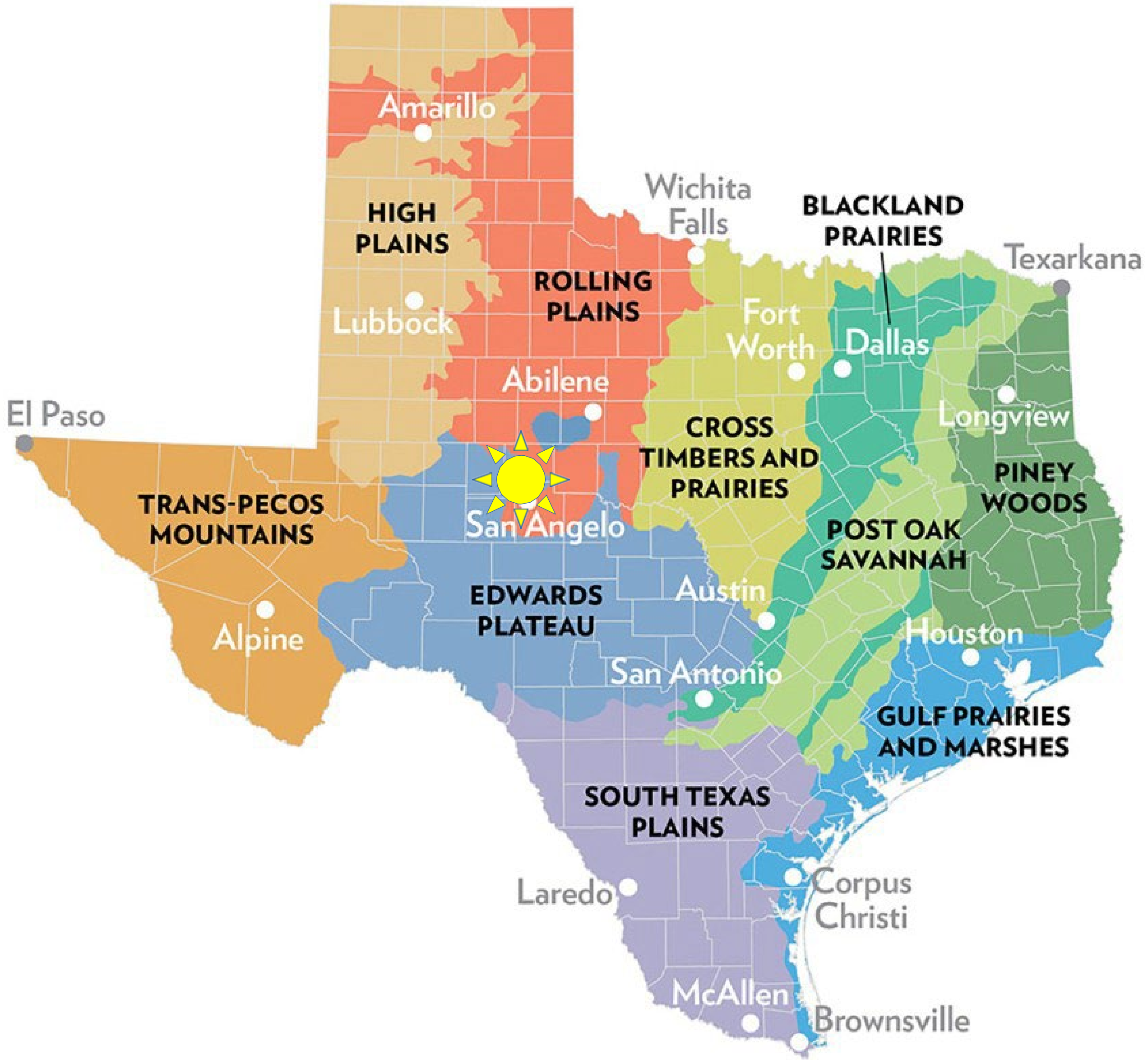
THANK YOU!

G. Cliff Lamb, Ph.D.
Director

Texas A&M AgriLife Research and Extension Center-San Angelo

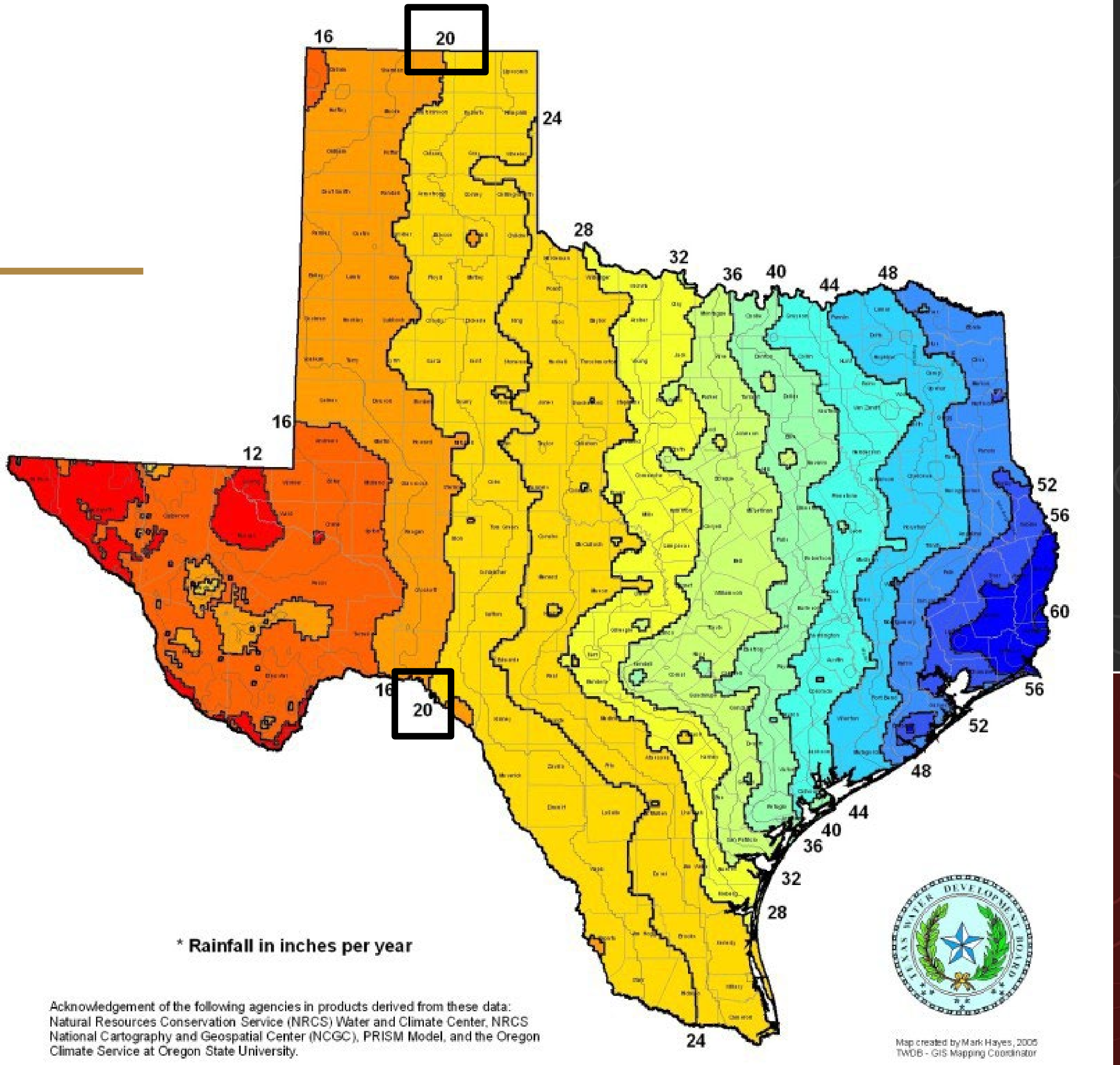
Russell Jessup, Ph.D.- Center Director

Texas A&M AgriLife
Research and Extension Center-
San Angelo

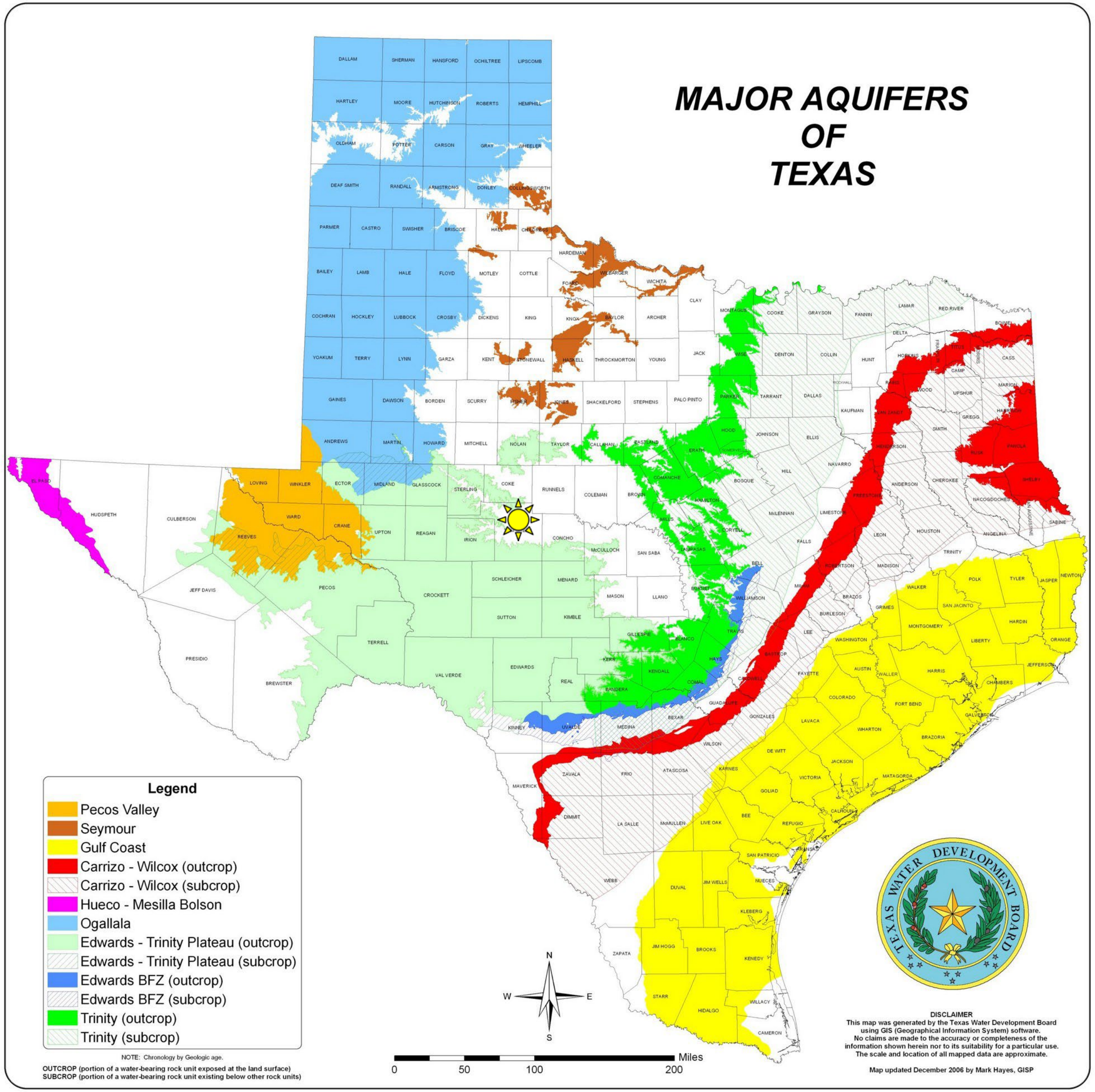


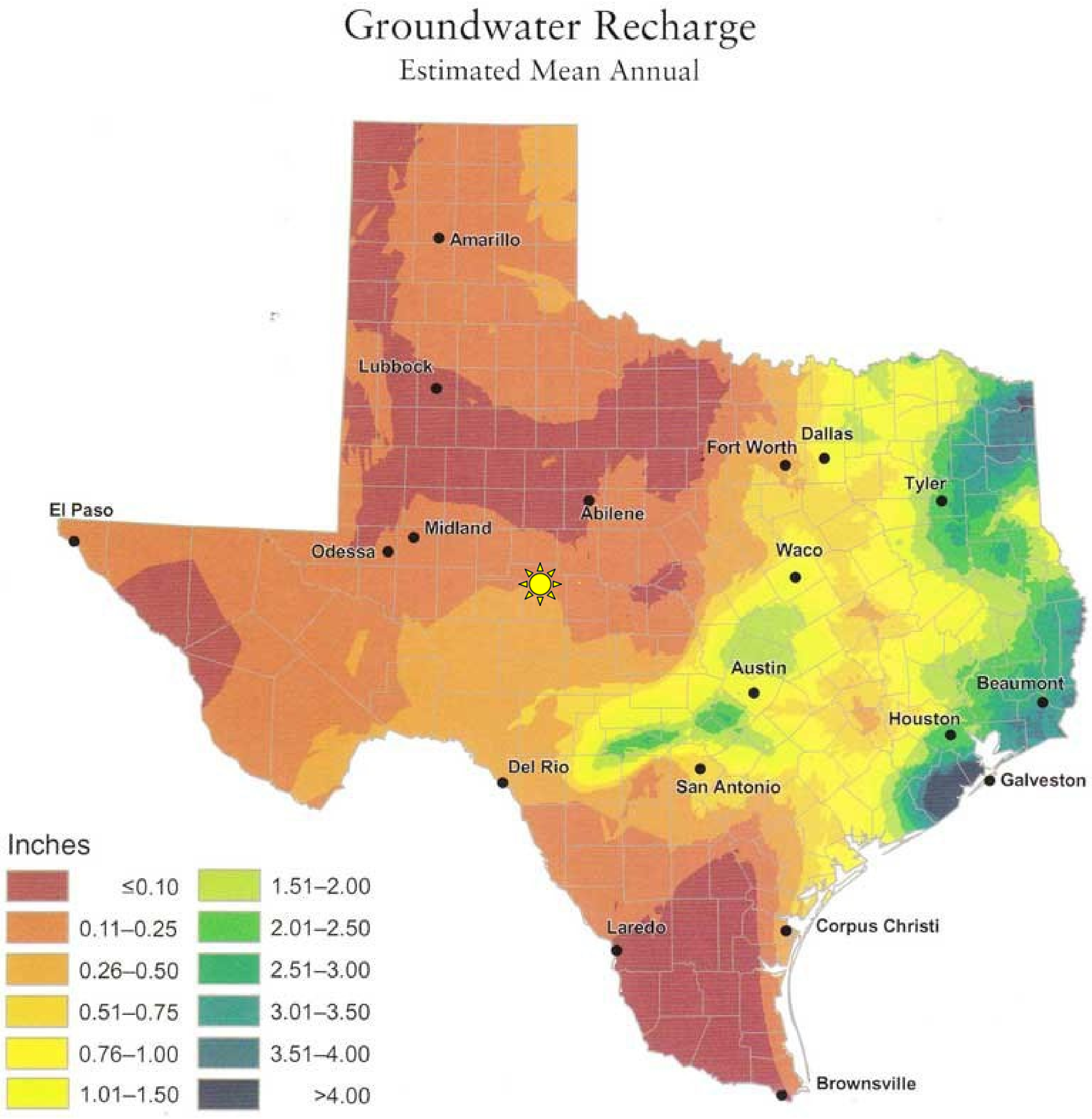
PRECIPITATION

- Extreme variability
- High intensity
- Few events
- Poor spatial and temporal distribution



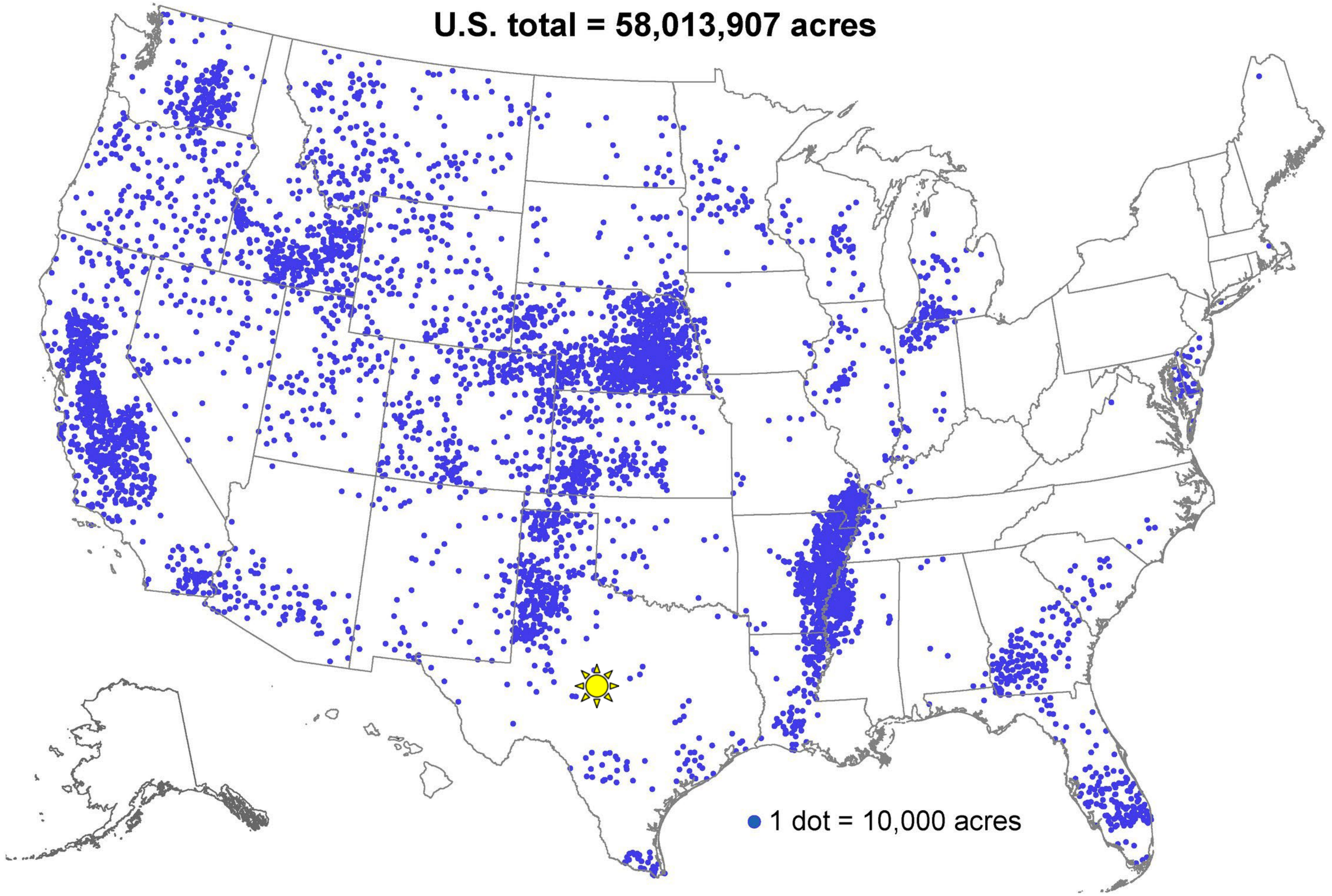
Texas A&M AgriLife
Research and Extension Center-
San Angelo




Groundwater Recharge
Estimated Mean Annual
Amarillo
Lubbock
Fort Worth
Dallas
Tyler
El Paso
Abilene
Midland
Odessa
Waco
Austin
Beaumont
Houston
Del Rio
San Antonio
Galveston
Laredo
Corpus Christi
Brownsville
Inches
≤0.10
0.11–0.25
0.26–0.50
0.51–0.75
0.76–1.00
1.01–1.50
1.51–2.00
2.01–2.50
2.51–3.00
3.01–3.50
3.51–4.00
>4.00

Texas A&M AgriLife
Research and Extension Center-
San Angelo

U.S. acres of irrigated land by county, 2017



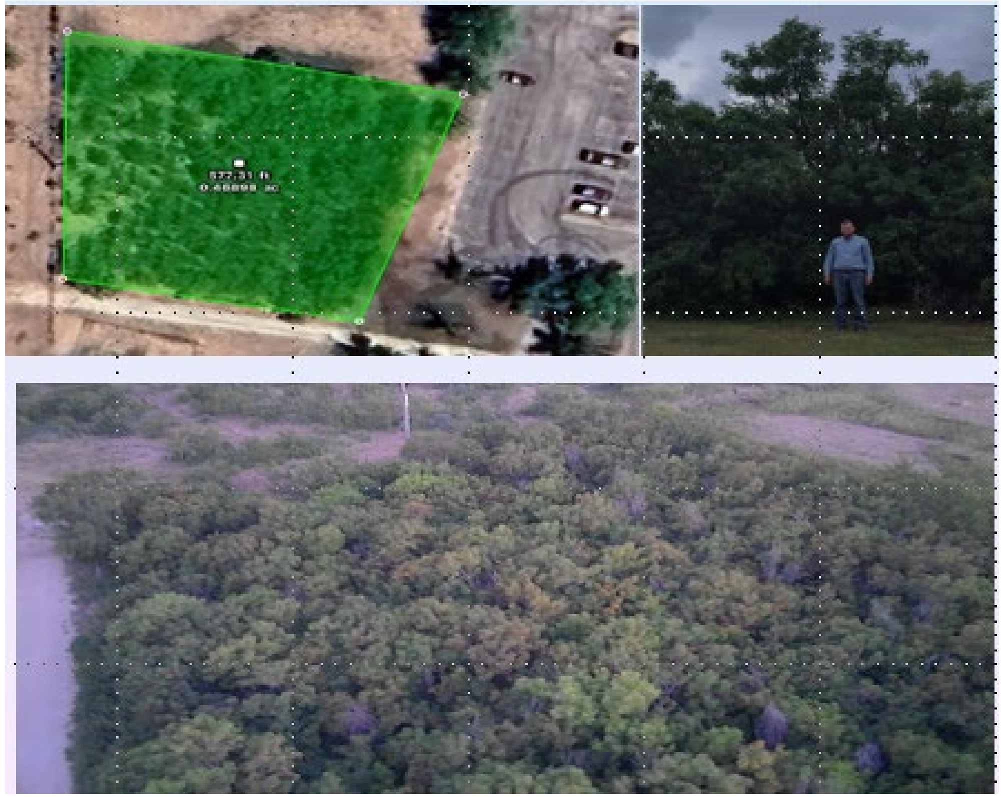
Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, 2017 Census of Agriculture.

