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Welcome from the Executive Director

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t is hard to believe that this is the **second** Texas Institute for Applied Environmental Research Annual Report since I accepted the mantel of Executive Director; time does fly! In 2018 TIAER scientists continued to produce. Dr. Ali Saleh and his team of modelers are supporting farmers in soil and environmental conservation across the nation and international arena with the Nutrient Tracking Tool. Drs. Anne McFarland and Larry Hauck continued to support state and federal agencies in evaluating and monitoring the water quality in Texas' streams and reservoirs. The field operations team, led

by Jeff Stroebel, traveled across Texas collecting water samples including trips along the Texas coast collecting samples for analysis of bacterial contamination. James Hunter and the chemistry lab staff were busy analyzing samples from all of these projects. Leah Taylor aggressively advanced marketing and public relations for TIAER to avoid the "out of sight – out of mind" syndrome. The rest of the TIAER team was hard at work supporting the science and education objectives of TIAER, handling the business tasks of a research institute.

Looking ahead, TIAER is moving forward to address watershed impacts in the coastal zone. Water quality impacts that we see locally accumulate and magnify as surface waters run "downhill" into the coastal zone. The coastal zone of the Gulf of Mexico is the fastest growing region in North America, an international population center with Mexico and Cuba included. The three nations of the Gulf of Mexico share the same challenges of resource conservation and environmental quality. We must work collaboratively to meet these challenges.

Our next major focus will be on establishing TIAER as an environmental first responder during catastrophic environmental events such as floods. Every flood is a significant event of environmental contamination. As floodwaters flow down roadways, through intensive animal production systems, industrial and hazardous waste sites, through kitchens and garages with countless hazardous chemicals stored, into and out of sewage treatment plants, etc. these floodwaters become a toxic soup. Toxins carried by the floodwaters are deposited in the soil, surface and ground water, and habitats as the floodwaters recede. TIAER is working with Texas A&M System associates and private sector interests to develop baseline data and prepare to collect data during flood events in order to advise the leaders and citizens of Texas on how best to protect public health and economic structures from these environmental events.

As we say at TIAER: CLEAN AIR + CLEAN WATER + HEALTHY SOIL = LIFE. The Texas Institute for Applied Environmental Research By Texas for Texans!



OTIAER QUICK FACT

While TIAER works in many different watersheds,
the North Bosque River running through
Stephenville provides an outdoor laboratory readily
accessible for student engagement and outreach
opportunities with the local community. Monitoring
along the North Bosque River is now in its 25th year
at some locations providing a unique long-term
water quality dataset for evaluating trends.



TIAER has become a national leader in understanding watershed linkages of landscape management to water quality of our waterways. Most of TIAER's early research focused on the North Bosque River with monitoring now in its 25th year providing a unique long-term water quality dataset for evaluating trends with changes in land management.

TIAER currently provides water quality monitoring and modeling support to at least 26 different watersheds in Texas, primarily addressing nutrient, dissolved oxygen, or bacteria issues. This work helps support standards review with Recreational Use Attainability Analyses (RUAAs) and Aquatic Life Use Assessments (ALUAs), and watershed planning in development of Watershed Protection Plans (WPPs) and Total Maximum Daily Loads (TMDLs). TIAER's work on water quality issues is recognized for its thoroughness and professionalism. TIAER staff have served on state-wide boards dealing with standards development for nutrient and bacteria criteria in Texas and aided instituting a tiered approach to bacteria impairments in recreational waterbodies in Texas. Our capabilities allow us to directly monitor and analyze samples as well as model the larger watershed system. We also engage and facilitate local stakeholder groups needed in addressing watershed issues that often involve a broad community mixing urban and rural areas.

Through the years, TIAER's watershed research efforts have expanded to areas throughout Texas, at least 35 states across the U.S., and internationally. One of our current goals is to expand our watershed linkages as upstream impacts influence water quality in our coastal waters and within the Gulf of Mexico.