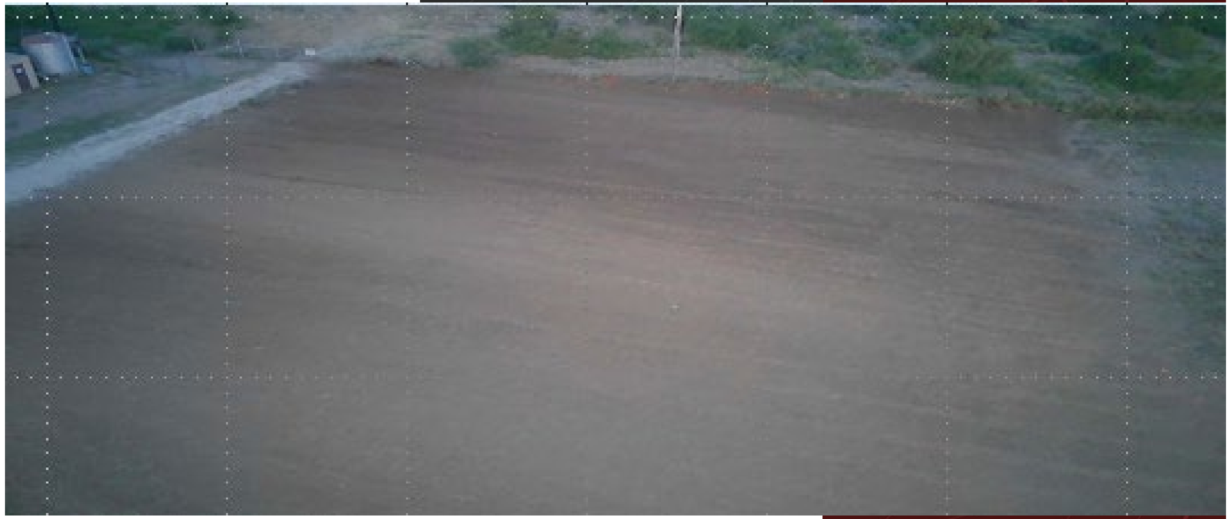
RAINWATER HARVESTING FOR IRRIGATION: RWHI

- Supplemental irrigation
- Previous examples (Asia, Africa, Georgia, Oregon)

Texas A&M AgriLife
Research and Extension Center-
San Angelo

SAN ANGELO DEMONSTRATION PROJECT

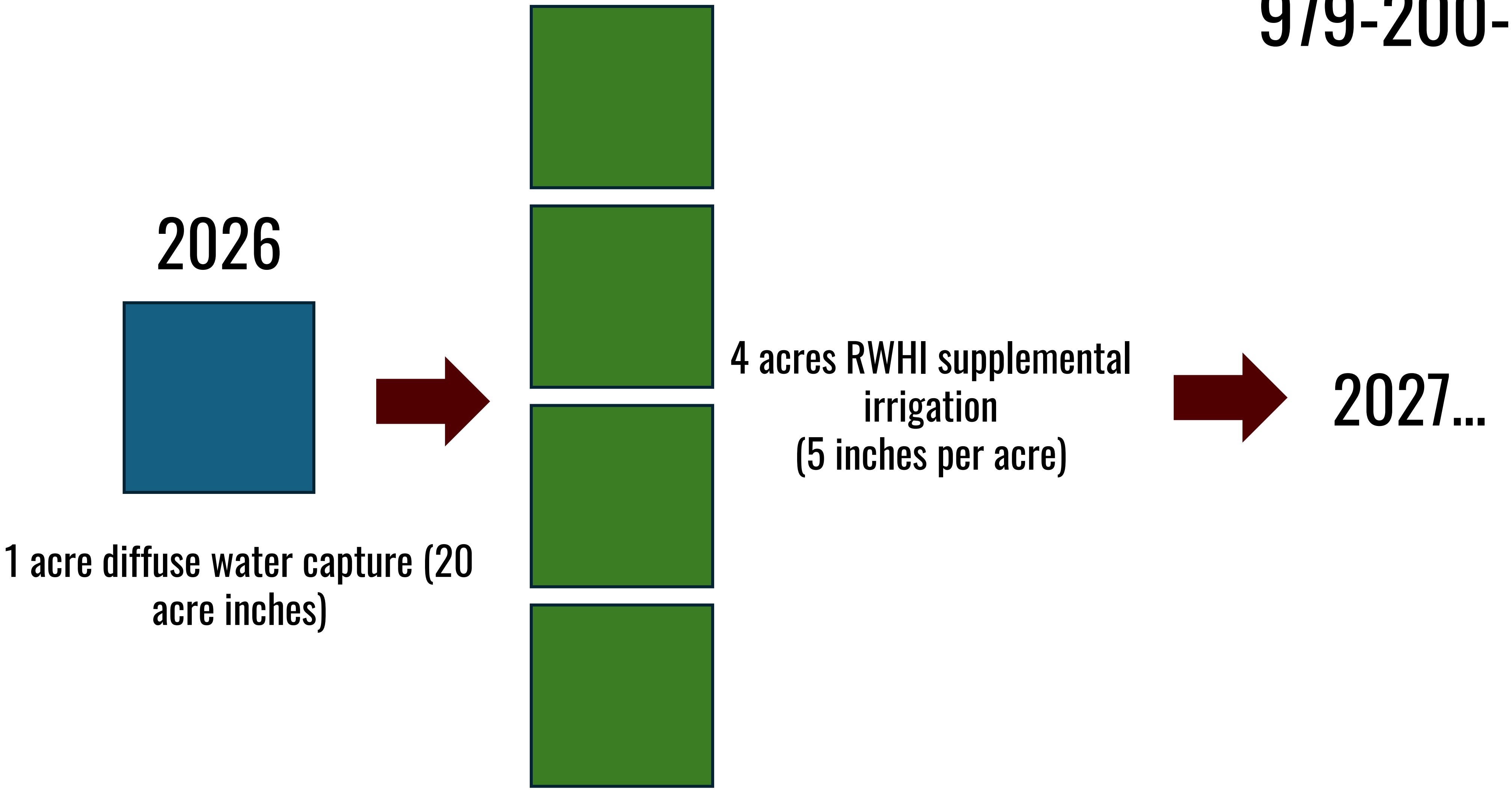


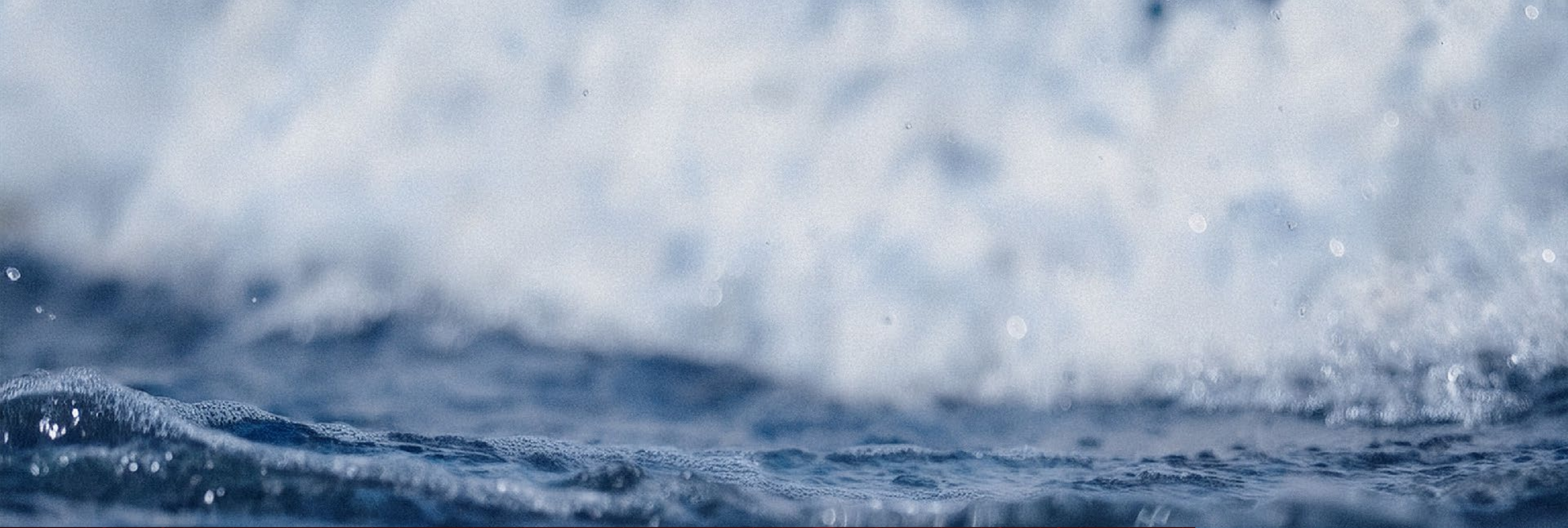


5 AUGUST 2025

SAN ANGELO DEMONSTRATION PROJECT

Russ Jessup
rjessup@tamu.edu
979-200-0707





Texas A&M Department of Plant Pathology and Microbiology

Won Bo Shim, Ph.D.- Department Head

TEXAS A&M UNIVERSITY
Plant Pathology
& Microbiology

Plant Pathology & Microbiology

Home of Bioenvironmental Sciences

TEXAS A&M
AGRILIFE

TEXAS A&M UNIVERSITY
Plant Pathology
& Microbiology

Plant Pathology & Microbiology

Home of **Bioenvironmental Sciences**

TEXAS A&M AGRILIFE

- **Research:** Programs focused on *multiple aspects on plant pathogenicity, plant signaling, plant- microbe interactions, plant and root microbiome, synthetic biology and biofuels, **plant and microbial environmental biotechnology.***
- **Teaching:** Graduate Program in *Plant Pathology (PhD and MS)* and Undergraduate Programs in ***Bioenvironmental Sciences (BS) and Environmental Studies (BS)***
- **Extension:** We have multiple plant disease diagnostic facilities (College Station, Amarillo, and Weslaco). We serve *clients across the entire state, the US and the world on multiple issues*, such as mycotoxins and pathogens important in food safety to insect-vectored pathogens causing disease on citrus, corn, wheat, potato, rice, vegetables, turf and many other crops.
- **Faculty :** as of August 2025, **28 faculty members in the department**
  - 12 tenured/tenure track faculty and 2 academic professional track faculty with 11 research program active faculty members on College Station campus.
  - 8 Extension Specialists (4 on-campus and 4 at Texas A&M AgriLife Centers) with active extension/research programs.
  - 6 faculty members administratively tied to Texas A&M AgriLife Research Centers with active research programs.

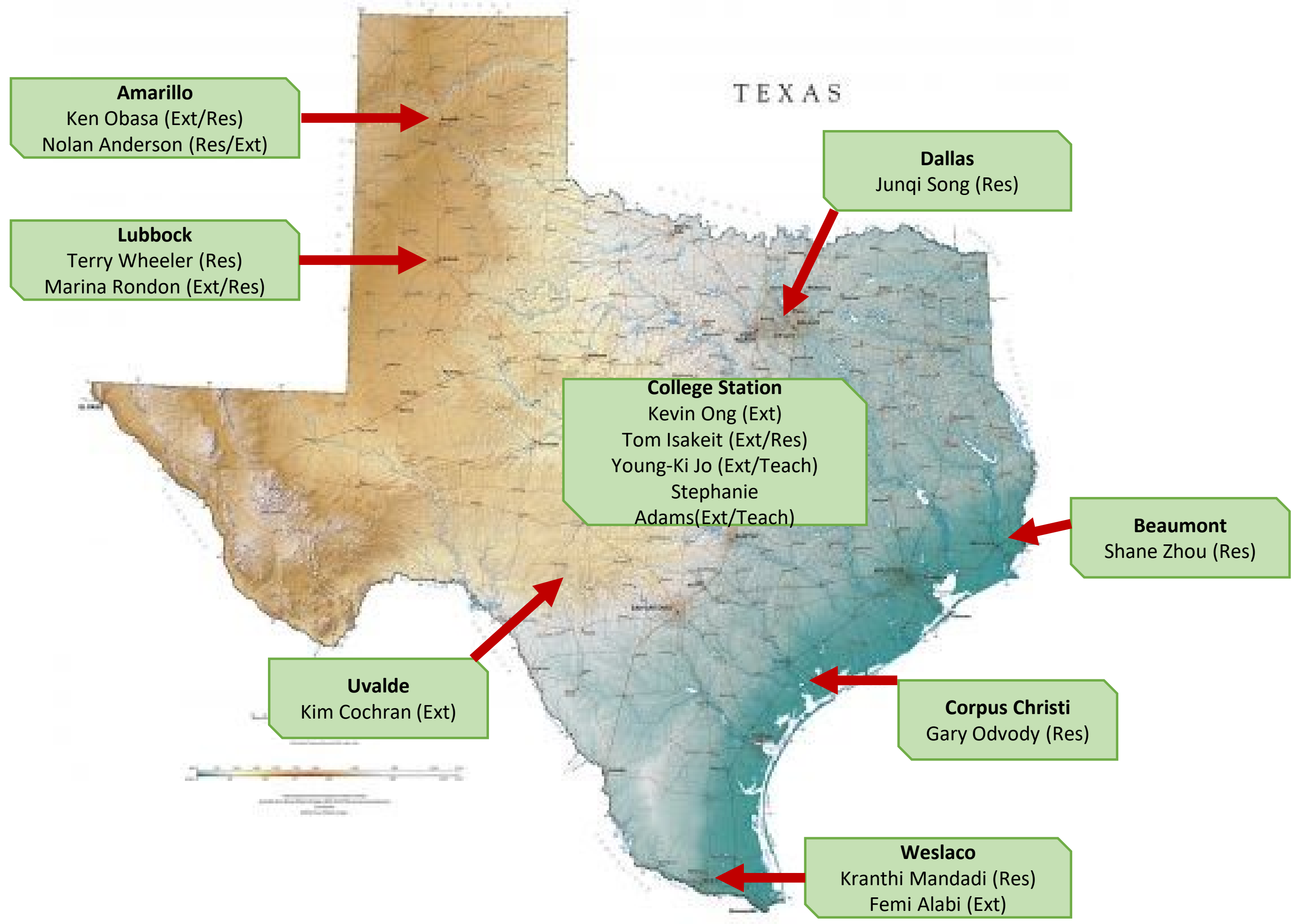
Plant Pathology & Microbiology
Home of **Bioenvironmental Sciences**

- Through science and education, we prepare citizens to improve these goals with knowledge relevant to plant health, food safety and environmental health.
- Our research is crucial for developing strategies to manage plant diseases to ensure food security and sustainable agriculture.
- Two undergraduate majors in PLPM (Fall 2025)
  - **Bioenvironmental Sciences, B.S.**
  - **Environmental Studies, B.S.**
- Our undergraduate programs, Bioenvironmental Sciences and Environmental Studies, provide tremendous opportunities for our teaching mission and expand our research capacity.
- NIFA funded REEU programs.
- NEW: Faculty-led Study Abroad to Kasetsart University, Bangkok, Thailand.

TEXAS A&M UNIVERSITY
Plant Pathology
& Microbiology

TEXAS A&M AGRILIFE

State-Wide PLPM AgriLife Faculty Members



CURRENT PLPM DEPARTMENT FACULTY

Assistant Professors

- Adams, Stephanie (Extension, College Station)
- Anderson, Nolan (Research, Amarillo)
- Antony-Babu, Sanjay (TAMU, College Station)
- Arreola-Vargas, Jorge (TAMU, College Station)
- Edwards, Joseph (TAMU, College Station)
- He, Baoye (TAMU, College Station)
- Obasa, Ken (Extension, Amarillo)
- Rondon, Marina (Extension, Lubbock)
- **Xu Zhang (TAMU, College Station)**

Associate Professors

- Chappell, Tom (TAMU, College Station)
- Cochran, Kim (Extension, Uvalde)
- Odvody, Gary (Research, Corpus Christi)
- Song, Junqi (Research, Dallas)
- Stoddard, Kati (TAMU, College Station)*

Professors

- Alabi, Olufemi (Extension, Weslaco)
- Gonzalez, Carlos (TAMU, College Station)
- Isakeit, Tom (Extension, College Station)
- Jo, Young-Ki (Extension, College Station)
- Kolomiets, Mike (TAMU, College Station)
- Magill, Clint (TAMU, College Station)
- Mandadi, Kranthi (Research, Weslaco)
- Ong, Kevin (Extension, College Station)
- Shaw, Brian (TAMU, College Station)
- Shim, Won Bo (TAMU, College Station)
- Verchot, Jeanmarie (TAMU, College Station)
- Wheeler, Terry (Research, Lubbock)
- Wilkinson, Heather (TAMU, College Station)*
- Zhou, Shane (Research, Beaumont)

TEXAS A&M UNIVERSITY
Plant Pathology
& Microbiology

TEXAS A&M AGRILIFE

Current Projects on Microbial Environmental Remediation

- **NIST** Bioenvironmental Security and Training Program
- **DARPA μSTASIS:** a Microbial System to Ameliorate Survival in Extreme Settings
- **USDA** REEU at the Interface of Plant, Microbial and Bioenvironmental Sciences
- **NSF EFRI:** High-throughput synthetic biology approaches for mixed plastic degradation and reutilization

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

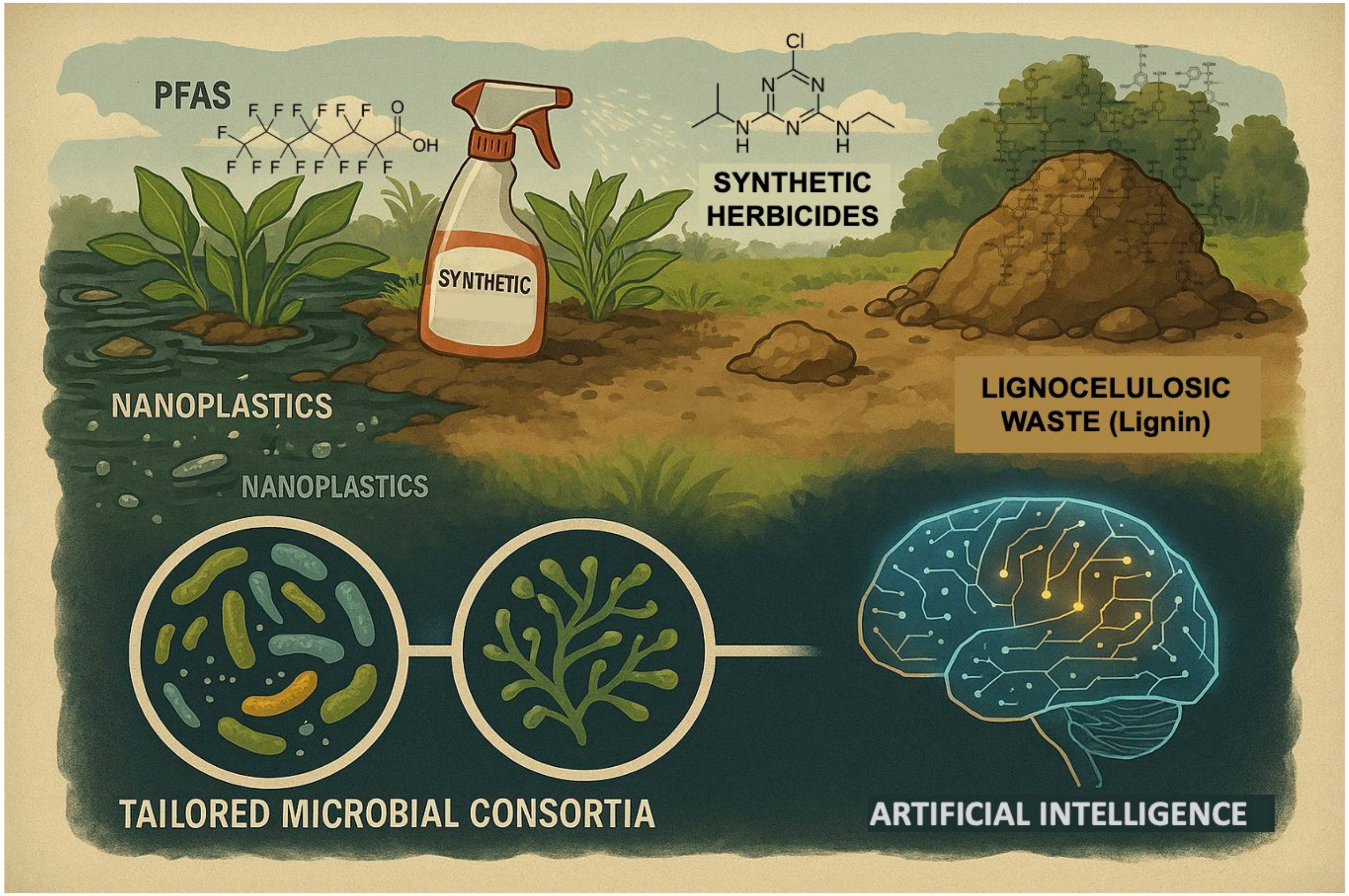
DARPA

NSF

USDA NIFA

The smallest solution to one of our biggest problems

Genetically and Environmentally Networked Intelligent Assemblies (**GENIA**) for the Degradation of PFAS, Herbicides, Nanoplastics, and Lignin



TEXAS A&M UNIVERSITY Plant Pathology & Microbiology

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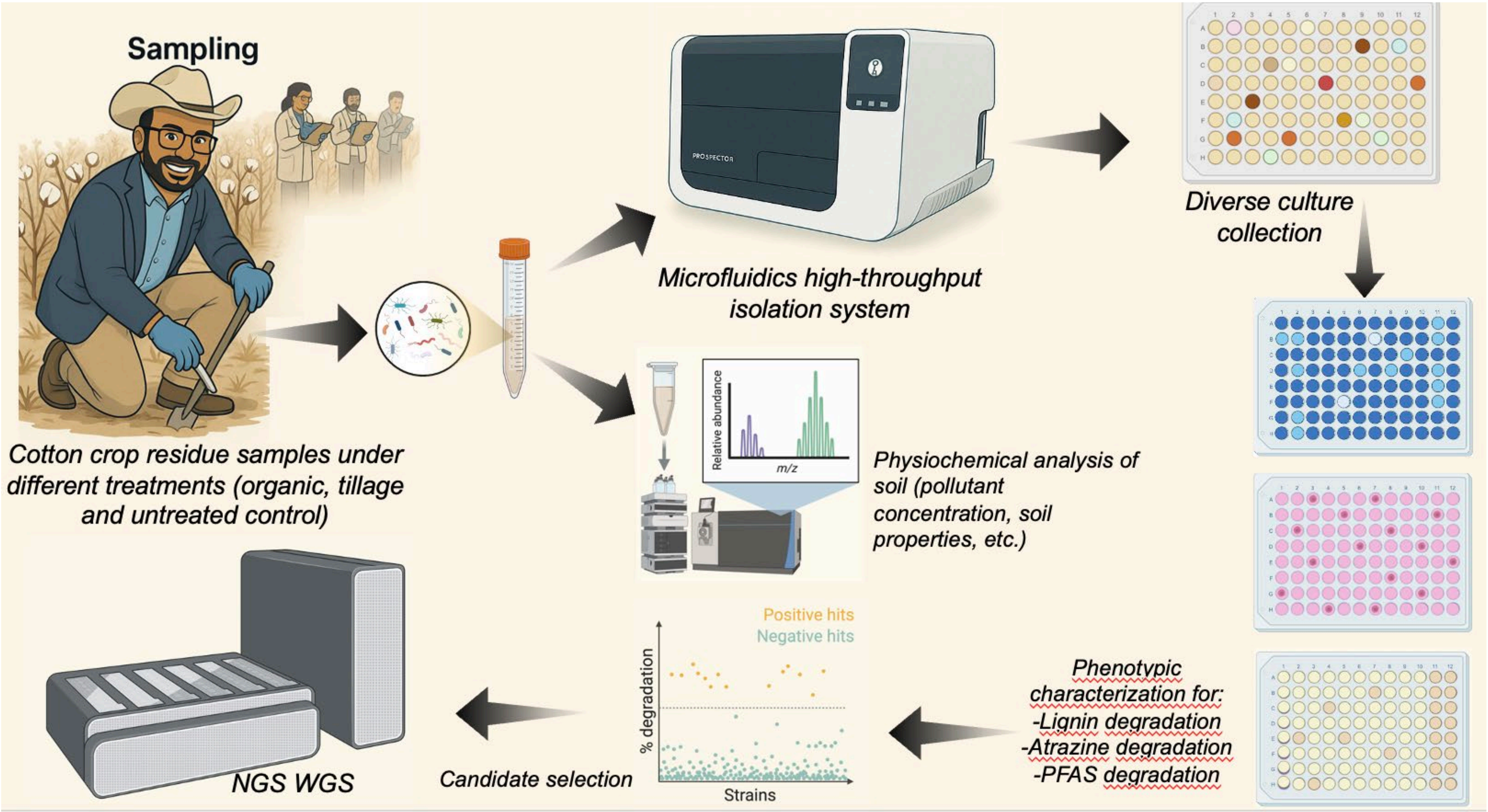
TEXAS A&M AGRILIFE

Genetically and Environmentally Networked Intelligent Assemblies (GENIA)



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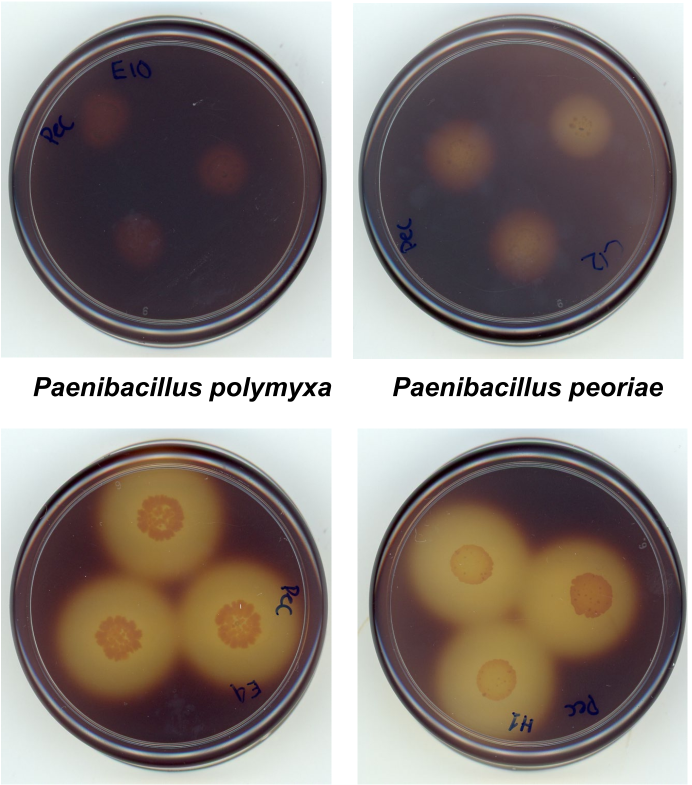
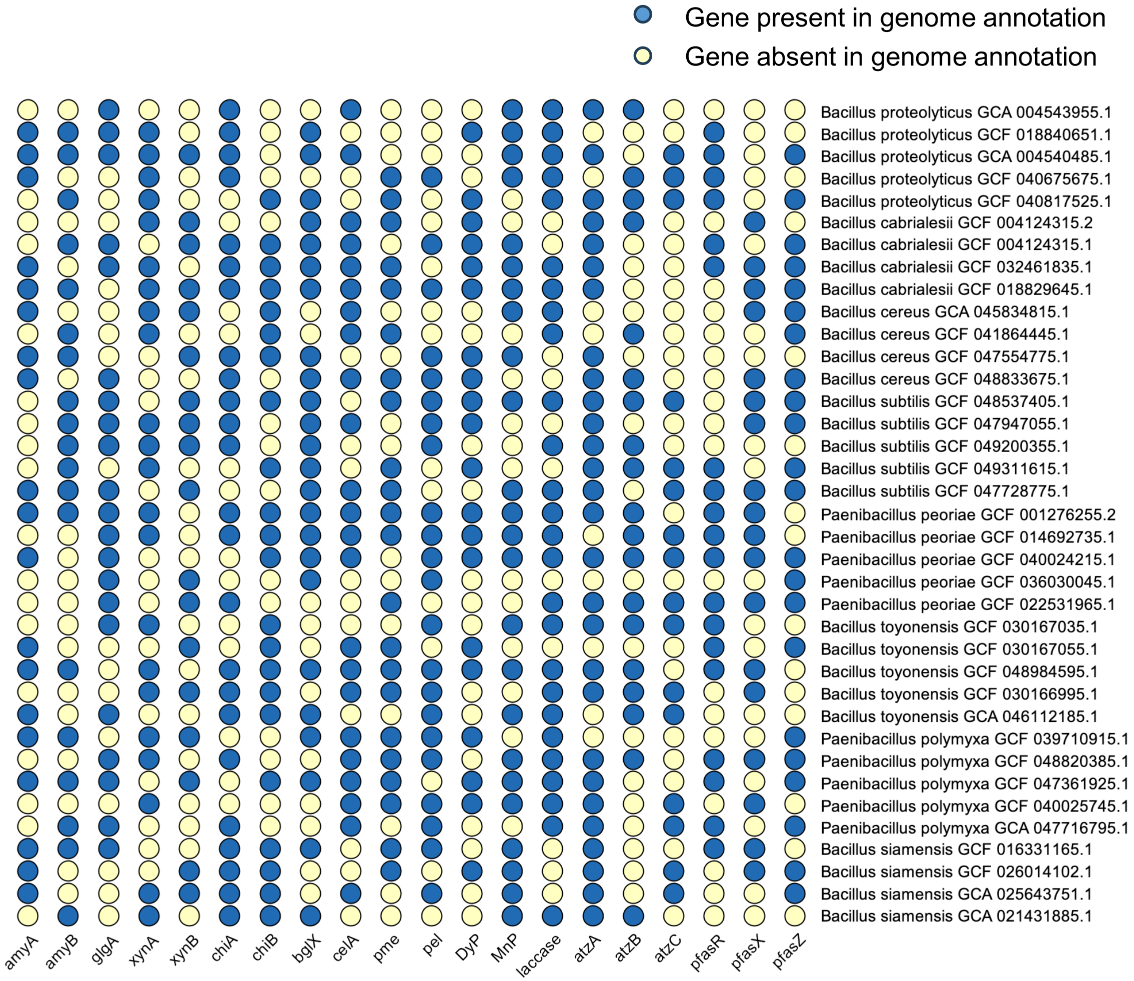
Who's Got the Tools?
Mapping Enzymes for Degradation Across Strains

Pectinase activity



Paenibacillus polymyxa *Paenibacillus peoriae*

Bacillus cabrialesii *Bacillus siamensis*



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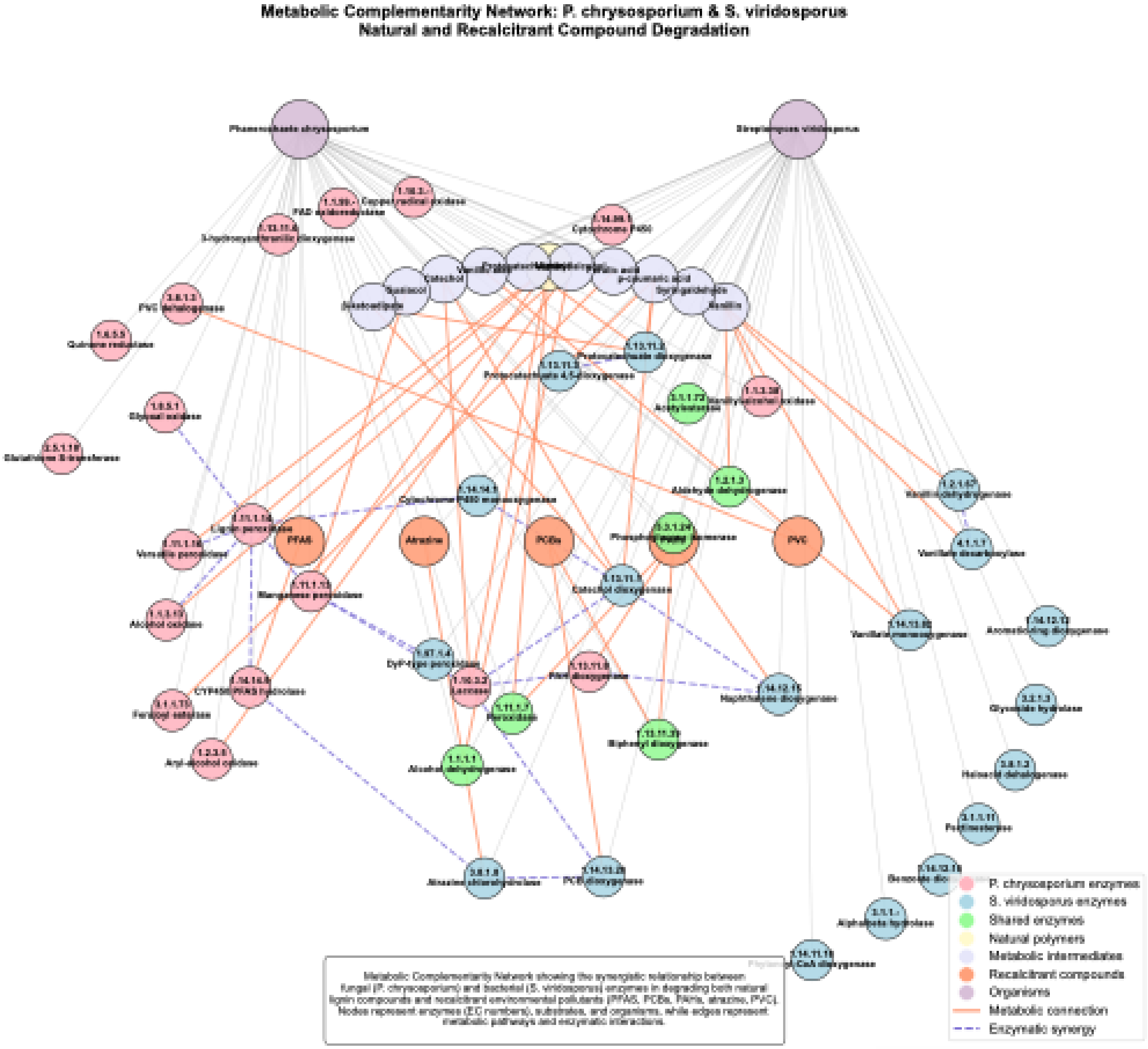
Metabolic Network Modeling & Synthetic Consortia

Implementation:
- Python NetworkX + Matplotlib with custom force-directed layout

Data structure:
- Directed graph with organism, enzyme (EC numbers), and substrate nodes

Scaling to Larger Communities
- DBSCAN clustering to group functionally similar enzymes
- Louvain algorithm for community detection (modularity Q > 0.65)
- Edge bundling using force-directed edge bundling (FDEB) algorithm

AI Applications
- Node2Vec embeddings to predict enzyme-substrate interactions
- GAT (Graph Attention Networks) to identify key metabolic nodes
- LSTM-based models trained on time-series metabolomics data
- GNN (R-GCN) for heterogeneous graph representation learning



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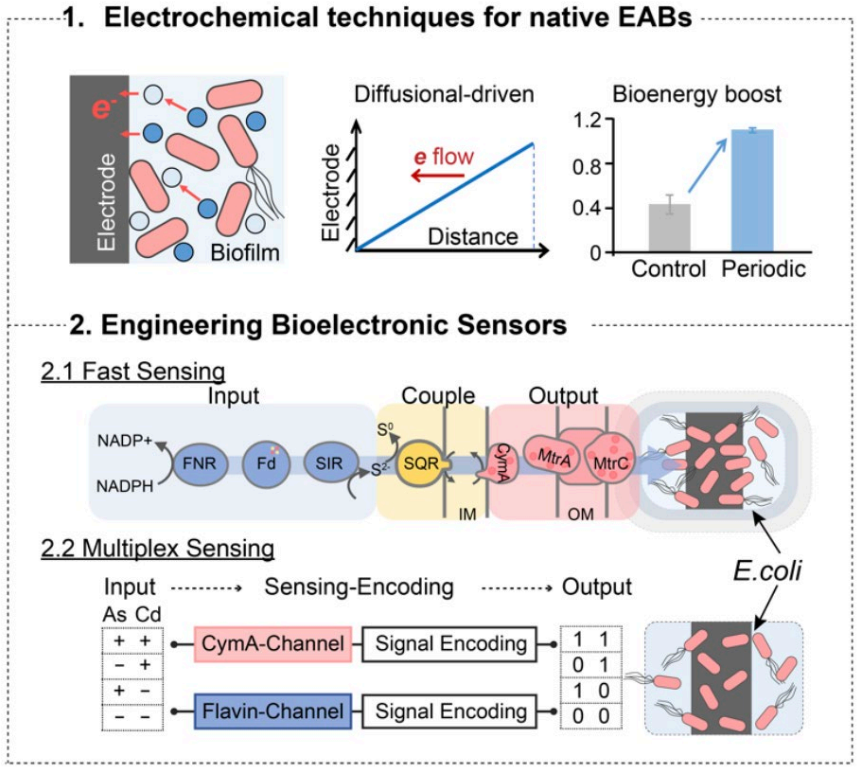
The Zhang Lab: Electrochemical approaches and synthetic biology tools for developing functional ElectroActive Bacteria (EABs)



Aim 1: Engineering Artificial EABs

- Synthetic biology of cell adhesion
- Fundamental study of biofilm matrix

Genetic parts and matrix properties ⇅ *Design rules for EAB formation*

AIM 2: EAB-based Bioelectronics

- Mechanics of cell matrix
- Electrochemical programs

Feedback from function output ⇅ *Design rules for EAB assembly*

AIM 3: Sustainable Bioelectronics

- Toxins monitoring
- Renewable Bioenergy
- Bioremediation

Integrated Bioelectronics

Dr. Xu Zhang
Assistant Professor, PLPM

X. Zhang, M. Charrier, C.M. Ajo-Franklin, 2024. Multichannel bioelectronic sensing using engineered *Escherichia coli*. *Nature Communications July 2025*

TEXAS A&M UNIVERSITY
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& Microbiology

TEXAS A&M AGRILIFE

Texas A&M Department of Soil and Crop Sciences

David Baltensperger, Ph.D.- Department Head

Howdy!

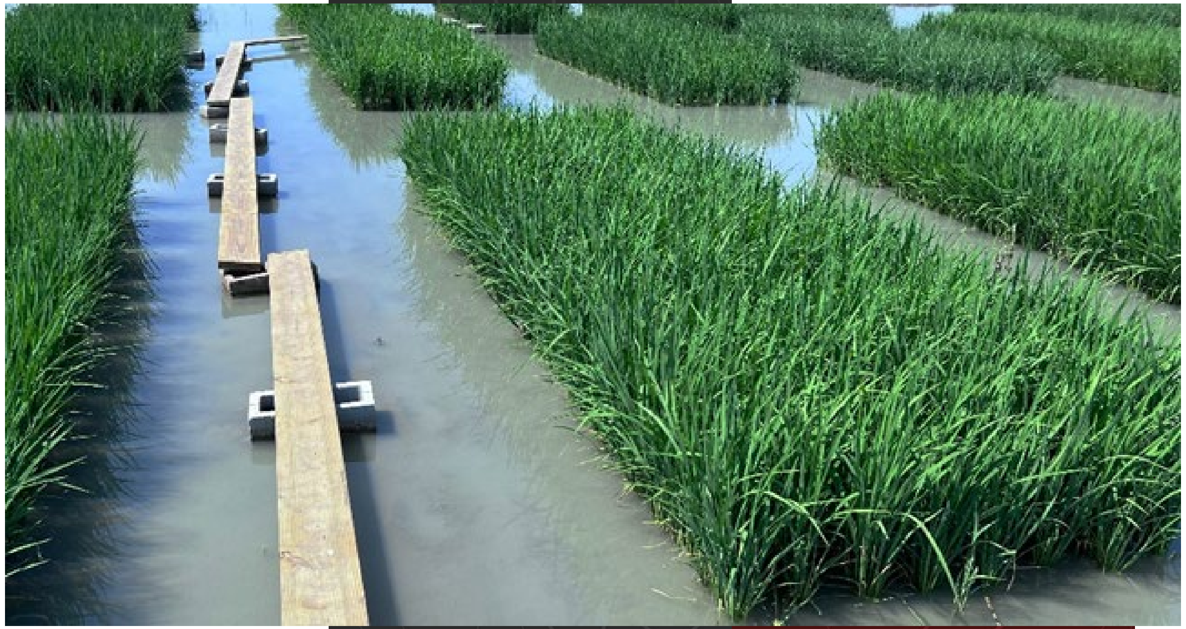
Soil and Crop Sciences

Utilizing our water to sustainably provide food, fuel, and fiber in an aesthetically pleasing environment!

- Faculty at every Texas A&M AgriLife Research and Extension Center in Texas and several satellite locations. Plus--Food Science and Technology

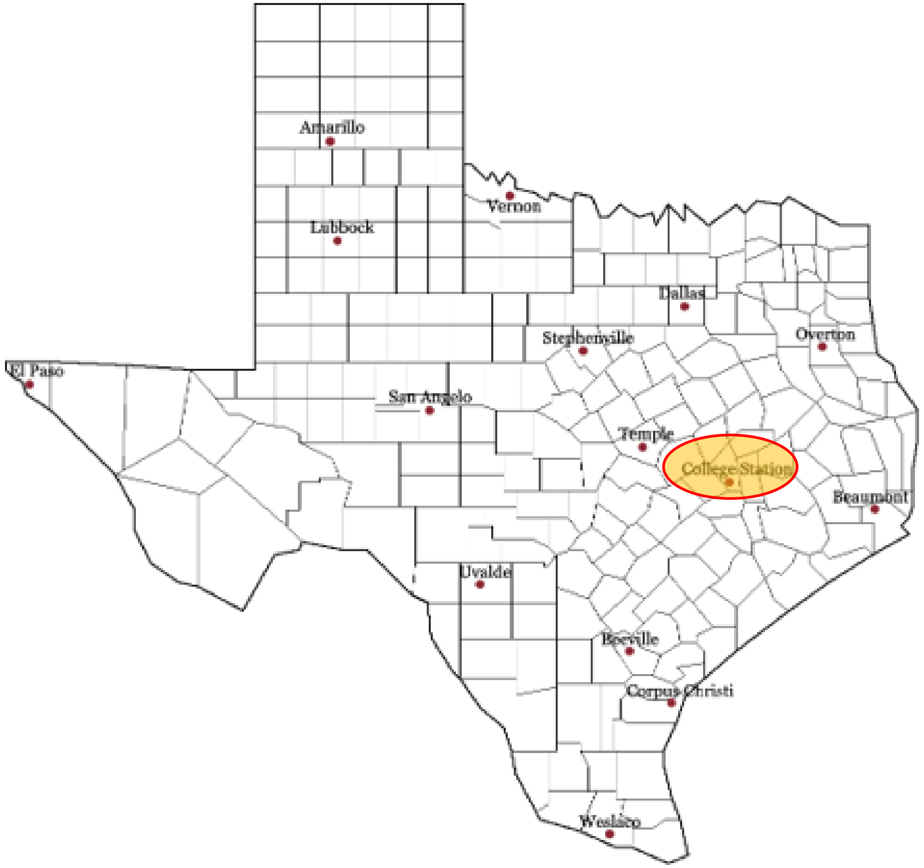
- The largest Agronomic Extension Unit on planet Earth!

- Everyone in the Department has some component focused on water



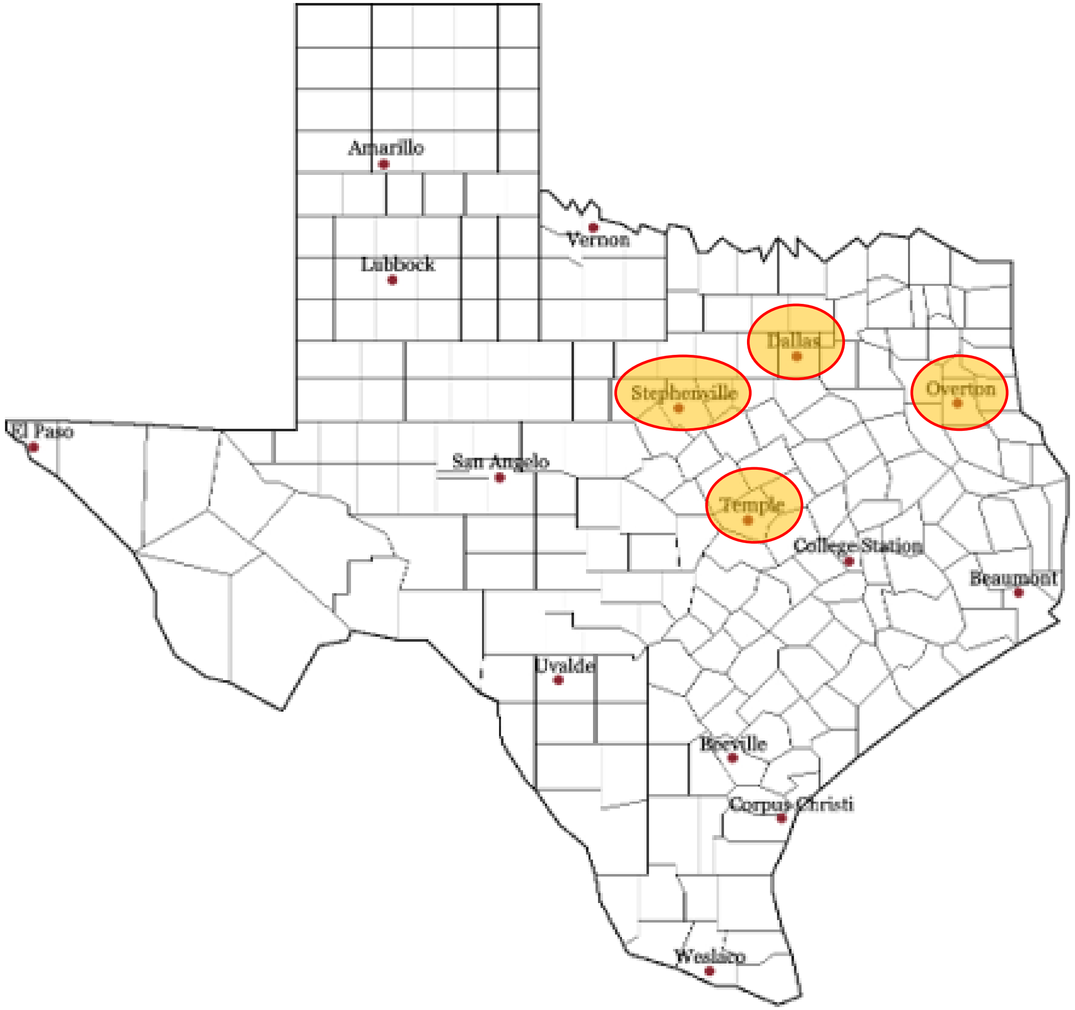
SCSC FACULTY

Approximately half of the Soil and Crop Science faculty are not located on campus but are located at one of the 13 research and extension centers across the state. While these off-campus faculty are not in College Station, they are active members of the department and participate in combined research and extension activities and in graduate advising of graduate students at Texas A&M or at other institutions where they hold adjunct or split appointments (such as West Texas A&M, Texas Tech, Texas A&M Kingsville, and Tarleton State).