TIAER has the capability to provide key research and tools needed to address emerging environmental issues in Texas and across the nation. With a staff comprised of environmental scientists, agricultural economists, and individuals with public relations expertise, TIAER is uniquely positioned to engage stakeholders while holistically addressing key environmental concerns.

The Nutrient Tracking Tool

he USDA Office of Environmental Markets has released the Nutrient
Tracking Tool (NTT) created by the Texas Institute for Applied
Environmental Research (TIAER) at Tarleton State University for
nationwide use.

Invented by TIAER researchers led by Associate Director Dr. Ali Saleh, in collaboration with the USDA, the free online NTT tool is a farm – scale simulator that is designed to estimate nutrient and sediment losses from fields managed under a variety of cropping patterns and management practices. When needed, the NTT can be linked to a watershed model to estimate watershed loadings. NTT helps assess the water quality improvements of conservation practices on farms, estimating nutrient (nitrogen and phosphorus) and sediment losses through its user-friendly link to the Agriculture Policy Environmental eXtender (APEX).

"This release marks the first national version of the NTT," Saleh said, "and is a huge program for TIAER, Tarleton, the USDA and farmers and producers across the United States. Not only can the NTT estimate the effectiveness of various field-specific cropping patterns and management practices, but it can optimize the crop production."

In addition to providing real-world information on the impact of conservation practices on production and sustainability of agricultural operations, the NTT facilitates the development of markets where farmers get paid for the water quality benefits they provide. Known as water-quality credit trading, these programs help reduce water pollutants, especially nitrogen and phosphorus, by letting pollution sources in a watershed trade among themselves to find the most cost-efficient way of reducing the nutrients. A modified version of NTT (Chesapeake Nutrient Trading Tool; CBNTT) and a registry program were developed by TIAER modeling team for States neighboring Chesapeake Bay for their nutrient trading program.

For example, Saleh explained, farmers might sell one pound of phosphorous to a wastewater treatment plant that needs to meet a water quality limit. The plant meets its needs at a lower cost, and the farmer receives a payment for improving water quality.



Thousands of farmers and associated agencies are depending on TIAER's NTT to provide internet-based programs, guidelines, and tools to improve water quality/quantity nationally, while economically optimizing crop and animal production.

Originally developed for the Chesapeake Bay, the NTT is functional for all of the United States. However, verification from each state is recommended for better use.

The NTT is free and available for use here:
ntt.tiaer.tarleton.edu

Soil Health

arming practices can have a critical impact on water quality Conservation farming practices, including no-till planting and the use of cover crops during the winter, can enhance soil health, increase the resiliency of agricultural yields, and protect water quality. These practices may also sequester carbon in the soil, thereby helping to reduce future impacts of climate change. A multidisciplinary study, being conducted by Dr. Barbara Bellows in partnership with Texas A&M AgriLife, is working with farmers across Texas to identify the impacts of their farming practices on the formation of soil aggregates, soil microbial activity, and the decomposition of organic matter. With the development of carbon and water quality trading programs in other states, we are surveying farmers to determine the feasibility of developing similar programs in Texas. These programs could enhance farmer use of conservation farming practices by providing them with economic incentives that would help cover the cost of equipment and seed needed to implement these practices. We are also examining the impacts of soil characteristics and management practices on the degradation and remediation of soil contaminants.

OTIAER QUICK FACT

This past spring, TIAER staff conducted or assisted with portions of the Future Farmers of America Invitation and State Contests on Tarleton Campus.