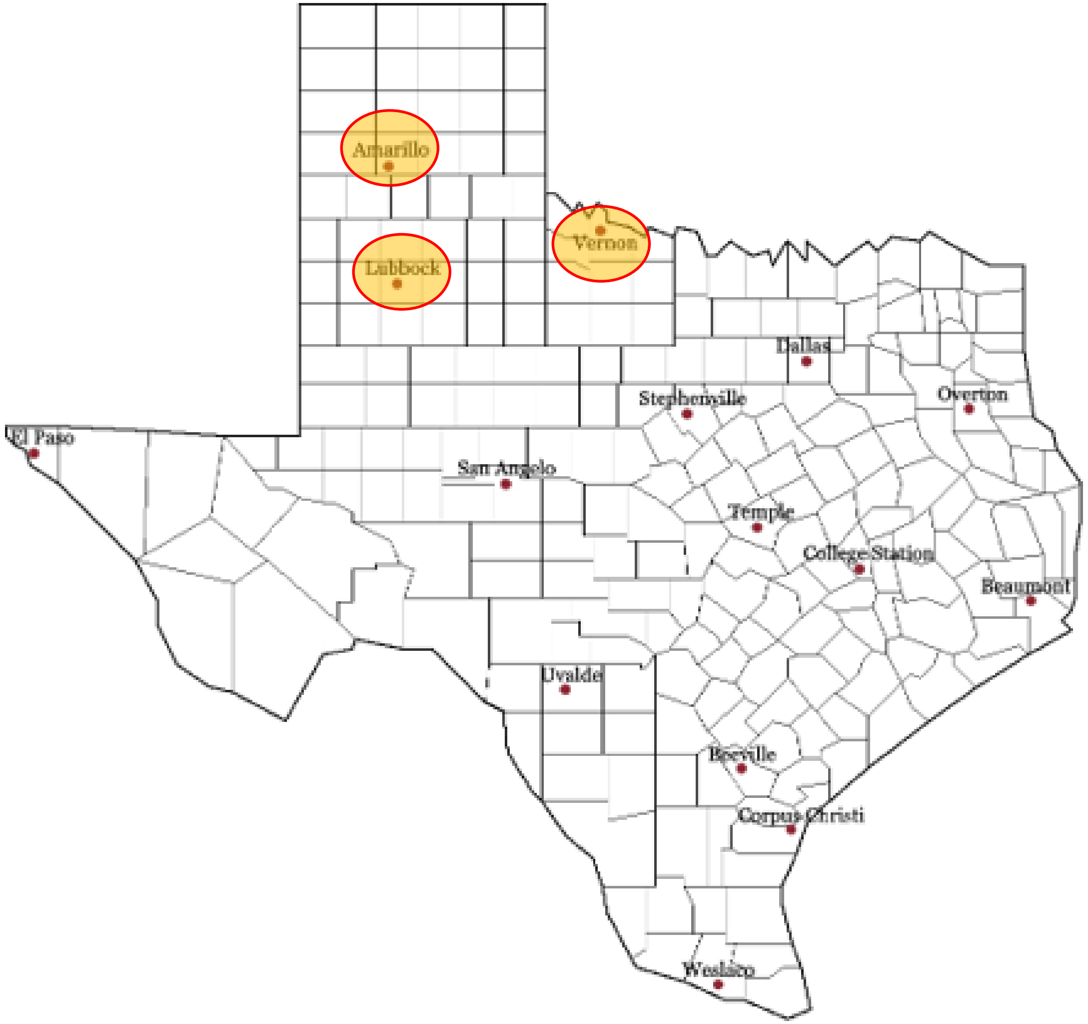
On Campus Faculty			
Muthukumar Bagavathiannan*	Shuyu Liu	Seth Murray*	Kate Szerlag
David Baltensperger	Tim Herrmann	Sakiko Okumoto	Peyton Smith
Scott Nolte	Julie Howe	Tony Provin	Wayne Smith
Katherine Carson	Mark Hussey	Nithya Rajan	David Stelly
Youjun Deng	Amir Ibrahim	Keerti Rathore	Baoxin Chang
Alma Fernandez	Russell Jessup	Larry Redmon	Nithya Subramanian
Scott Finlayson	Kevin McInnes	William Rooney*	Michael Thomson*
Terry Gentry	Felipe Aburto	Ronnie Schnell	Ben Wherley
Manuel Chavarria	Ben McKnight	Endang Septiningish	Briana Wyatt
Ying Wang	Jake Mowrer	Aart Verhoef	Hongbin Zhang
Brandon Gerrish	Giovanni Piccinni	Thanos Gentimis	Qianqian Dong

SCSC FACULTY



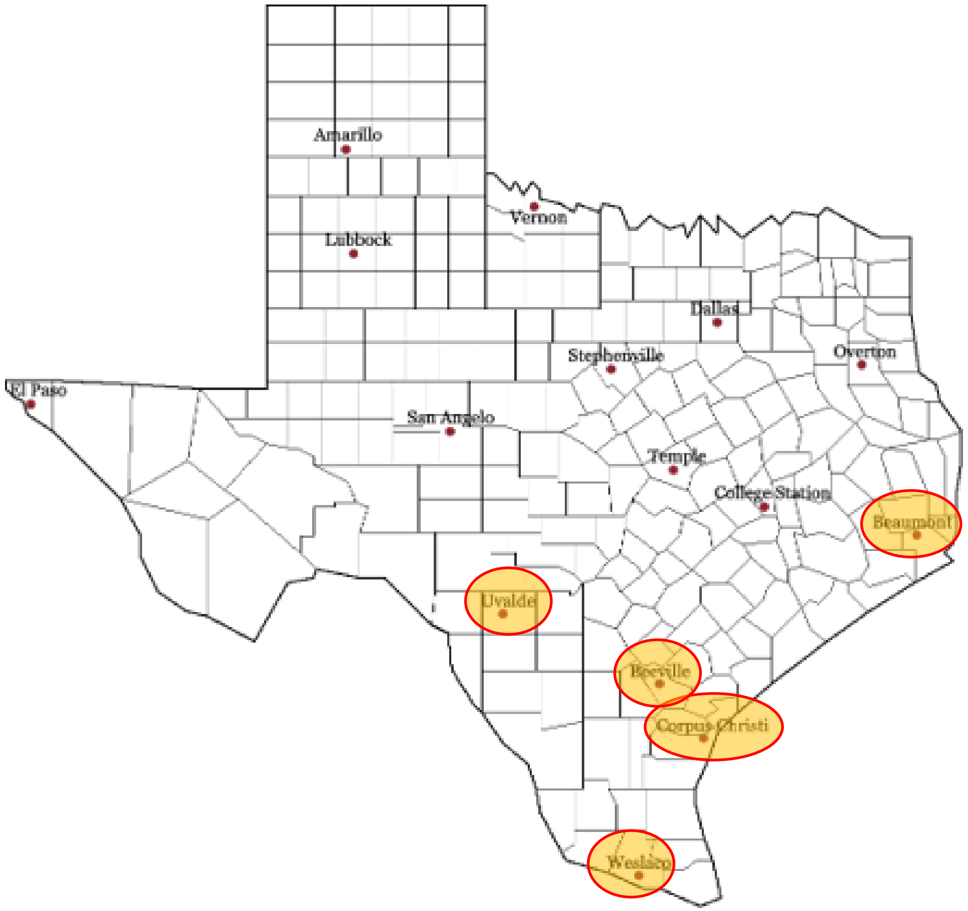
Central and East Texas Faculty	
Commerce	Grace Ogden
Dallas	Ambika Chandra
Dallas	P. Agustin Boeri
Dallas	Murukarthick Jayakodi
Stephenville	Jeff Brady
Stephenville	John Cason
Stephenville	James Muir
Stephenville	Charles Simpson**
Temple	Gurjinder Baath
Overton	Vanessa Corriher Olson
Overton	Monte Rouquette
Overton	Gerald Smith
Overton	Anil Somenahally
Overton	Prem Oli
** working retiree	

SCSC FACULTY



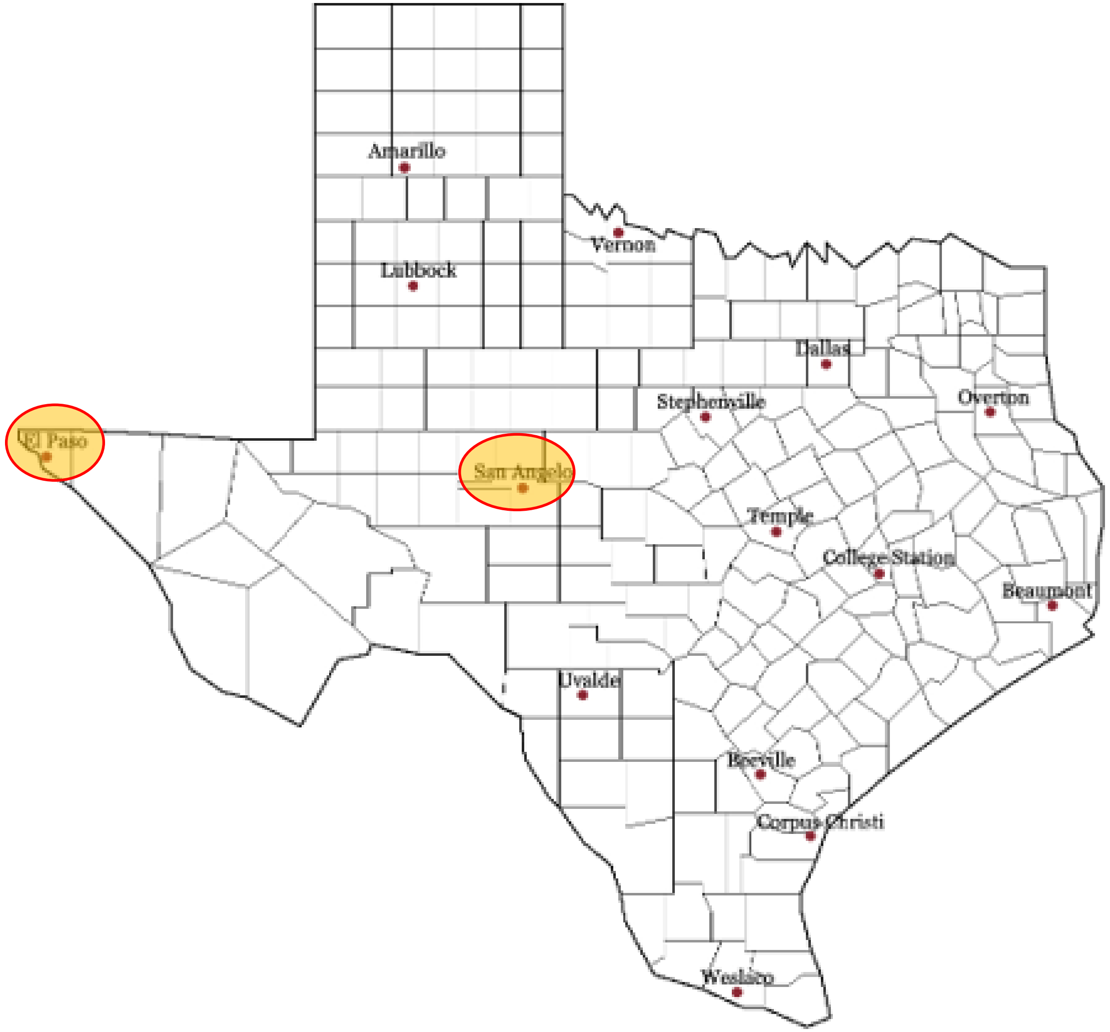
Panhandle and Rolling Plains	
Amarillo	Jourdan Bell
Amarillo	Jackie Rudd
Amarillo	Qingwu Xue
Amarillo	Junli Zhang
Amarillo	Craig Bednarz
Lubbock	Todd Baughman
Lubbock	Joseph Burke
Lubbock	Mark Burow
Lubbock	Carol Kelly
Lubbock	Peter Dotray
Lubbock	Brendan Kelly
Lubbock	Wayne Keeling**
Lubbock	Ken Lege
Lubbock	Katie Lewis
Lubbock	Wenxuan Guo
Lubbock	Jaroy Moore**
Lubbock	Calvin Trostle
Lubbock	Wenwei Xu
Vernon	Paul DeLaune
Vernon	Dariusz Malinowski
Vernon	Emi Kimura
Vernon	Waltram Ravelombola
Vernon	*Curtis Adams*
** working retiree	

SCSC FACULTY



South Texas and Gulf Coast			
Beaumont	Lee Tarpley	Corpus Christi	Jamie Foster
Beaumont	Fugen Dou	Corpus Christi	Mahendra Bhandari
Beaumont	Omar Samonte	Corpus Christi	Josh McGinty
Beaumont	Shyamal Talukder	Eagle Lake	Sam Rustom
Beaumont	Mithila Jugulam	Uvalde	Xuejun Dong
Beaumont		Weslaco	Jorge Da Silva
Beaumont	Yubin Yang	Weslaco	Dirk Hays
		Weslaco	Peter Omara

SCSC FACULTY



West Texas			
San Angelo	Reagan Noland	El Paso	Girisha Ganjegunte

CURRENT EFFORTS IN WATER RESEARCH, TEACHING, AND EXTENSION

- Research-Based Extension and Education is our backbone and the very definition of the Land Grant System.

- We provide the guidance for the most sustainable water-use practices for every major row crop and forage in Texas, including the largest irrigated crop in Texas -*turfgrass*

- ***This includes***:
  - Predictive models for optimizing irrigation.
  - Weed control strategies and technology to reduce the competition for water
  - Managing to enhance or maintain water quality
  - Managing our wells for safe drinking water

WATER STRESS TOLERANCE IN TURFGRASS

FORAGE SORGHUM, MATURITY CLASS, AND IRRIGATION

- **1.7 inches** less irrigation per acre per season with early-medium hybrids
- **46,162 gallons** saved per acre
- **5.5 million gallons** saved per 120-acre pivot
- If adopted on 10K acres, **55 Billion gallons** could be water saved by adopting early-medium maturing hybrids under limited irrigation

CURRENT EFFORTS IN WATER RESEARCH, TEACHING, AND EXTENSION, CONTD

- Mine reclamation work to make sure restoration includes quality water resources.
  - Example is the Illuminant mine!
    - Largest recent addition to water supply in Texas
- Produced Water
- While already discussed this is a huge current and future effort of faculty in the department

- Breeding for crops with enhanced water use efficiency and water stress tolerance.
- Breeding for tolerance to flooded conditions.
- Livestock and wildlife management for water quality
- Nutrient management and formulations for enhanced water quality

EXAMPLE- DR. BRIANA WYATT

- Quantifying how removing woody plants can increase groundwater recharge to the Carrizo-Wilcox aquifer (where BCS gets its water)

- Using soil moisture data to develop seasonal-scale streamflow prediction models for irrigation management

- Testing alternative materials in urban rain gardens to reduce runoff and remove contaminants

- Measuring how dynamic soil properties due to agricultural management (tillage) impact soil water availability

- Quantifying the impact of soil moisture on flash drought development in Texas

CURRENT EFFORTS IN WATER RESEARCH, TEACHING, AND EXTENSION, CONTD

- Salinity management
- Including desalinization
- Microbiome management

- Big Opportunities
  - Interaction with greenhouse gas emissions
    - Biological nitrification inhibition
    - Waste management
    - Water reuse in food processing
- Resilient Ag
- Growing dairy industry
  - Forages rather than grain
- Remediation and microbial plant interaction
- Breeding new varieties
- Advances in weed science
  - Robotic control
  - Ecology of the system

EXAMPLE- MICHAEL KUITU

Texas Watershed Steward

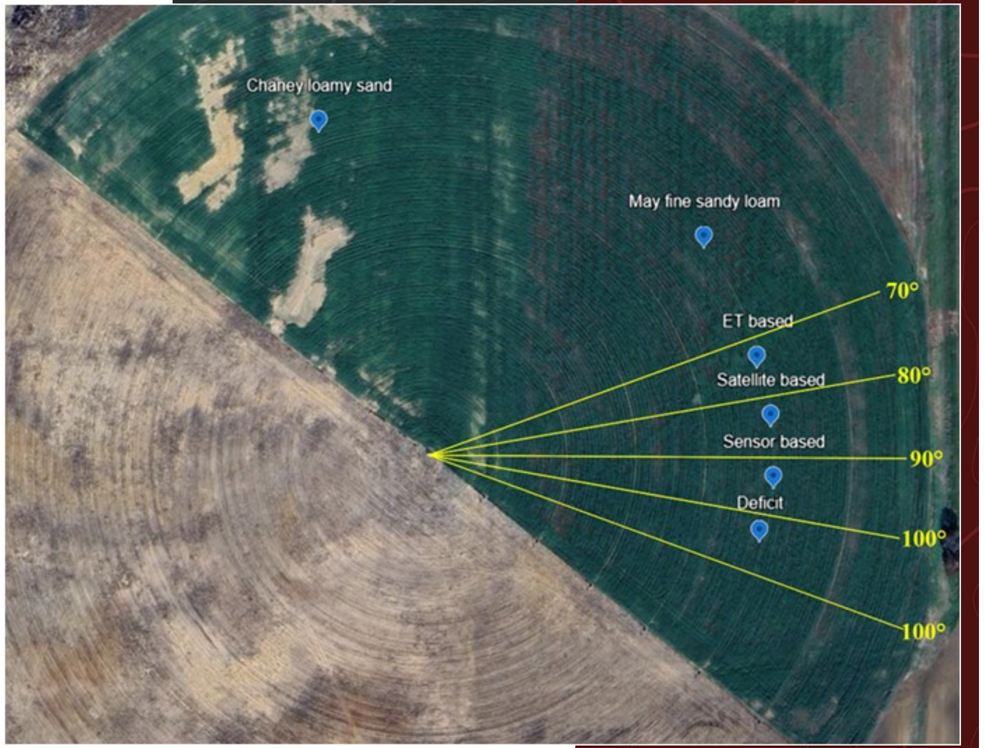
- The Texas Watershed Steward (TWS) program is a statewide educational program designed to improve the quality of Texas' water resources. The program educates and informs locals about their watershed, its potential problems, and steps people can take to improve and protect surface water quality in their area. The TWS half-day program equips watershed stakeholders to engage in local efforts to implement practices that improve water quality.
- *Select continuing education credits available
- https://tws.tamu.edu/

COLLABORATION

- We have entered an era where big problems require **multi- inter- and trans -disciplinary** research and programing.
  - TWRI in partnership with departments, centers, and institutes can be the spark to make this work

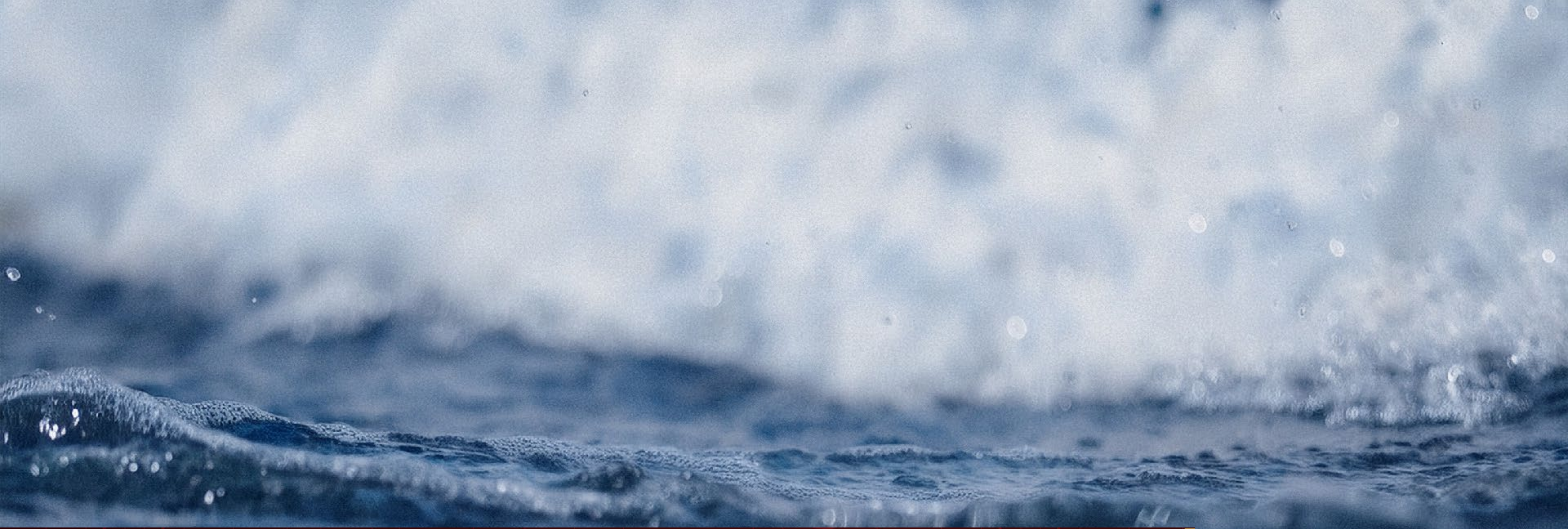
- **Partnerships** with Producers

- Commodity **Support**
  - Turf, corn, wheat, rice, sorghum peanut, livestock, fruit, nut and vegetable ,
    - Wheat growers started checkoff on silage to support research.



With vision and passion to make our water resources the most productive and sustainable,

we can garner the resources to make a better future for Texas and the world.



Texas A&M Department of Agricultural Economics

Rodolfo Nayga, Ph.D.- Department Head

BROAD RESEARCH AREAS (>70 FACULTY)

- Environmental & natural resource economics; Economics of climate change
- International development economics, Economic development
- Agricultural policy and trade
- Experimental and Behavioral economics
- Nutrition and health economics; Consumer economics
- Econometric theory and methods; Data analytics
- Production economics
- Agricultural business, finance, marketing, management, entrepreneurship

MAJOR WATER-RELATED ISSUES

- Water Scarcity and Drought (Nayga, Rouhi Rad, Bahrami, Kang, Yang)
- Aquifer Depletion and Groundwater Management (Nayga, Rouhi Rad, Bahrami)
- Water Quality and Salinity (Rouhi Rad, Judd)
- Valuation and Security of Water Access (Nayga, Rouhi Rad, Bahrami)
- Technology Adoption and Water-Efficient Practices (Rao, Nayga, Kafle, Bahrami)
- Urban and Turf Water Use (Rao, Rouhi Rad)
- Livestock Water Footprint Reduction (Rao)
- Broader Global Issues (Kafle)

What are some on-going projects addressing these issues/what faculty members in your department are addressing these issues?