CEEOT

he Comprehensive Economic and Environmental Optimization Tool (CEEOT) is an integrated suite of economic and environmental models designed to simulate economic and environmental impacts of policy alternatives and individual practices or combinations of management practices. CEEOT was initially developed by TIAER in 1995 as part of a National Pilot Project funded by the United States Environmental Protection Agency. Under the project's initiative, CEEOT was applied to the dairy industry in the upper North Bosque River and the Lake Forest Reservoir watersheds. Currently, CEEOT incorporates the following environmental models: 1) the SWAPP program, a fully linked SWAT/ APEX program with dynamic fertilizer management capabilities, and 2) the Farm-Level Economic Model (FEM), a comprehensive farm-level economic model also developed at TIAER that combines simulation, optimization, and accounting features to estimate the economic impacts of scenarios on representative agricultural economics.

Nutrient Criteria

xcessive nutrients in stream, lakes and reservoirs can lead to water quality problems often linked with accelerated algal growth. Excessive algae can cause issues with use of our waters for drinking, industry, irrigation and recreation. Excessive algae also impacts our aquatic ecosystems by causing extreme daily fluctuations in dissolved oxygen and pH with diurnal variations in photosynthesis and respiration. Decay as bacteria process large amounts of dead algae can decrease dissolved oxygen in our waters to levels that can cause fish kills. Some algae may even release toxic or carcinogenic compounds with their decay. Nutrients are needed at a low levels to maintain a healthy aquatic system, but the difficultly is in defining the tipping point from "just right" to "too much."

Throughout the United States, nutrient criteria are being developed to determine what are appropriate versus excessive concentrations of nutrients. With funding through TCEQ, Dr Larry Hauck and Mr Jimmy Millican along with others at TIAER are working to help address this issue in Texas. Focusing on periphyton, which are macroscopic algae that attach themselves to rocks and other substrate, TIAER is working with the University of Texas at Arlington to enhance our understanding of periphyton-nutrient dynamics by intensively studying sites with varying nutrient levels to aid in future development of nutrient criteria for streams and rivers in Texas. This study involves identifying the algae communities associated with various habitat and water quality parameters as well as the overall quantity of algae present.

OTIAER QUICK FACT

TIAER promoted environmental education by participating in EarthX in Dallas, Texas and visiting local 1st and 2nd grade classes to discuss the importance of caring for the environment.

Continuous Water Quality Monitoring

outine grab samples taken at set intervals, often only quarterly or monthly are generally used to assess water quality of our streams and reservoirs.

Monitoring the quality of our water resources occurs infrequently because it is expensive in that it requires personnel to collect those samples and then precise laboratory analyses to assess the components in the water. To increase the frequency of monitoring and decrease costs, Mr. Todd Adams of TIAER in cooperation with TCEQ is evaluating the operational feasibility of continuous monitoring technology. Past efforts have focused on nutrients and TIAER is now involved with evaluating probes for quick deployments for evaluation of parameters, such as dissolved oxygen, in either streams or reservoirs. Deployments occur over weeks or months allowing a longer period of evaluation. These types of real-time instruments, if proven operationally effective, will aid in allowing a more timely evaluation of potential water quality issues as well as an evaluation over time rather than relying on instantaneous readings representing single points in time.

Watershed Planning

issues exist that require a concerted planning effort to determine how best to implement management practices for mitigation. Two types of watershed planning efforts are generally implemented, Watershed Protection Plans (WPPs) or Total Maximum Daily Loads (TMDLs). TIAER is assisting with watershed planning across Texas. This assistance occurs in multiple ways. Often more focused monitoring is needed to assist in defining pollutant sources, and TIAER's field operations team and laboratory are ready to assist. TIAER's laboratory is accredited with TCEQ through the National Environmental Laboratory Accreditation Program for many water quality impairment parameters. TIAER also comprehensively evaluates the land use and geographic features of an area using geographic information systems. At times, more complex modeling approaches are needed, which then allow TIAER researchers to evaluate current and future conditions under varying proposed management scenarios. As examples, TIAER is directly involved with facilitating the Nolan Creek/ South Nolan Creek WPP, which includes Killeen, Harker Heights, Nolanville, Belton and parts of Fort Hood within its watershed boundaries. TIAER has also assisted TCEQ in addressing TMDLs in watersheds as diverse as Dickinson Bayou along the coast to Sycamore Creek in central Texas. TIAER's technical support and work with stakeholder groups facilitates these watershed-planning efforts throughout Texas.