WATER SCARCITY AND ITS IMPLICATIONS FOR IRRIGATED AGRICULTURE

- **The Value of Water Access Security** (Bahrami, Rouhi Rad, Nayga)
  - Senior rights, storage, and groundwater add value
  - Irrigated land worth 73% more than dryland

- **The Cost of Climate-driven Water Scarcity** (Bahrami, Rouhi Rad, Nayga)
  - Snowpack loss → Increase in curtailments → Loss in farm values
  - Land value declines 0.6% per 1pp increase in curtailment risk of water rights

- **Wired for Water** (Rouhi Rad)
  - Hot days increase electricity use for groundwater pumping (0.64% short-run, 3.22% long-run

AQUIFER DEPLETION IN THE HIGH PLAINS

- **Amarillo Dairy Feed Study** (Rao)
  - Developing alternative feeding strategies to reduce dairy farms’ water use in the Ogallala region
  - The economic impact of dietary modification

- **Well Worth It** (Bahrami, Rouhi Rad, Nayga)
  - Well capacity adds significant value to farmland (2% per 100 GPM)
  - Omitting capacity and focusing only on saturated thickness undervalues groundwater by >10%

- **Ogallala Aquifer Depletion and Farmers’ response** (Rouhi Rad)
  - New dataset on farmer response to aquifer depletion and drought
  - How farmers respond to aquifer depletion and market signals
  - Collaboration with groundwater modelers to integrate hydrological and economic analysis

WATER QUALITY

- **Salinity as an Externality of Agricultural Production** (Rouhi Rad)
  - Irrigation mobilizes salts, degrading groundwater and surface water used by others (e.g., farmers, municipalities, recreation)
  - Interdisciplinary hydro-salinity-economic model quantifies salinity costs and tradeoffs

- **Has the Clean Water Act been effective in improving water quality?** (Rouhi Rad)
  - Assesses the effectiveness of Municipal Separate Storm Sewer System regulations
  - National estimates of the policy's impact on water quality
  - Quantifies health, recreational, and economic benefits of improved water quality

TECHNOLOGY ADOPTION

- **Turfgrass & Smart Irrigation Tech** (Rao)
  - Develops drought-resilient turfgrass varieties and improved turf management tools (e.g., smart irrigation, robotic mowers)
  - Evaluates short- and long-rum economic and environmental benefits for homeowners, gold courses, and the public sector

- **Most Crop per Drop Irrigation Yield Contest** (Bahrami, Nayga)
  - Farmers receive report cards on how their WUE compares with other farmers
  - Program increases the adoption rate of irrigation practice by 4%
  - Spillovers observed in non-contestant farmers who were indirectly exposed to the program

- **Canal Conveyance Efficiency and Sprinkler Irrigation Adoption** (Yang, Rouhi Rad, Bahrami, Nayga)
  - How canal conveyance efficiency influences farm-level adoption of sprinkler irrigation systems
  - Higher canal efficiency is associated with lower adoption of on-farm sprinkler systems

GLOBAL PERSPECETIVE ON WATER, TECHNOLGY, AND DEVELOPMENT

- **Artificial Intelligence in Irrigation Management** (Kafle)
  - Synthesizes global evidence (2015–2025) on AI's role in optimizing irrigation schedules, water use efficiency, and water quality

- **Water Security and Land Use in the Hindu Kush Himalayas** (Kafle)
  - Reviews peer-reviewed studies on how pastoralist communities are affected by land use changes and shifting water access under climate stress

- **Irrigation and Climate Adaptation in Nepal** (Kafle)
  - Uses quasi-experimental evidence to show how irrigation infrastructure and awareness training improve agricultural productivity and climate resilience

RESEARCH GAPS AND LIMITATIONS

- **Limited integration of surface water and groundwater systems in economic modeling**
  - Most studies treat these systems separately, despite their strong hydrologic and institutional linkages
- **Insufficient data on farm-level responses to water stress and policy interventions in the Ogallala Aquifer**
  - Limited information is available about how producers respond to aquifer depletion, and how they adjust their irrigation in response to droughts and market signals

FUTURE COLLABORATIONS

- **Integrated modeling across disciplines**
  - Collaborate with hydrologists and groundwater modelers to link aquifer dynamics with economic behavior and policy analysis
  - Work with agronomists to assess the yield, input, and water-use impacts of conservation technologies and feed strategies
- **Water quality and externality**
  - Collaborate with environmental scientists and engineers to model water salinity, runoff, and other irrigation-related externalities
  - Engagement with public health scientist to measure health outcomes linked to water quality exposure (e.g., nitrate contamination, etc.)
- Importantly – we are eager to collaborate with you all!

Texas A&M Department of Biological & Agricultural Engineering

Patricia Smith, Ph.D.- Department Head

BAEN WATER FACULTY

Texas A&M Department of Biological and Agricultural Engineering

- Binayak Mohanty (College Station) COALS/AR
- Vijay Singh (College Station) COALS/AR
- Rabi Mohtar (College Station) COALS/COE/AR
- Patricia Smith (College Station) COALS/AR
- Salvo Calabrese (College Station) COALS/AR
- Uday Vaddevolu (College Station) COALS/AR
- Guy Fipps (College Station) AE
- Zong Liu (College Station) AE/AR
- Dana Porter (Lubbock) AE/AR
- Hope Nakabuye (Lubbock) AR
- Srini Ale (Vernon) AR
- Fouad Jaber (Dallas) AE/AR
- Eunsung Kan (Stephenville) AR
- Anish Jantrania (Temple) AE/AR
- Jaehak Jeong (Temple) AR
- Arun Bawa (Temple) AR
- Juan Enciso (Weslaco) AR
- Santosh Palmate (El Paso) AR/AE

MAJOR WATER-RELATED CONCERNS

- Declining groundwater and surface water for agriculture, livestock, domestic uses
- Higher crop water demand from increased temperatures, unpredictable rainfall
- Degraded cropland/rangeland reduces rainfall capture
- Salinity, pathogens, contaminants in alternative water sources
- Limited irrigation resources and need for efficiency
- Reproducible hydrologic models in ungauged basins
- Water scarcity in arid West Texas

MAJOR ADVANCES IN RESEARCH

- Efficient irrigation strategies, decision-support tools, automated control systems
- Long-term evaluation of regenerative agricultural practices
- Modeling nature-based solutions at city/watershed scales
- Crop breeding for heat, drought, salinity tolerance
- Advanced hydrologic modeling with AI/ML techniques
- Drone and imaging-based crop monitoring
- Removal of emerging contaminants from wastewater
- Participatory water systems modeling

Texas A&M Department of Biological and Agricultural Engineering

RESEARCH GAPS AND LIMITATIONS

- Insufficient research infrastructure
- Affordable, reliable soil water sensors
- Difficulty removing low-concentration contaminants
- Limited integrated agricultural systems data
- Underrepresentation of soils in models
- Lack of binational water data (West Texas)
- Unclear long-term ecosystem impacts of extreme events

DESIRED COLLABORATIONS

- Cross-disciplinary work (engineering, agronomy, data science, social science, chemistry, ecology, economics)

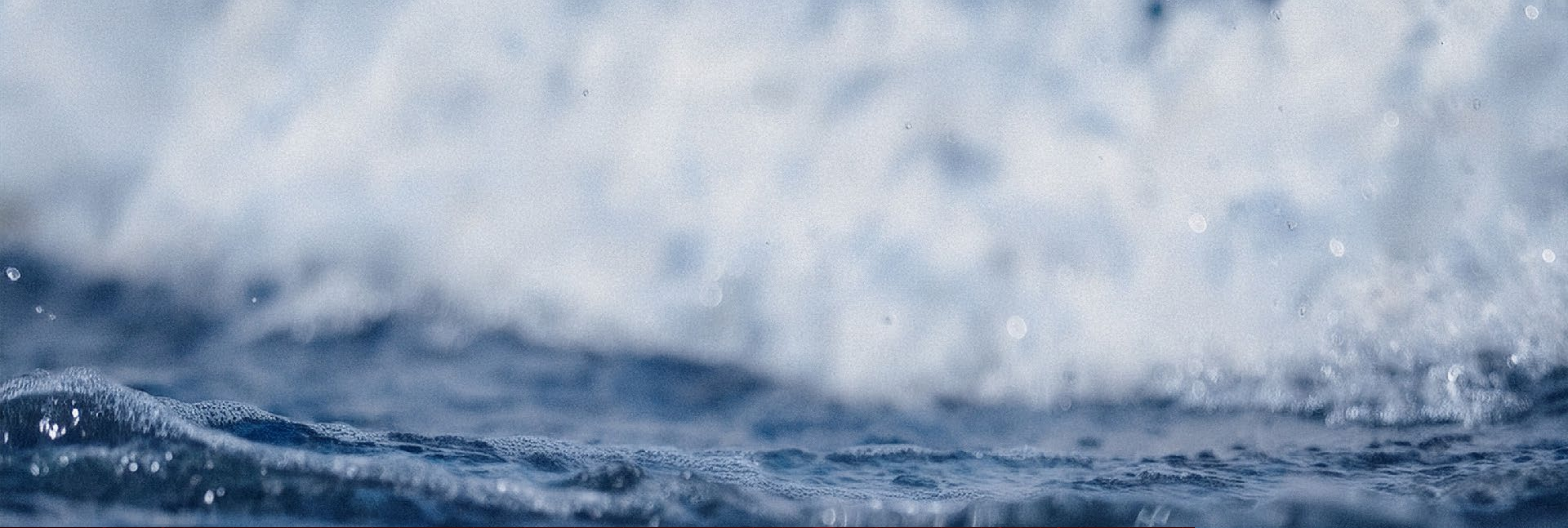
- Holistic approach to address these complex problems that integrates field/watershed scale process investigations with broader integrated projects

- Collaboration and support for large multi-disciplinary, multi-state, multi-year projects that allows better positioning for USDA-AFRI and USDA-NIFA funding

- Collaboration with state and federal agencies, water management districts, farmers, binational groups

ON-GOING PROJECTS

- Sensor, modeling, and machine learning for water use efficiency
- Deficit irrigation adoption and groundwater conservation
- Climate-Smart Irrigation (USDA-AFRI)
- Nature-based stormwater management
- Hydrologic & crop modeling at national scale (HAWQS)
- PFAS removal using engineered biochar
- Border water resilience (USGS-funded)
- Specialty crop conservation in Rio Grande Valley
- Solar/hydro panel integration for arid regions



Texas A&M Department of Horticultural Sciences

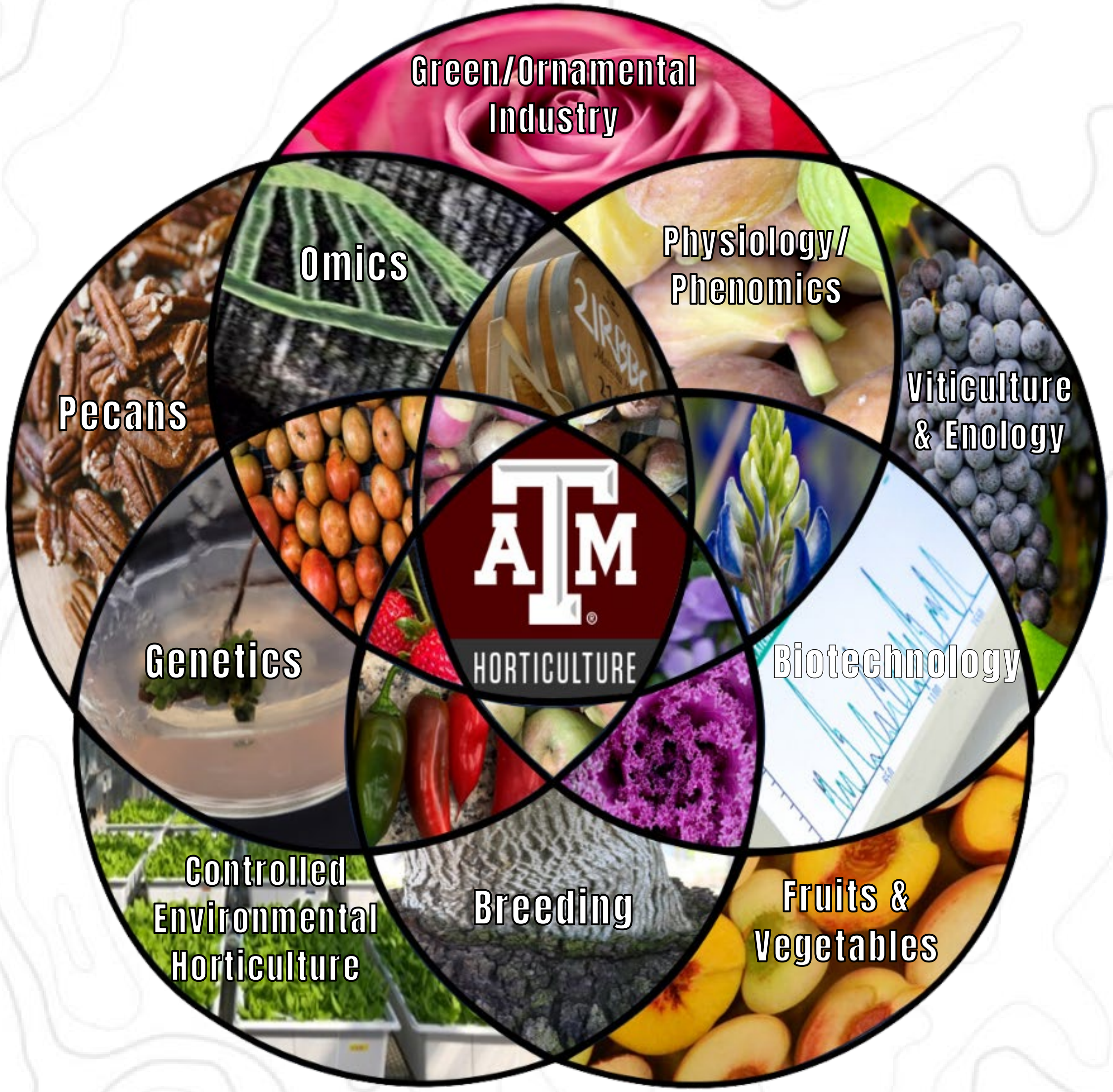
Amit Dhingra, Ph.D.- Department Head

SUSTAINABILITY | WELLNESS | FOOD SECURITY

TEXAS A&M UNIVERSITY
Horticultural Sciences

TEXAS A&M AGRILIFE RESEARCH
TEXAS A&M AGRILIFE EXTENSION

College Station | Dallas| Fredericksburg
El Paso | Lubbock | Overton | Uvalde | Weslaco



Amit Dhingra, Ph.D.
Professor and Department Head

What is Horticulture?

…… the science, technology, art, and business of *producing* and *improving* healthful, edible, and beautiful plants that include fruits, vegetables, nuts, tea, coffee, flowers, wine, medicinal plants, turf, and ornamental plants, along with the design and management of landscapes and interior spaces.

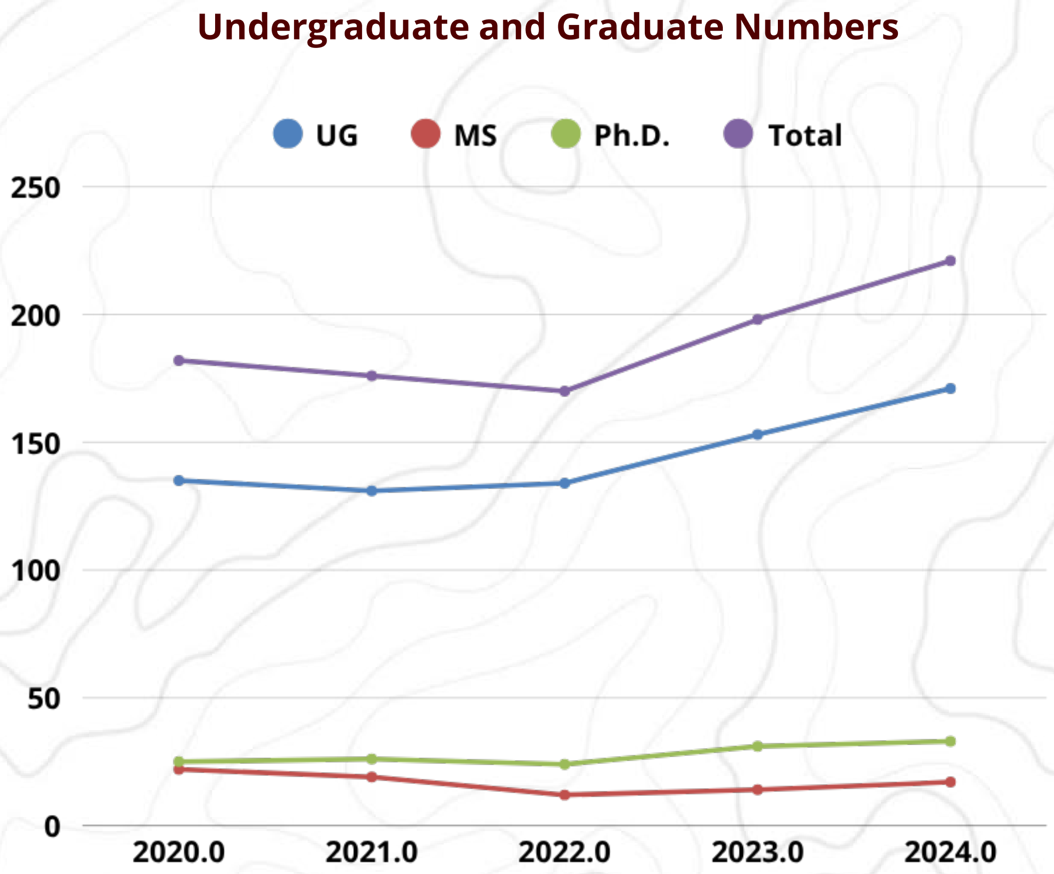
Sustainability | Wellness | Food Security

FACILITIES

1. **Horticulture/Forest Science Building (HFSB) on campus**
   - 90,000 square foot building with a beautiful atrium
   - The Benz Gallery of Floral Art
   - Research and teaching laboratories
   - Convenient access to greenhouses and growth chambers
   - Greenhouse space, totaling 38,000 square feet, is located behind the building and at the HortTREC (Horticulture Teaching, Research, and Extension Center)
2. **The Vegetable and Fruit Improvement Center**, located in the Centeq Building in the TAMU Research Park, occupies 7,367 sq. ft. of office and lab space
3. The greenhouse and nursery support facilities, vineyard, pecan orchard, peach orchard, and rose test plots are co-located at the **HortTREC** 10 miles from campus in the Brazos Bottoms off state highway 50

HortTREC
Farm to Market Road 50
TAMU Pecan Orchards
Vineyard
Vegetable & Ornamental Field Plots
USDA World Carya Germplasm Collection
Rose Breeding & Rose Rosette Project
Peach Advanced Selections

WE ARE GROWING....



Application being submitted for:

Landscape and Interior Scape Certificate Program for Undergraduate Students

FUTURE OF FOOD SECURITY

First Green Revolution

- Annual crops – large environmental footprint
- Subsistence
- Predominantly carbohydrate derived calories
- Cereals – 1644 liters of water per kilogram of grain
- Yield – 1 – 1.5 tons per acre

Second Green Revolution

- Horticultural crops
- Subsistence plus nutrition
- Carbohydrates, vitamins, minerals and other dietary needs
- Fruits – 962 liters of water per kilogram of fruit
- Yield – 35 – 65 tons per acre (250 trees per acre)

Statewide Horticulture Team

TEXAS A&M UNIVERSITY
Horticultural Sciences

14 Tenure/tenure-track Faculty

- **4** Assistant Professors
- **10** Professors (Includes Trish and Amit)

3 APT faculty

- **2** Assistant Instruction Professors
- **1** Assistant Professor of Practice
- Search in progress for 1 APT faculty or Professor of Practice

TEXAS A&M AGRILIFE RESEARCH

8 AgriLife Research Faculty

- **2** Assistant Professors
- **4** Associate Professor
- **3** Professors (includes Dan Leskovar)

TEXAS A&M AGRILIFE EXTENSION

10 AgriLife Extension Faculty

- **5** Assistant Professors
- **2** Associate Professors
- **3** Professors (Includes Juan Anciso)

8 AgriLife Extension Program Specialists

29 Horticulture Extension Agents

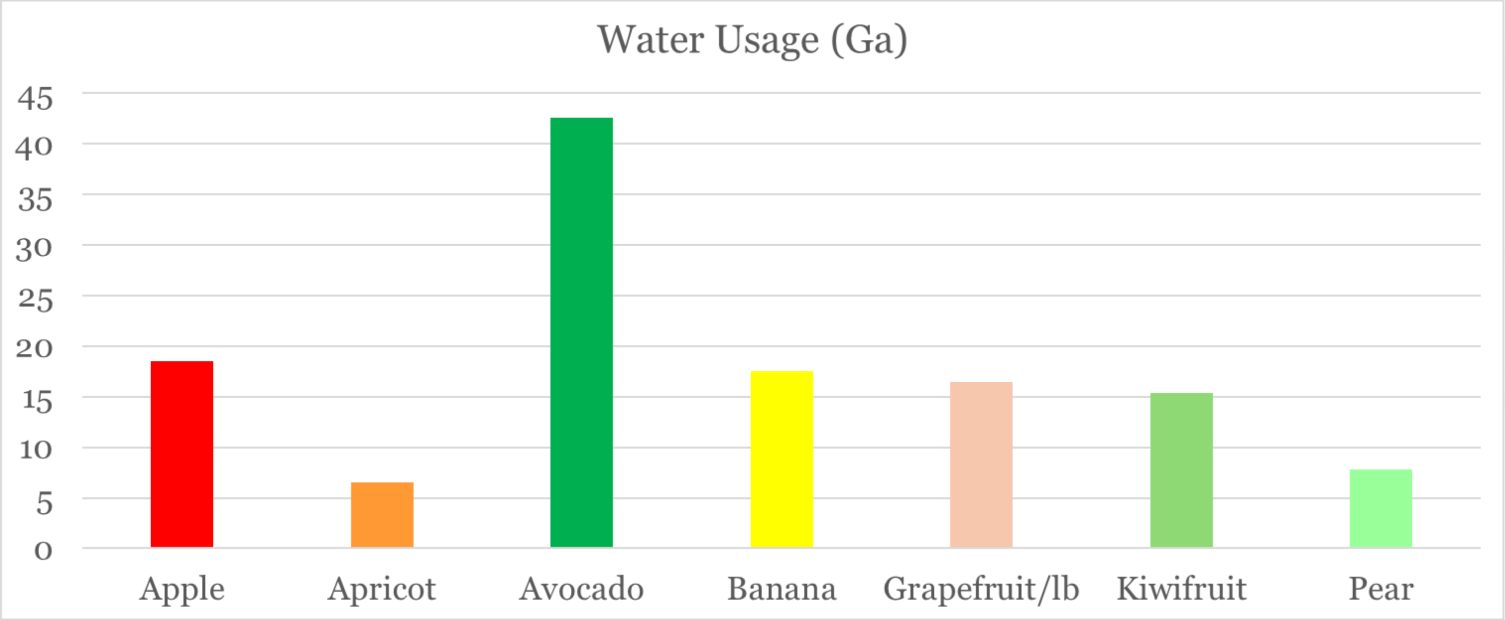


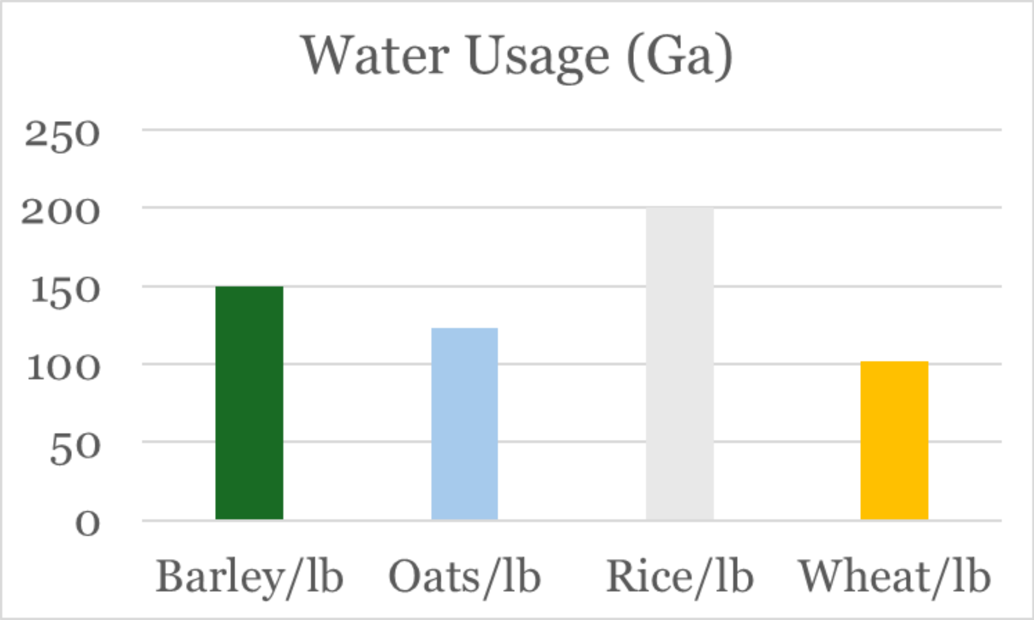


Varied Growing Environments and Growth Habits

..... trees, shrubs, annuals, and permanent crops

Horticultural Permanent Crops Consume Less Water





Major Water-Related Concerns

- Water scarcity and drought resilience for horticultural crops.
- Improving water-use efficiency in controlled environment and open-field systems. – Practices and Genetic Improvement
- Impacts of combined heat and drought on irrigation demands and water availability.
- Water quality issues, including salinity, nutrient runoff, and pathogen contamination.
- Competition for water resources between farm and urban/industrial sectors.

Major Advances in Research

- Deployment of precision irrigation technologies (soil moisture sensors, plant-based sensing, AI-driven scheduling).
- Development of drought-tolerant and salt-tolerant horticultural crop varieties through genomics, bioengineering, and breeding.
- Regenerative agriculture and integration of deficit irrigation strategies to reduce consumption without yield loss.
- Use of recycled or reclaimed water in horticulture with risk assessment protocols.
- Modeling tools to predict crop water needs under future production environment scenarios.

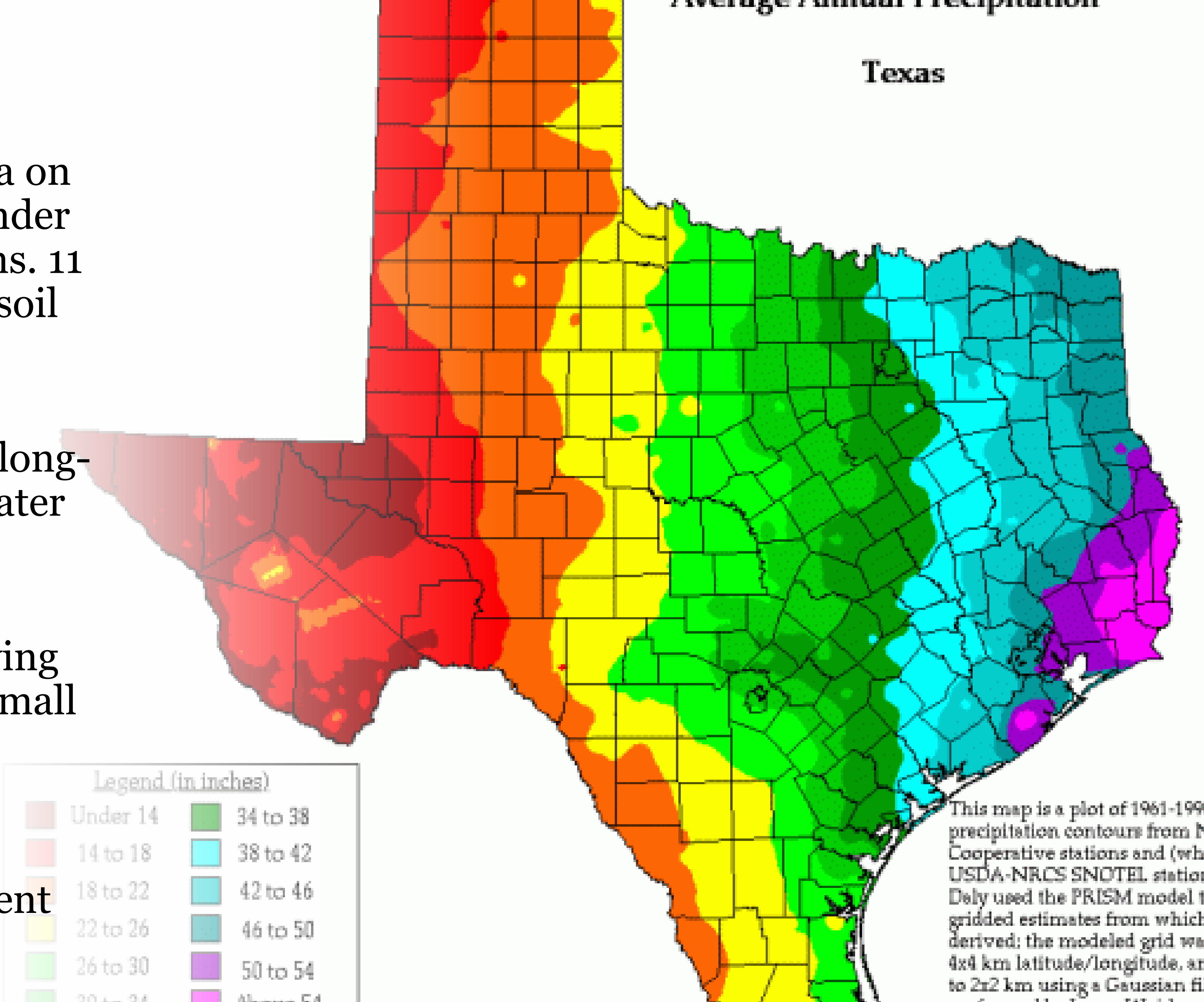
Major Limitations

- Limited region-specific data on crop water requirements under changing climatic conditions. 11 Growing regions and 1300 soil types in Texas

- Gaps in understanding the long-term effects of reclaimed water use on soil health.

- Need for scalable water-saving technologies accessible to small and mid-size producers.

- Long generation cycles for permanent crop improvement



Desired Collaborations Moving Forward

- Sensors, Economics, and Water Use Modeling Platforms.
- Advanced, AI-driven precision irrigation solutions.
- Understanding root systems in permanent crops – Root imaging
- New Technologies such as Sky H_2O – joint project proposal

SKYH2O

- Each SkyH2O Superstation can produce over 113,562 liters/day of potable water.
- Each station contains water production, filtering, and bottling.
- Financing Required - $30 Million (+15% IRR, 30-year expected life)
- Provides up to 25 Green Collar Jobs and 30 indirect service/community jobs.

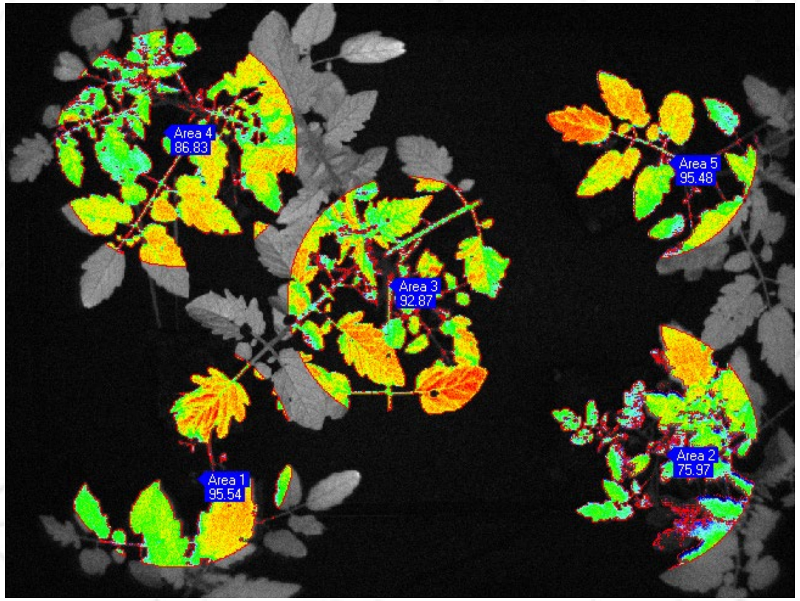
Ongoing Research

Water use efficiency, physiology, and genetics research – *Rossi, Masabni, Koiwa, Nesbitt, Niu, Leskovar, Dhingra, Scheiner, Zhen, Jifon, Mahal, Cisneros, Klein, Stein, Cervantes*

Earth-kind® Horticulture and Biochar use in orchard and containerized production systems – *Winski, King, Dhingra, Rossi*

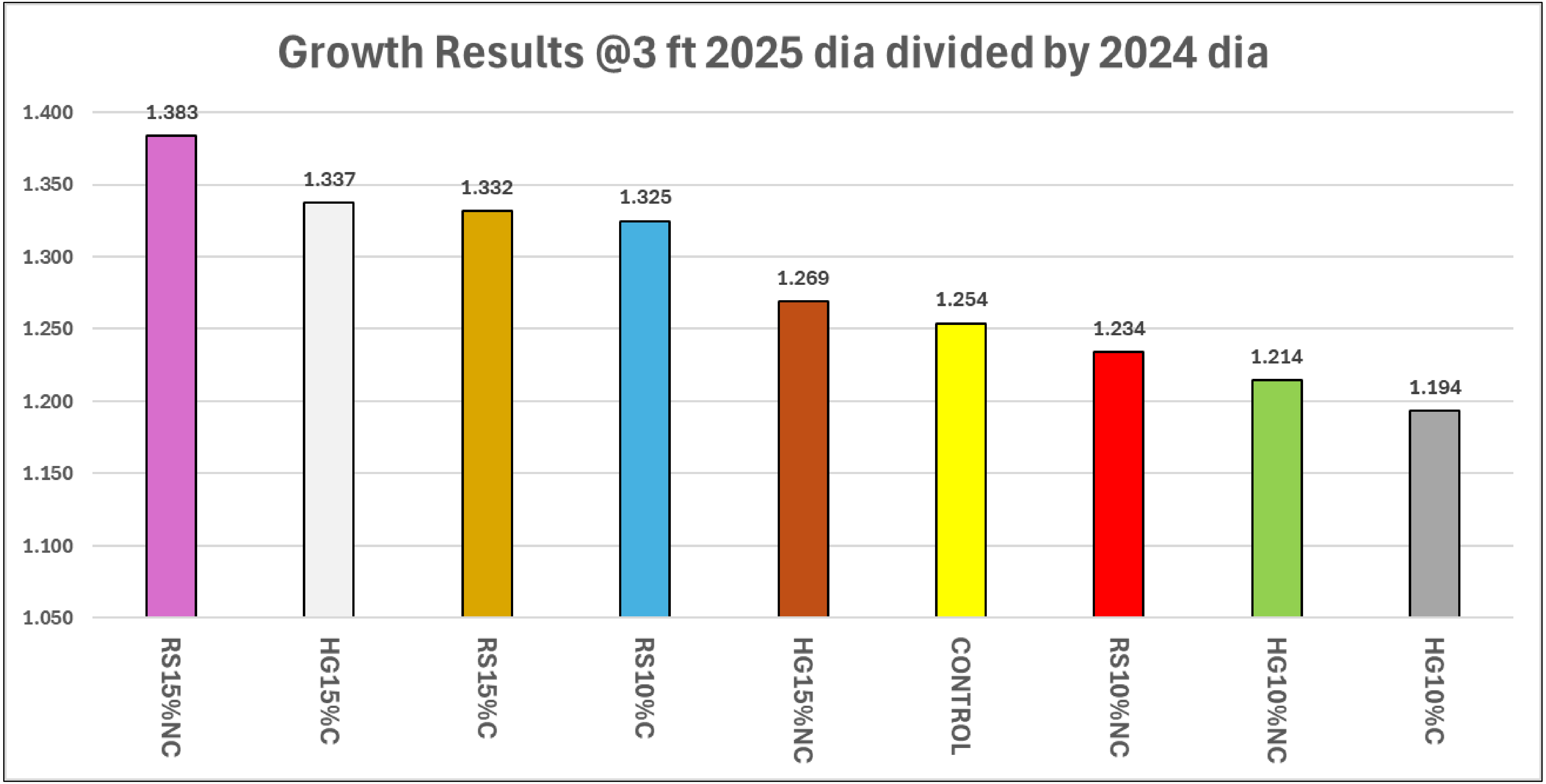
Bioengineering and breeding for water use efficiency – *Bhattarai, Koiwa, Svyantek, Vales, Crosby, Patil*

Phenotyping and Phenomics-assisted environmental resilience research – Zhen, *Rossi, Darwish, Dhingra*



Biochar Trial – Paul Winski

- Biochar-amended plants look comparable to the control
- Biochar treatments have <u>50% less fertilizer</u>
- Biochar treatments have a <u>water savings of 26-36%</u>
- No statistical differences in total plant dry weight control and treatments
- Statistical significance in root dry weights between treatments – biochar containing potting mix had larger roots



Data and slide provided by Troy Swift

Ongoing Research

Water use efficiency, physiology, and genetics research – *Rossi, Masabni, Koiwa, Nesbitt, Niu, Leskovar, Dhingra, Scheiner, Zhen, Jifon, Mahal, Cisneros, Klein, Stein, Cervantes*

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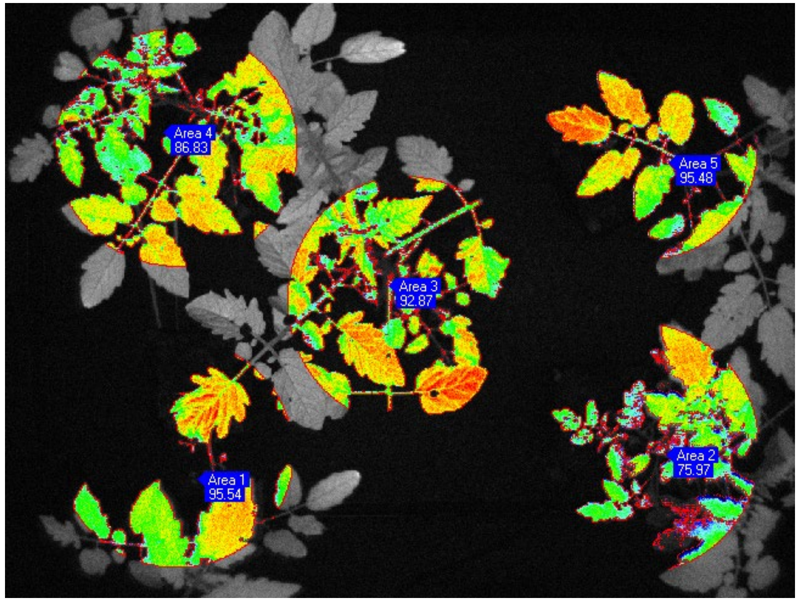


Celebrating Texas Horticulture

A collaborative and interactive experience created to bring together our students, the Texas Horticulture Industry, and the larger Texas community.

Spirited Learning.™

525 Total Attendees

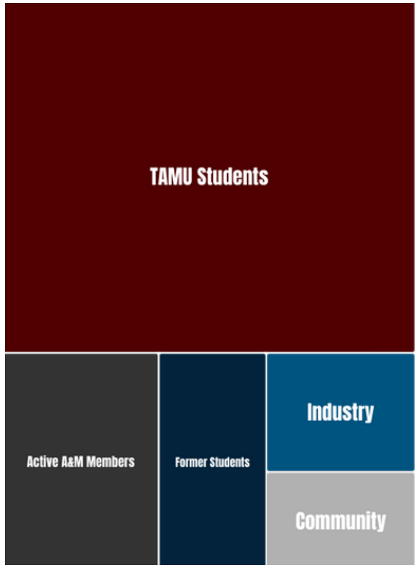
85 Different Majors Present

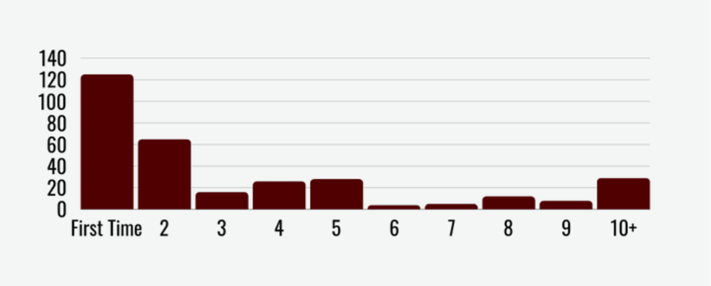
125 Attendees first Spirited Learning!

38 Horticultural Enterprises Featured

63 Different Wines Featured

Unlimited Friendship Created





Partnerships – a new podcast

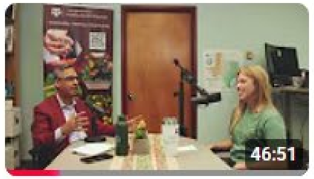
Horticulture Innovators

TAMU Department of Horticultural Sciences

Podcast • 6 episodes • Last updated on May 19, 2025

Horticulture: A World of Science, Aesthetics, and Sustainability I wonder what you think when you h... ...more

Play all

1 
46:51

S1: Episode 1: Meet the Horticulture Influencer Kaitlyn Thornton

TAMU Department of Horticultural Sciences • 382 views • 4 months ago

2 
1:05:24

S1: Episode 2: Earth-Kind® Program - The power of environmental kindness.

TAMU Department of Horticultural Sciences • 198 views • 4 months ago

3 
42:05

S1: Episode 3: Helping children all around the world through the Junior Master Gardener program

TAMU Department of Horticultural Sciences • 122 views • 4 months ago

4 
42:47

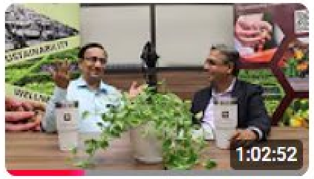
S2: Episode 4: Anna Ball - Leading Woman of Horticulture

TAMU Department of Horticultural Sciences • 52 views • 9 days ago

5 
37:23

S2: Episode 5: Haven Baker - Food Forward

TAMU Department of Horticultural Sciences • 37 views • 13 days ago

6 
1:02:52

S2: Episode 6: Arun Sharma - Keeping tomatoes fresh

TAMU Department of Horticultural Sciences • 919 views • 13 days ago

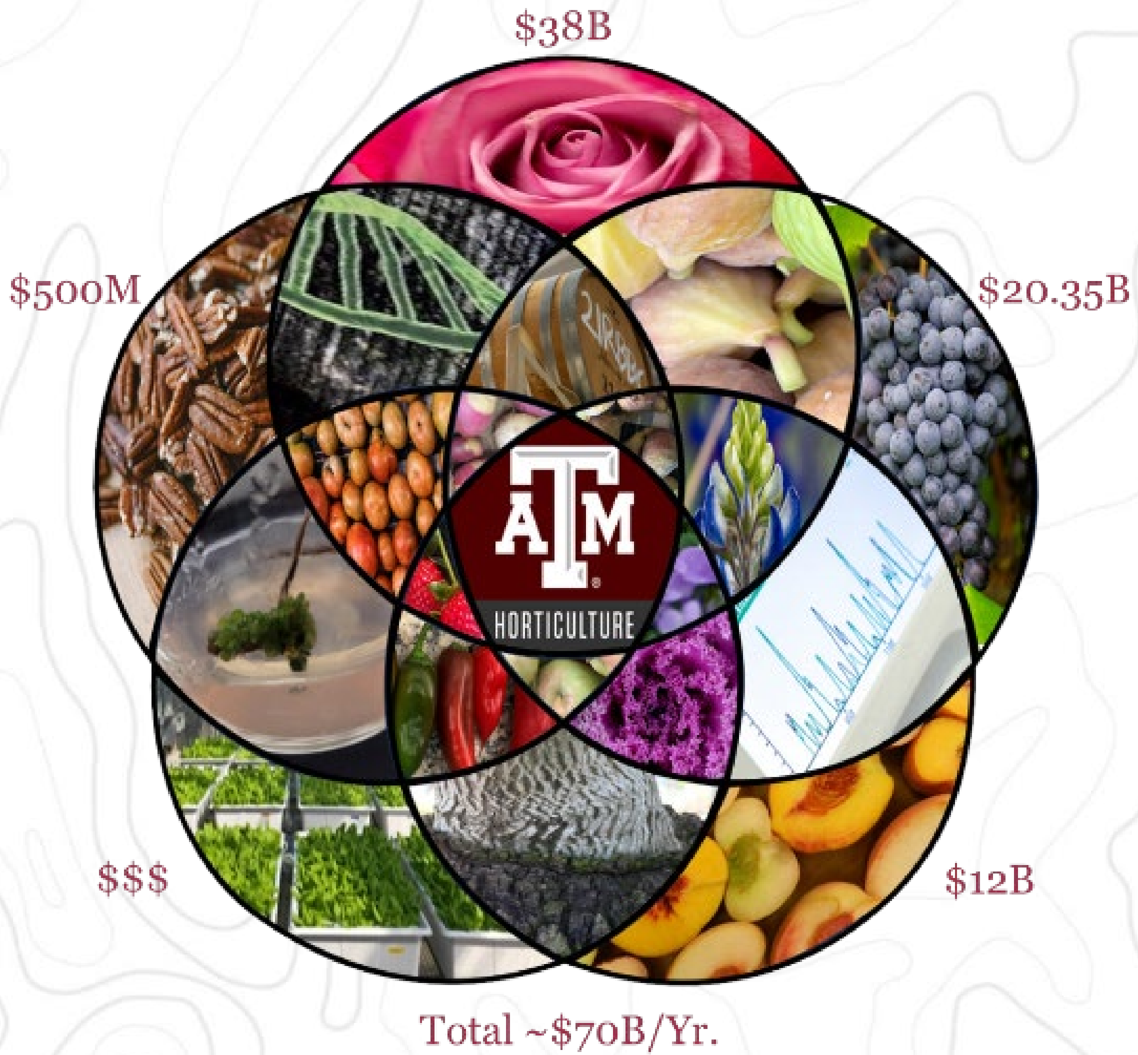
THANKS AND GIG'EM

HEALTHFUL – EDIBLE – BEAUTIFUL

Amit Dhingra, Ph.D.
Professor and Department Head
Amit.dhingra@ag.tamu.edu
509-432-3683

JOIN US

in Growing Horticulture and the Next Generation



Texas A&M Department of Rangeland, Wildlife, and Fisheries Management

Texas A&M Natural Resources Institute

Roel Lopez, Ph.D.- Department Head and Director

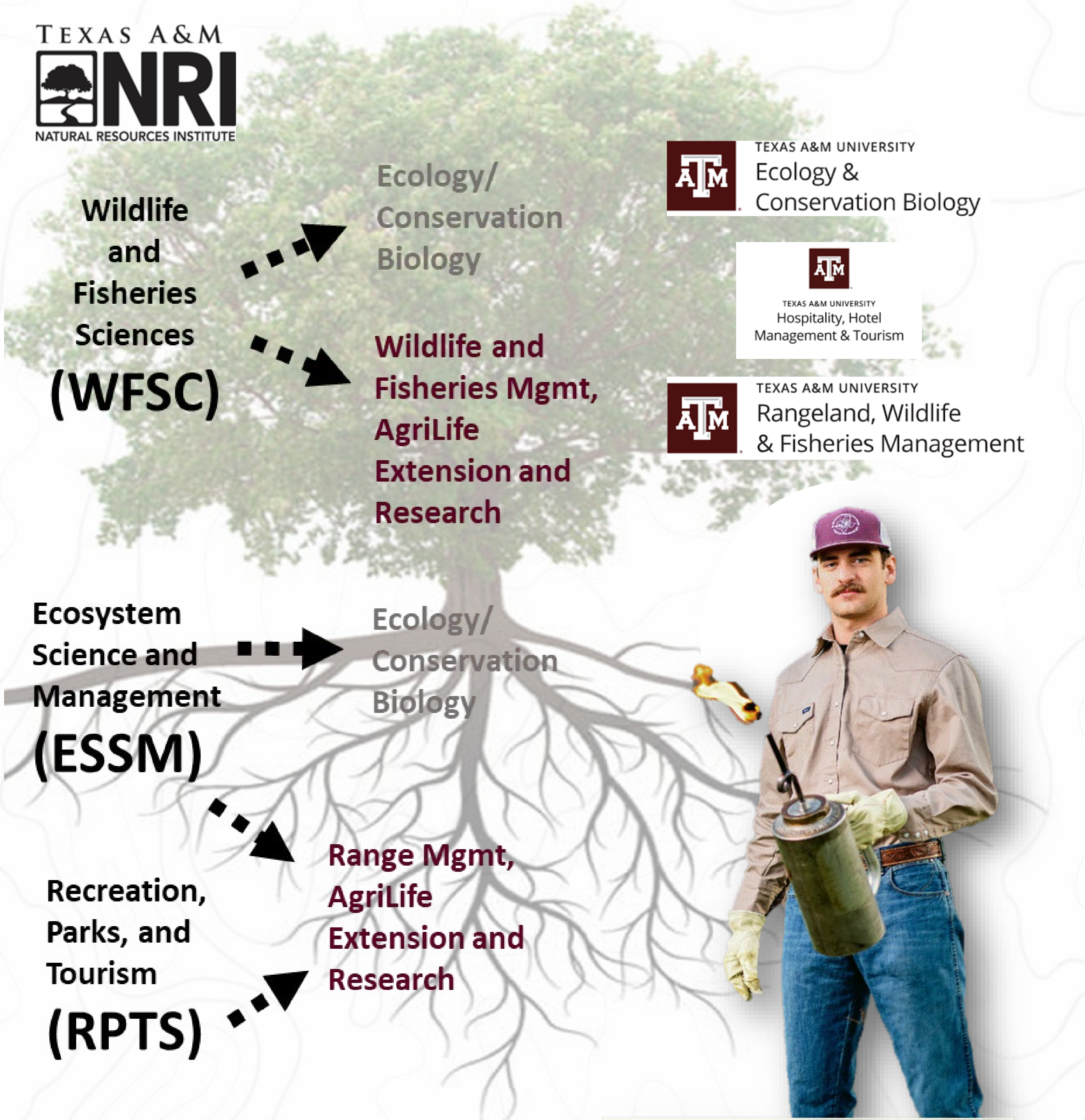
Texas A&M AgriLife

Texas A&M University
Rangeland, Wildlife & Fisheries Management

Texas A&M NRI
Natural Resources Institute

Focus Areas

- ***Land Grant Mission***: Research, Teaching, Extension, Policy
- ***NRI*** – 100+ scientists, program coordinators, project managers (est. 2007)
- ***RWFM*** – 35 faculty, Research, Teaching, and Extension, 300+ students (est. 2020). 10 Centers