n many water bodies throughout Texas, impairment

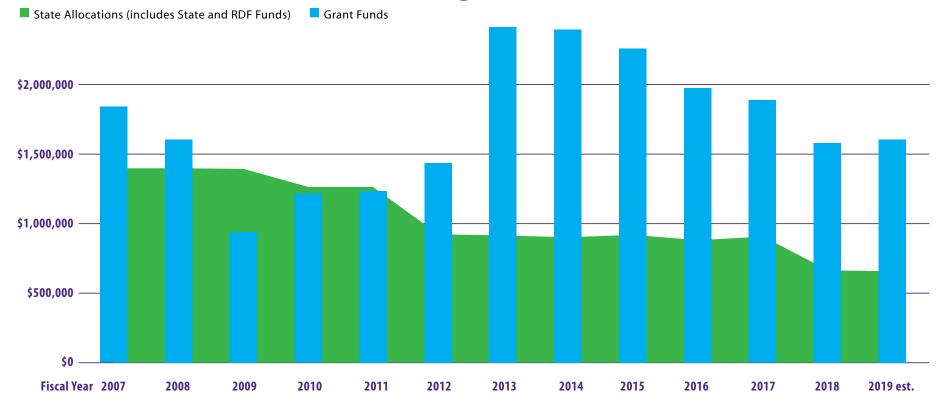
Beach Bacteria Evaluation

exas beaches are popular recreational areas, thus, knowing when it is unsafe to be in the water due to elevated bacteria levels is important beach safety information. Enterococcus is the genus of bacteria used as an indicator to assess recreational use along the Texas coast. Using current incubation methods, it typically takes about 24 hours from when a sample is collected to when bacteria concentration results are available for beach advisories. To speed the turnaround time between monitoring and results, Dr. Larry Hauck and Ms. Stephanie Brady of TIAER are is working with Texas A&M AgriLife Research in Stephenville to evaluate use of quantitative polymerase chain reaction (qPCR) as a more rapid method for assessing Enterococcus concentrations in comparison to currently approved laboratory methods. For this project, a combined TIAER/ AgriLife field operations team has collected water samples along the Texas Coast at nine different locations stretching from Galveston Bay to South Padre Island to represent a variety of coastal beach conditions.



◆TIAER 2018 Highlights

TIAER State & Grant Funding FY2007-2019



OTIAER QUICK FACT

In FY18, for every dollar of state funds, TIAER generated 2.4 dollars in grant funding

TIAER Proposals FY2018

TIAER submitted 21 proposals.



for a total of **\$1,344,000** (as of July 2018)

EXAMPLE 1 THE PARTNERED WITH

12

DIFFERENT CONTRACTING AGENCIES

Chesapeake Bay Foundation

Kansas State University

Maryland Dept. of Ag

Providence of Alberta Canada

Texas AgriLife Extension

Texas AgriLife Research

Texas AgriLife Research -Texas Water Resources Institute

Texas Commission on Environmental Quality

Trinity River Authority

Texas State Soil and Water Conservation Board

USDA-ARS

USDA-OCE

TIAER managed 33 contracts involving partnerships with 29 different contracting agencies,

generating almost \$2 million.

STUDENTS SUPPORTED

TIAER has expanded its involvement in student research with staff serving on at least 15 graduate student committees & undergraduates working with TIAER on research projects



5 Classes Taught



14 Presentations given



Publications & Reports



Watersheds Influenced

TIAER through Dr Saleh's team was

recognized nationally

through official release of the

Nutrient Tracking Tool (NTT)

by the USDA Office

of Environmental Markets.

its work internationally

through Dr Saleh's work in Ecuador & now Vietnam

TIAER 2018 Highlights







Farron Fiedler is studying the effects of excess phosphorus on fish populations. His two year study compares the "fishability" of a river that is impaired by nonpoint source pollution from excess nutrients with a river that is not impaired. With the help of TIAER's field crew, Farron was able to complete the first half of his field research. Farron plans to graduate in the Fall of 2019 from the College of Science and Technology-Tarleton State University.