Overview

Texas Economic Drivers

- Energy (O&G) - $172B
- Military - $137B
- Agriculture - $100B

TEXAS A&M AGRILIFE RESEARCH

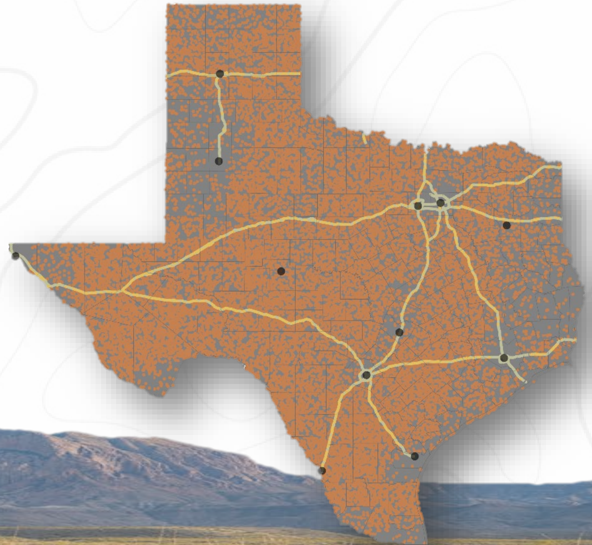
TEXAS A&M NRI NATURAL RESOURCES INSTITUTE

TEXAS A&M AGRILIFE EXTENSION

TEXAS A&M UNIVERSITY Rangeland, Wildlife & Fisheries Management

Economic Threats

- T&E Species
- Military Encroachment
- Land Fragmentation and Loss
- Rangeland resiliency
- Private water resource stewardship
- Water quality and cleanup



Water Questions

- Rangeland resiliency
- Produced water on rangelands
- Aquaculture efficiency-reuse
- Aquatic vegetation and pond management
- Environmental flows
- Endangered species (e.g., mussels, western chicken turtle)
- Land trends and water accessibility mapping
- Flood risk and land uses

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Rangeland, Wildlife & Fisheries Management

TEXAS A&M NRI
NATURAL RESOURCES INSTITUTE

Research Projects

- Plant response to application of produced water, distribute large water volumes
- Brush and grazing management impacts to freshwater availability
- Endangered species – mussels and salinity/temperature
- Wildlife impacts to water quality/impaired streams
- Quantification of ecosystem services (water)
- Coastal resiliency of military installations

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Rangeland, Wildlife
& Fisheries Management

TEXAS A&M NRI
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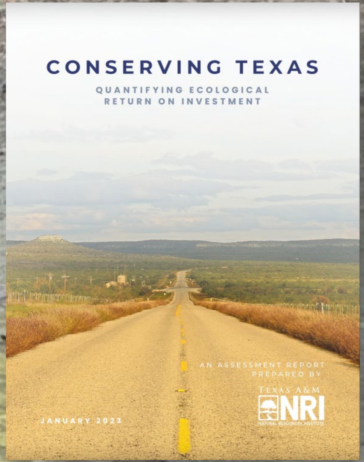
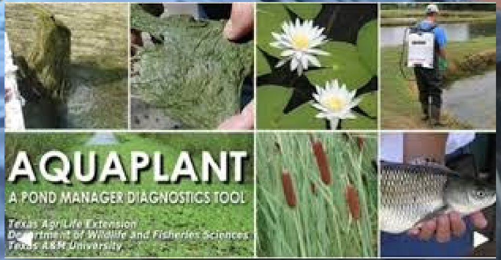
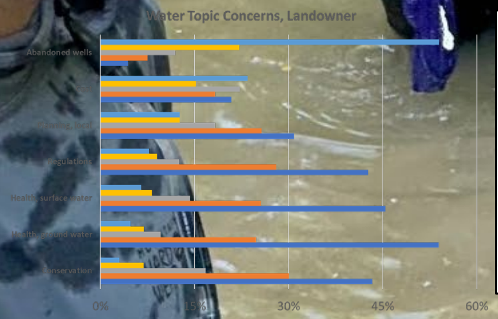
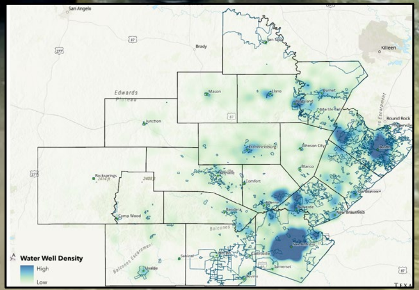
Project Examples

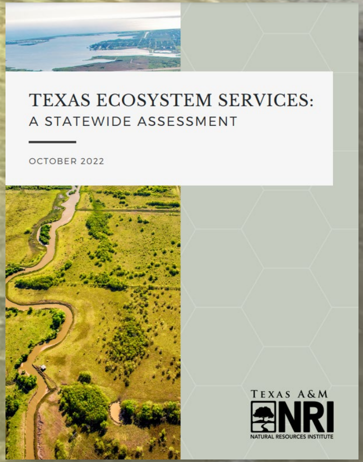
SOUTH ATLANTIC SALT MARSH INITIATIVE











Future Research and Collaboration

- Climate/population change impacts to environmental flows (e.g., municipal demand, salinity and temperature)
- Flash flood impacts to riparian zones and endangered species habitats (e.g., freshwater mussel beds)
- Scale up of produced water applications
- Flood risk mapping/riparian restoration targets
- On-going/future projects with TWRI, SCSC, BAEN, HORT, ECCB, ??

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Rangeland, Wildlife & Fisheries Management

Questions?

TEXAS A&M UNIVERSITY
Rangeland, Wildlife
& Fisheries Management

TEXAS A&M NRI
NATURAL RESOURCES INSTITUTE

Institute for Advancing Human Health Through Agriculture

Marco Palma, Ph.D.- Interim Associate Director

The Institute for Advancing Health through Agriculture

UNITING SCHOLARS ACROSS THREE FIELDS

The IHA aims to improve **human health** through innovations in **agriculture**, nutrition and food systems.

Precision Nutrition

Healthy Living

Responsive Agriculture

SCIENCE-BASED INNOVATIONS:
Responsive Agriculture fosters innovation in the agricultural sector and food environment

PROSPEROUS FARMERS:
Fosters the prosperity of farmers.

CONSUMER-CENTERED:
Intentionally provides safe, abundant, nutritious and delicious food.

STRATEGIC PARTNERSHIPS:
Works with agriculture and food industry stakeholders to ensure a robust economic system to encourage health and well-being.

Dr. Marco Palma
IHA Associate Director for Responsive Agriculture
Director Human Behavior Laboratory

TEXAS A&M AGRILIFE
INSTITUTE FOR ADVANCING HEALTH THROUGH AGRICULTURE

Responsive Agriculture

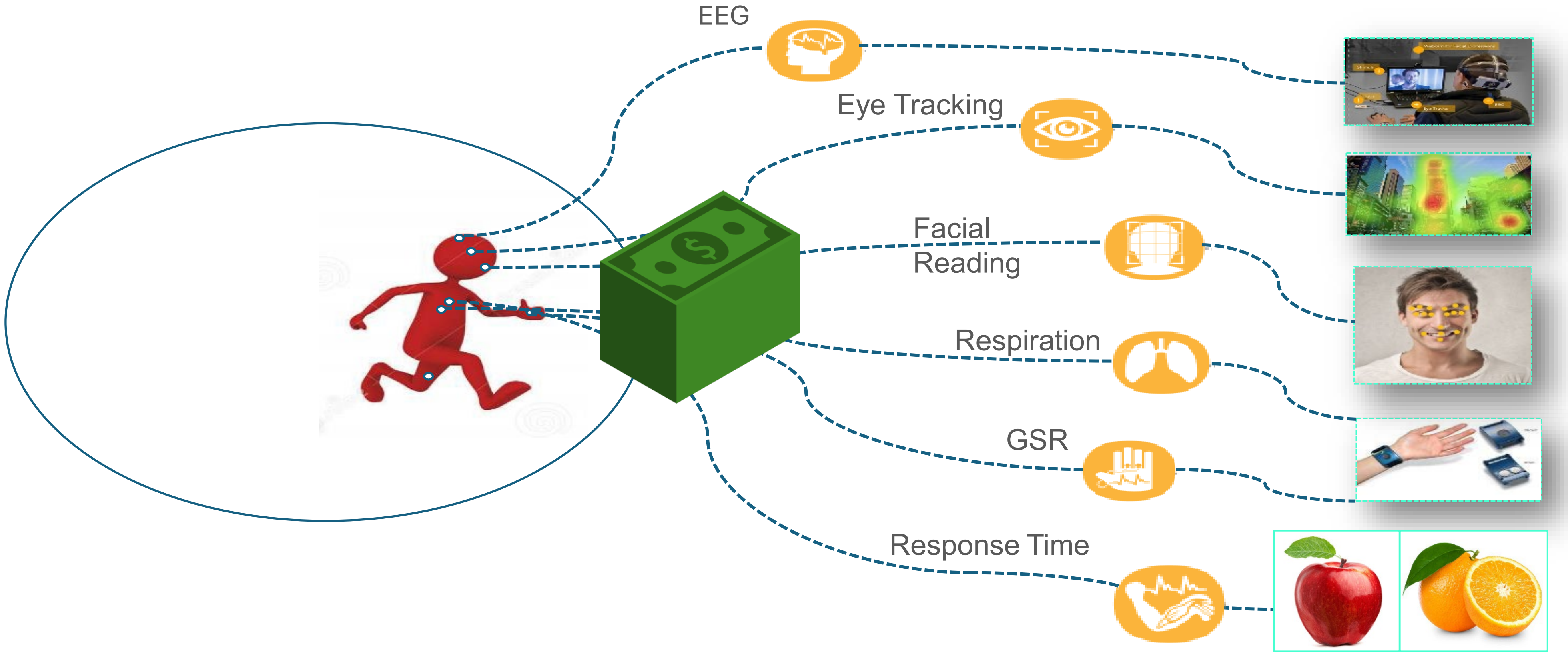
Horticulture

Row Crops

Animal Protein

Human Behavior Research

Intentionally provides safe, abundant, nutritious and delicious food.



TEXAS A&M AGRILIFE
INSTITUTE FOR ADVANCING HEALTH THROUGH AGRICULTURE

Participant Recruitment

Data collection: March-August 2023.

Two studies with approximately 1,500 adult participants

Locations

- Two large regional malls
- UD’s Ag Day
- UD Creamery in Newark, Delaware

PFAS Testing Items

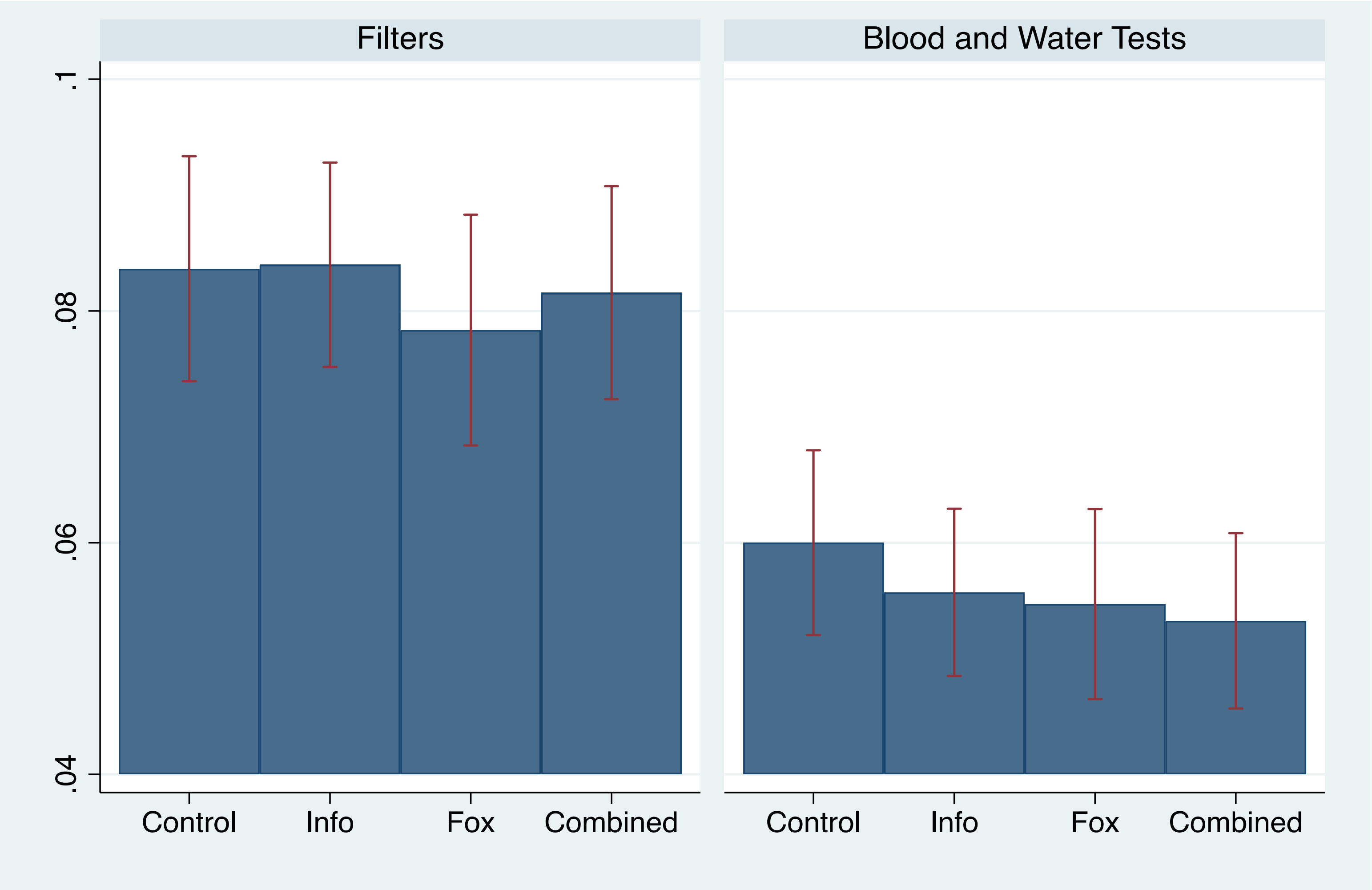
Eurofins PFAS water test kit – $250

Eurofins PFAS blood test kit – $200

Aquasana Countertop carbon filter – $130

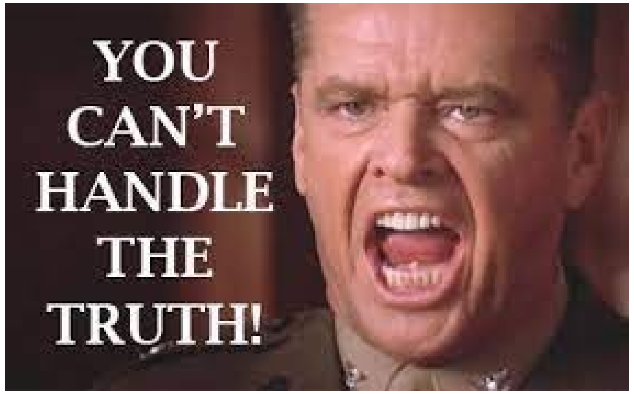
Aquasana Under-the-sink carbon filter – $250

What steps will people take to detect or prevent PFAS contamination? Willingness to Pay for Filters and Tests



	Tests	Filters	P-Value
Control	6.0%	8.4%	0.0019
Impact	5.6%	8.4%	<0.0001
Media	5.5%	7.8%	0.0001
Impact + Media	5.3%	8.2%	<0.0001

You Want to Know the Truth? You Can't Handle the Truth! Field Experiments on the Public Response to PFAS



Collaborators
Kent Messer, U. Delaware
Diya Ganguly, U. Delaware
Samuel L. Priestley – Texas A&M

PFAS

Information Avoidance

Before/After

Taste

Recycled Water

Willing to Forgo Money to Avoid Information

Environmental Characteristic	Before-taste	After-taste
PFAS	23.9%	25.0%
Recycled water	25.0%	24.0%

Marco Palma
Institute for Advancing Health through Agriculture
Human Behavior Laboratory
mapalma@tamu.edu

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TWRI Overview

August 2025

TWRI LEADERSHIP TEAM

GIOVANNI PICCINNI
DIRECTOR
College Station

DANIELLE KALISEK
ASSISTANT DIRECTOR
Chief Financial Officer
College Station

ALLEN BERTHOLD
ASSOCIATE DIRECTOR
Chief of Staff
College Station

LUCAS GREGORY
ASSOCIATE DIRECTOR
Chief Science Officer
College Station

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TWRI **EXTENDED** LEADERSHIP TEAM

ED RHODES
RESEARCH SPECIALIST

EMILY MONROE
PROJECT SPECIALIST

LESLIE LEE
COMMUNICATIONS MANAGER

MICHAEL SCHRAMM
RESEARCH SPECIALIST

ROSARIO SANCHEZ
SENIOR RESEARCH SCIENTIST

TINA HENDON
PROGRAM SPECIALIST

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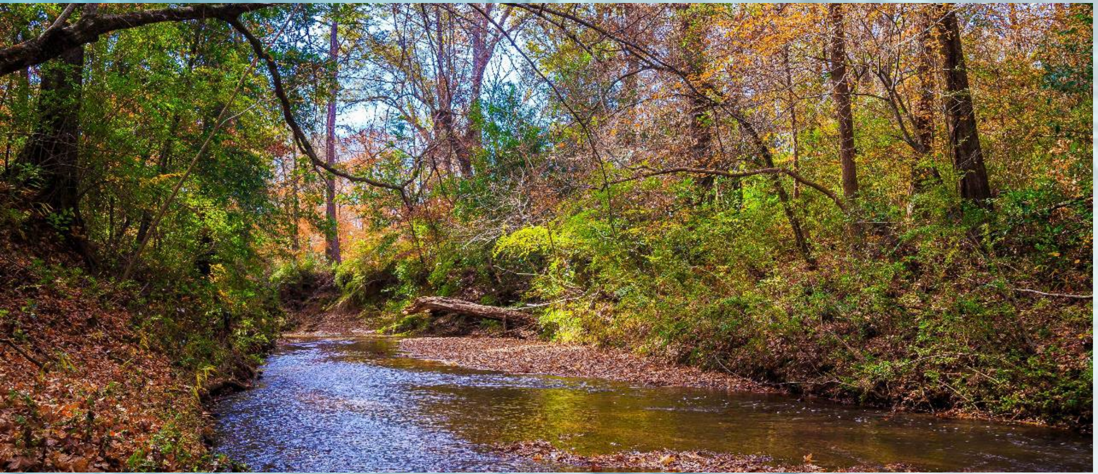
Presentation Outlines:

- What We Do
- Mission
- Core Values
- TWRI Goals
- Our Approach



OUR MISSION

Coordinate, facilitate, and deliver science-based, community-supported solutions for current and future water challenges through technical expertise and collaborations.

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What We Do

TWRI addresses the state's water challenges through a comprehensive approach that focuses on four key areas:

- **Envision -** Identify new challenges and anticipate emerging water issues
- **Evaluate -** Assess community needs and engage in water policy discussions
- **Integrate -** Lead collaborative approaches for multidisciplinary, multi-state teams
- **Coordinate -** Facilitate efforts across diverse teams, stakeholders and water-related experts

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Proposal Submissions

- **70 TWRI-led proposals** submitted requesting nearly $31.5 million

To date, of the 70 proposals submitted in 2024:

- **31 selected for funding totaling over $4.25 million** (**44% success rate**)
- 20 pending sponsor selections totaling over $5.3 million (29%)
- 19 not selected (27%)

New Project Awards

- **30 new awards** started in 2024 totaling **over $5 million**

- Currently **80 ongoing externally sponsored projects** totaling **over $18.5 million**
    - Includes projects both led by us and/or that we have a support account under with an external PI lead

Core Values

- Collaboration
- Scientific Integrity
- Impact
- Innovation

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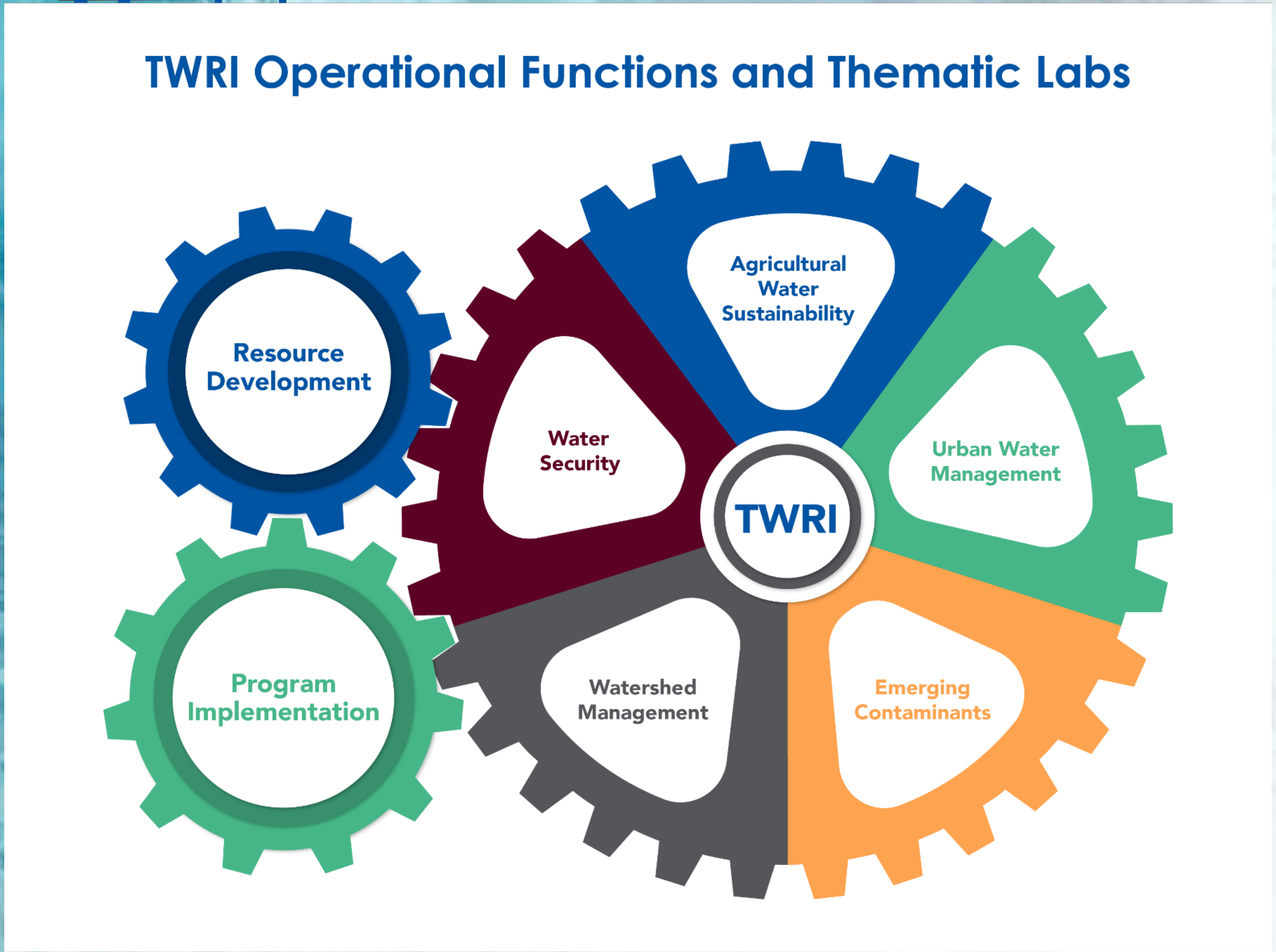
Our Approach – Thematic Lab



Interdisciplinary research and outreach hubs focused on key water priorities to address both existing and emerging challenges.

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Thematic Labs

Agricultural Water Sustainability
Director: Dr. Katie Lewis

Goal: Develop strategies that help agricultural producers efficiently manage water resources, mitigate contamination risks, explore alternative water sources, and assess the impacts of scarcity and drought on agricultural production.

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Thematic Labs (continued)

Urban Water Management.
Director Dr. Ambika Chandra

Goal: Assess the impact of urbanization on water resources and develop science-based strategies to sustain future growth.

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Thematic Labs (continued)

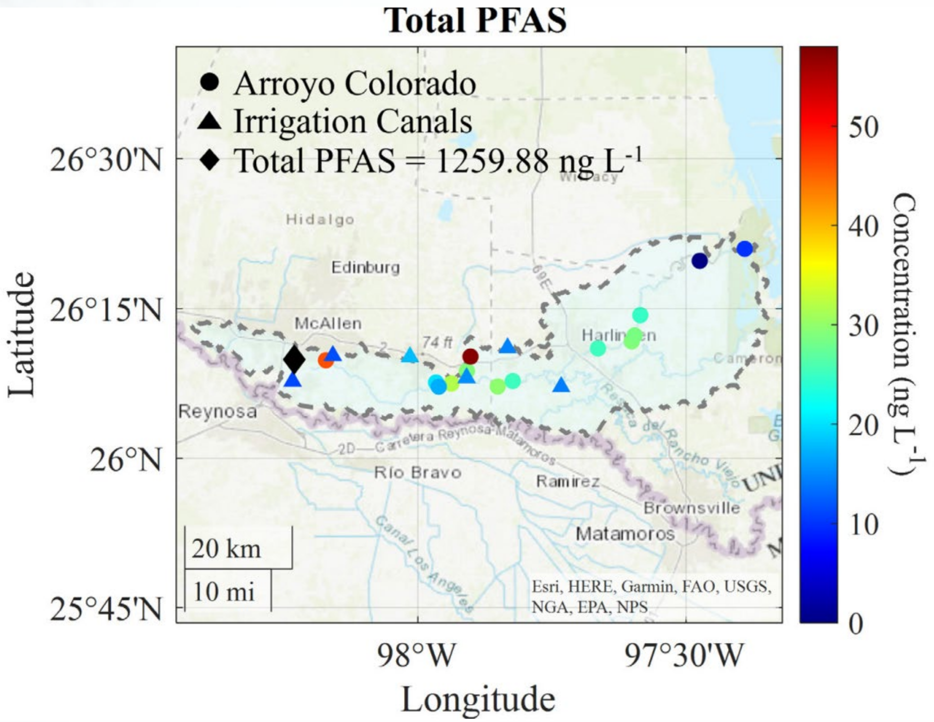
Emerging Contaminants, TBD

Goal: Advance scientific knowledge and understanding of emerging contaminants, develop innovative detection methods, assess treatment technologies, and promote sustainable management practices to protect water resources for future generations.

UNIVERSITIES COUNCIL ON WATER RESOURCES
JOURNAL OF CONTEMPORARY WATER RESEARCH & EDUCATION
ISSUE 180, PAGES 23-36, JUNE 2024

Distribution of Per- and Polyfluoroalkyl Substances in the Rapidly Urbanizing Arroyo Colorado Watershed, Texas

*Yina Liu[1,2], Michael R. Shields[2], Sangeetha Puthigai[1], Lucas F. Gregory[3], and Allen A. Berthold[3]



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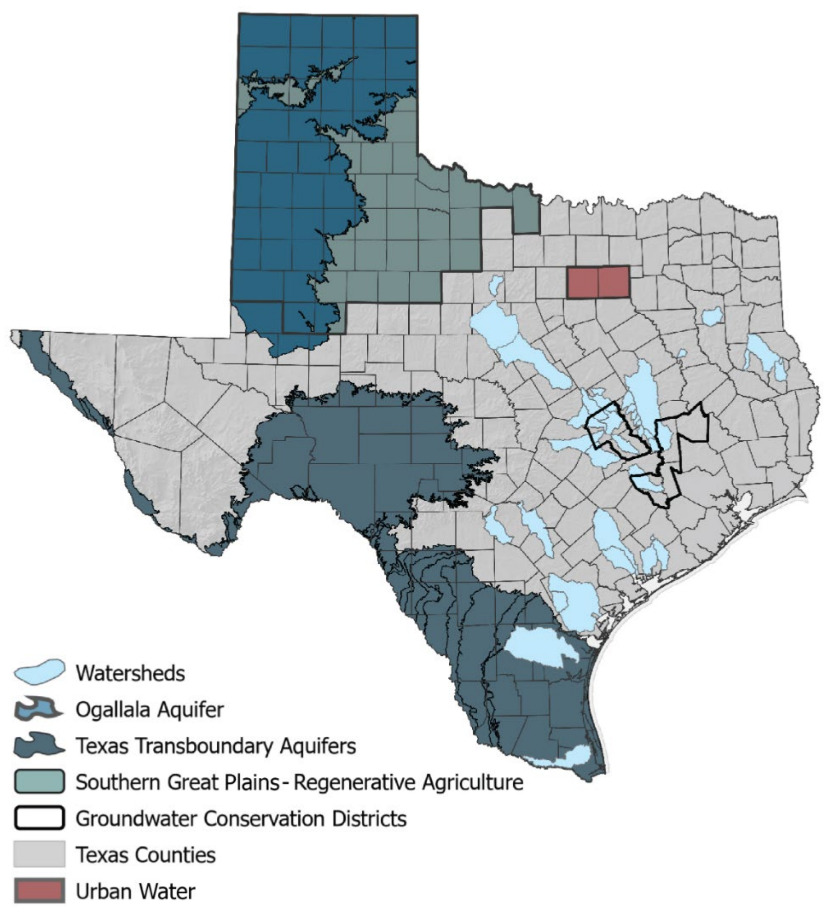
Thematic Labs (continued)

Watershed Management.
Director: Dr. Lucas Gregory

Goal: Enhance watershed health and function through integrated, systems-level research, education, and applied science.



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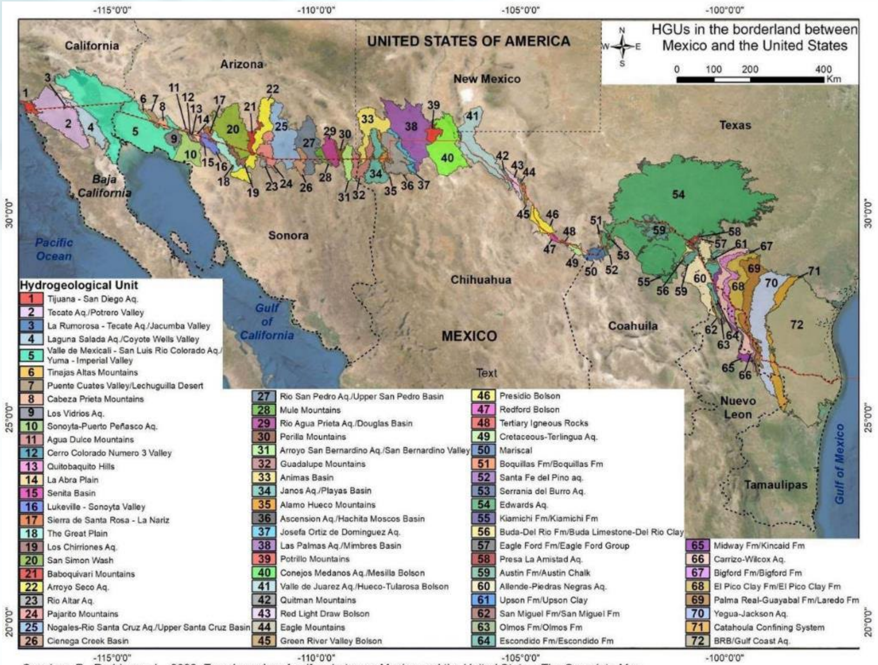
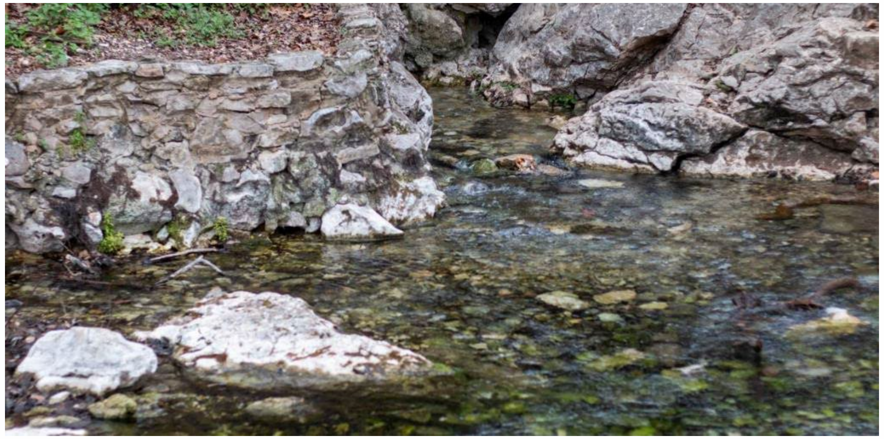
Thematic Labs (continued)

Water Security
Director Dr. Rabi Mohtar

Goal: Position TWRI as a leading international institution for water research by developing water security strategies, fostering social capacity in developing regions, and supporting global water priority goals.



Sanchez, R., Rodriguez, L., 2022. Transboundary Aquifers between Mexico and the United States: The Complete Map. UNESCO ISARM. International Conference on Transboundary Aquifers "Challenges and the way forward", December 2021, Paris.



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TEXAS A&M AGRILIFE

Operational Functions

- Resource development & collaboration
  - Collaborative Relationships
  - Funding Support
  - Pre-Award Management

- Program Implementation & Administration
  - Post-Award Management
  - Project Management
    - Research and outreach support
    - Communications and publications

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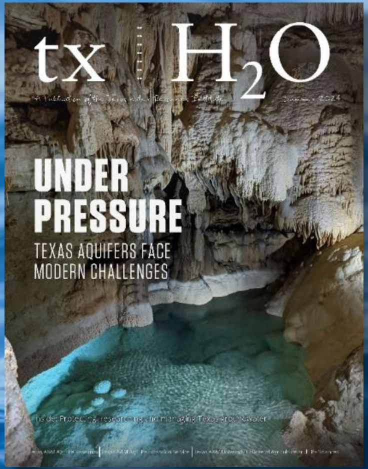
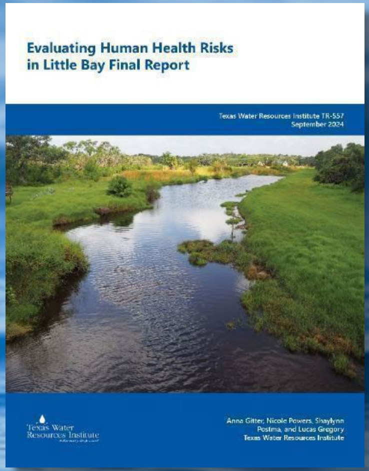
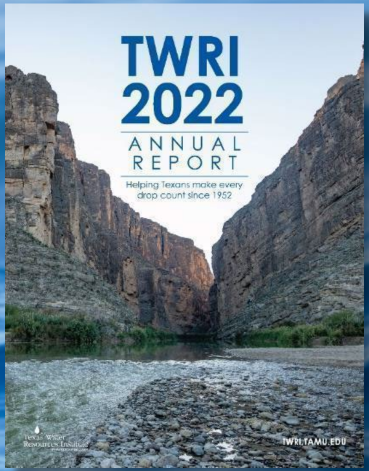
TWRI PUBLICATIONS

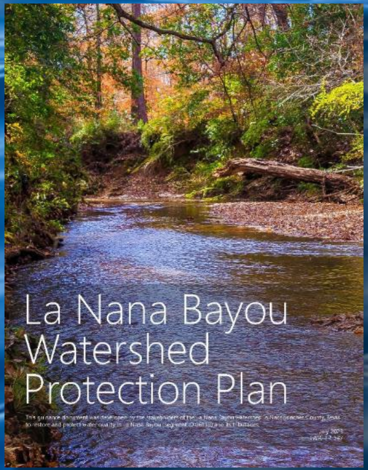
Texas A&M AgriLife

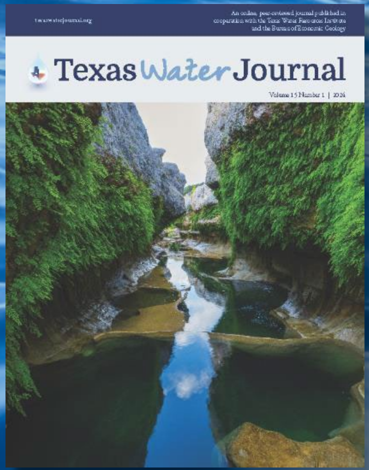
Stay up-to-date with Texas water research and solutions, TWRI-funded research and feature stories on priority water issues in Texas.

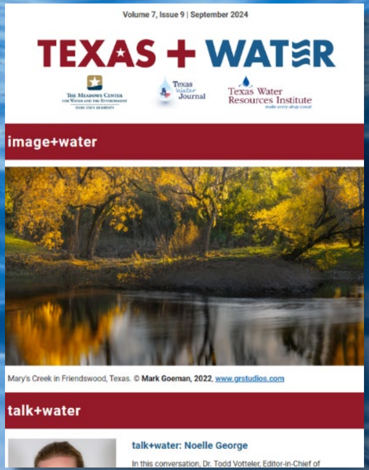


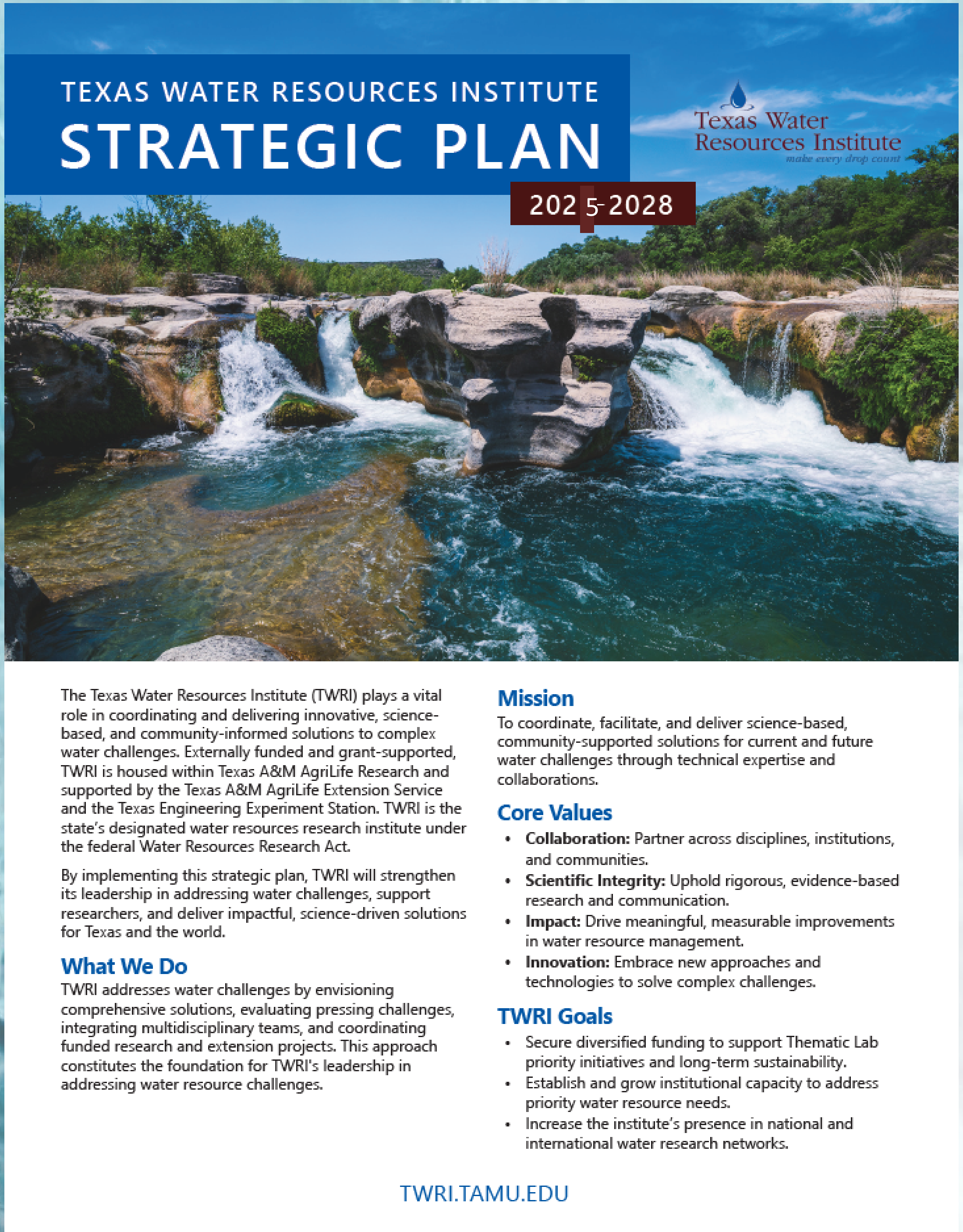












TEXAS WATER RESOURCES INSTITUTE

STRATEGIC PLAN

2025-2028

Texas Water Resources Institute
make every drop count

The Texas Water Resources Institute (TWRI) plays a vital role in coordinating and delivering innovative, science-based, and community-informed solutions to complex water challenges. Externally funded and grant-supported, TWRI is housed within Texas A&M AgriLife Research and supported by the Texas A&M AgriLife Extension Service and the Texas Engineering Experiment Station. TWRI is the state's designated water resources research institute under the federal Water Resources Research Act.

By implementing this strategic plan, TWRI will strengthen its leadership in addressing water challenges, support researchers, and deliver impactful, science-driven solutions for Texas and the world.

What We Do

TWRI addresses water challenges by envisioning comprehensive solutions, evaluating pressing challenges, integrating multidisciplinary teams, and coordinating funded research and extension projects. This approach constitutes the foundation for TWRI's leadership in addressing water resource challenges.

Mission

To coordinate, facilitate, and deliver science-based, community-supported solutions for current and future water challenges through technical expertise and collaborations.

Core Values

- **Collaboration:** Partner across disciplines, institutions, and communities.
- **Scientific Integrity:** Uphold rigorous, evidence-based research and communication.
- **Impact:** Drive meaningful, measurable improvements in water resource management.
- **Innovation:** Embrace new approaches and technologies to solve complex challenges.

TWRI Goals

- Secure diversified funding to support Thematic Lab priority initiatives and long-term sustainability.
- Establish and grow institutional capacity to address priority water resource needs.
- Increase the institute's presence in national and international water research networks.

TWRI.TAMU.EDU

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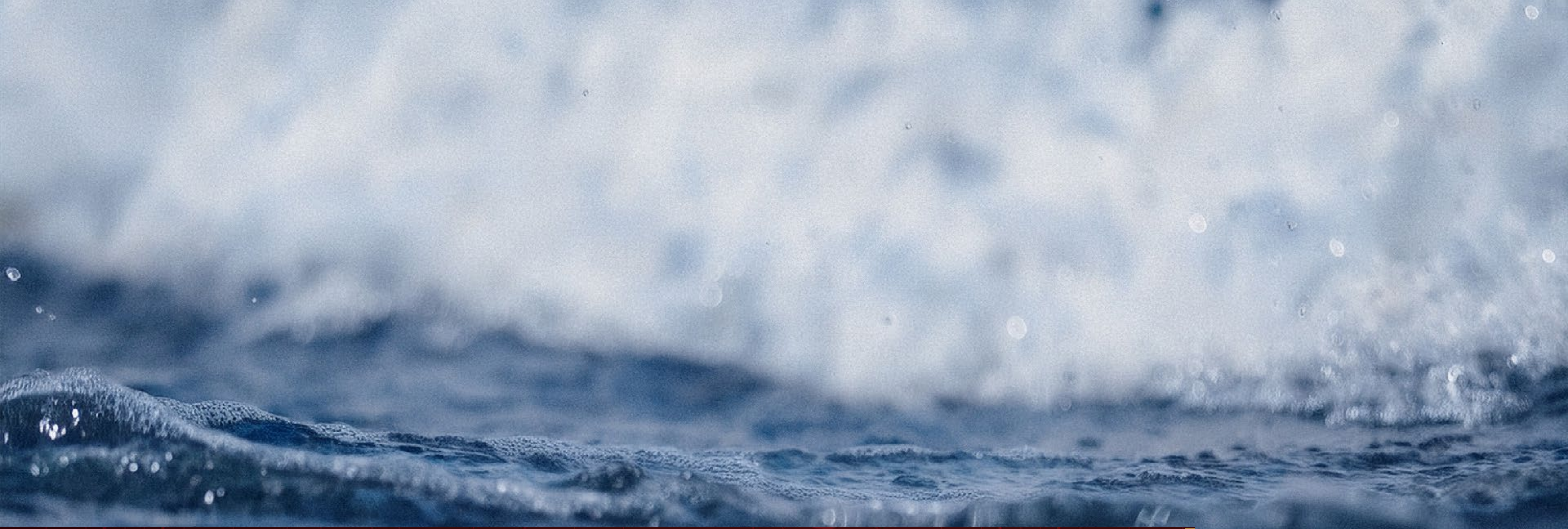

Texas A&M AgriLife Water Symposium

August 12-14, 2025

Texas A&M AgriLife Research and Extension Center- Dallas, TX