Student & Community

OTIAER QUICK FACT

TIAER staff conducted the
Global Positioning System
portion of the National
Future Farmers of America
(FFA) Environmental and
Natural Resources Career
Development Event
held October 2018 in
Indianapolis, Indiana.

The purpose of **Gabriel Nejad's** study is to sample a subset of potential reference sites identified by the National Rivers and Streams Assessment but have yet to be sampled. Gabriel's study will collect water chemistry data using field and laboratory methods in compliance with NRSA protocols.

Each site will be sampled in spring, summer, and fall in order to compare seasonal differences in water quality. Statistical analyses will employ temporal and spatial comparisons of water quality among different streams by season, ecoregion, and watershed land use. Doing so will bridge data gaps in the national assessment to include rural Texas ecoregions, helping to determine the extent to which rivers and streams support healthy biological conditions and to identify their major stressors to inform management.

Gabriel plans to graduate in the spring of 2019 from the College of Science and Technology at Tarleton State University.





Kendall Adair is continuing previous research conducted by TIAER in 2004. Kendall is studying the phosphors sorption potential of stream sediments in the Upper North Bosque River watershed. Her study will determine if streambed sediments are releasing phosphorus into the water column or if phosphorus in the water column is being sorbed by these sediments. The goal of Kendall's project is to determine if implementation of phosphorus control practices at wastewater treatment plants in 2005 and best management practices by animal feeding operations in the watershed have affected not only instream phosphorus concentrations, but the potential for stream sediments to act as a sink or source of phosphorus.

Kendall hopes her research will expand TIAER's knowledge and work in the Bosque River to include a focus on sediment and phosphorus sorption. Kendall plans to graduate in the Spring of 2019 from the College of Science and Technology-Tarleton State University with a Master of Science in Environmental Science.

Engagement

Graduate Student, **Lisa Akinyemi** is working with the Tarleton's Farm Economics Model, TIAER's Nutrient Tracking Tool, and other simulation models to help agriculture producers adopt ecosystem service market payments (an organized trading market with ecosystem services like carbon sequestration and improved water quality as credits instead of stock). The ecosystem service market is an essential link for those wanting to improve the environment and agriculture producers have the ability to invest directly in ecosystem services. Lisa will study simulations that can show how the improved demand will affect the present value of the ecosystem service markets and how the improved markets can increase agriculture practices that provide ecosystems services such as reduced erosion, sequestered carbon, mitigated greenhouse gas emissions, and improved water quality.

Accurate simulations can aid in existing ecosystem service markets facilitating more farmers and ranchers in adopting these practices. Lisa's study will help to estimate costs and benefits of the ecosystem service markets to the farmers and ranchers that will aid in helping them reap financial benefits, as well as assist in streamlining accurate estimates of verifiable benefits for a streamlined ecosystem service market adoption. Lisa is expected to graduate in December 2019 with a M.S. in Environmental Science from Tarleton State University's Department of Chemistry, Geosciences, and Physics, and plans to pursue a Ph.D. in a related field shortly after graduation.







Tarleton, a member of The Texas A&M University System, provides a student-focused, value-driven educational experience marked by academic innovation and exemplary service, and dedicated to transforming students into tomorrow's professional leaders. With campuses in Stephenville, Fort Worth, Waco, Midlothian and online, Tarleton engages with its communities to provide real-world learning experiences and to address societal needs while maintaining its core values of tradition, integrity, civility, leadership, excellence and service.



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