U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA)
Research and Extension Experiences for Undergraduates (REEU)
Research and Extension Experience in Energy and the Environment across Agriculture Disciplines (RE²AD)

June 2, 2025 to August 1, 2025

List of Research Projects

Project #1: The Impact of Extreme Events on Agriculture Product Supply Chain

By Dr. Kai Jin, Professor, Dept. of Mechanical and Industrial Engineering

i. Motivation: From early of 2020 until now, COVID-19 pandemic has disrupted the food and other agriculture supply chain in the US and global wide. At each stage of the supply chain, from farms to the retailers, efficiency and availability were affected and decreased as a result of delayed production and distribution. Food security becomes more critical when pandemic and other hazard happens.

ii. *Project Description*: This project will study the disruption factors of the agriculture product supply chain caused by different extreme events. Students will investigate how attributes of the agricultural sector were impacted by the extreme events and how these challenges affected the food supply chain. Data analysis and sensitivity analysis will be conducted on the labor shortage, transportation, government response policies and other factors. A quickly response framework and strategy will be proposed for the prevention of future supply chain disruptions.

iii. *Undergraduate Research Opportunities*: Two students will work on this project. They will start together with the data collection mainly from USDA NASS website. Students will be trained with data virtualizations, present value analysis, benefit to cost analysis, sensitivity analysis, forecasting methods, risk analysis, etc. Each student will implement different methods and tools on the collected data, and evaluate the effectiveness and efficiencies of these methods and tools on agriculture applications.

Project #2: Feasibility Analysis of Developing Wind or Solar Energy Facilities in Farms and Ranches

By Dr. Hua Li, Professor, Dept. of Mechanical and Industrial Engineering

i. Motivation: Farms are vital to sustaining rural jobs and economies. More than 85 percent of U.S. farms are small and 50.1% of farms have economic sales lower than $10,000. Energy consumption is costly for individual farmers in rural America. Unstable energy prices and electricity disruptions cause more harms to farmers. This project aims to analyze the feasibility of developing medium to large scale wind or solar energy facilities in farms and ranches to supply energy for farm operation and to the grid through data collection, data visualization and feasibility analysis.

ii. Project Description: The possibility of achieve self-sustaining energy supply for farm and ranch operation is of great interest. Three major tasks will be completed: 1) Data collection. Solar radiation data will be obtained the National Solar Radiation Database while wind data will be obtained from the Climate Forecast System Reanalysis. 2) Data visualization. A visualization platform based on big data analytics will be created using Geographic Information Systems (GIS) software. The platform will be able to dynamically visualize the collected data and conduct statistical analysis to explore and assess the wind or

solar energy potential in Texas farms and ranches. 3) Conduct technical and economic feasibility analysis on the development of medium to large wind or solar energy facilities in Texas farms and ranches using different computer software.

iii. Undergraduate Research Opportunities: Two REEU students will work on this project. Both students will work on data collection. One student will focus on 1) converting collected data into images using GIS tools, and 2) creating a visualization platform based on GIS animation with statistical analysis function. The other student will focus on conducting 1) technical feasibility assessment considering available natural resources, and 2) economic feasibility assessment considering lifecycle economic analysis.

Project #3: Chemical Impregnation of Crop-Derived Activated Carbon for Enhanced Removal of Air Pollutants from Gas Streams

By Dr. David Ramirez, Professor, Dept. of Environmental Engineering

i. Motivation: Non-traditional crops such as dried beet pulp contains an important amount of structural carbohydrates that makes it attractive for the production of activated carbon adsorbents. The production of crop-derived activated carbon (CDAC) provides a two-fold environmental and economic benefit: An innovative use path is created for alternative crops, and novel low-cost adsorbents are produced for potential environmental applications. Chemical impregnation of CDAC with metal oxides can result in improved adsorbents for enhanced uptake of air pollutants from gas streams. This project will use chemical activation and impregnation methods to manufacture CDACs.

ii. Project Description: Specific objectives of this project are 1) to prepare new chemically-impregnated CDAC adsorbents through a sequential chemical activation and impregnation methods using crop products such as sugar beet; 2) to assess the effects of carbonization, sequential activation, and impregnation on the physical properties of the adsorbents; and 3) to assess the application of the manufactured CDAC for air quality control.

iii. Undergraduate Research Opportunities: Undergraduate students will learn about the carbonization, activation, and chemical impregnation processes for the production of CDAC using state-of-the-art instrumentation. Students will integrate their specific project outcomes to assess optimal conditions for the production of a high-quality CDAC product.

Project #4: Analysis of Sediments and their Associated Contaminants from Agricultural Lands and Coastal Watersheds

By Dr. Jianhong Ren, Professor, Dept. of Environmental Engineering

i. Motivation: An accurate knowledge of sediments and their associated contaminants is vital for aquatic habitat preservation, water-quality maintenance, the sustainability of marine-dependent industries, and sustainable agriculture. The South Texas region including the Coastal Bend and the Rio Grande Valley of Texas are the pillars of the economy in Texas and provides the habitats for key fisheries such as oysters, blue crab, and brown shrimp and various crops and vegetable production. These ecosystems are vulnerable to changes in the amount and quality of sediments. Factors that can affect these changes range from direct human activities such as land use changes occurring in adjacent watersheds to natural events such as seasonal flooding and hurricanes.

ii. Project Description: This project will fill the current regional sediment and contaminants data gaps. It will focus on 1) ***conducting field sediment and contaminant data collection to contribute to the regional sediment and contaminant database development***. Grab samples of bedload sediment, water-column samples for suspended sediments, and sediment core samples will be collected at various locations along

the coast in the South Texas area such as near river/creek entrances in Nueces Bay, Baffin Bay, in South Padre Island, and in irrigation waters, farmland soils, and agricultural products in Lower Rio Grande Valley (LRGV). Collected suspend and bedload sediments will be analyzed for density, settling velocity in different salinity levels, sediment size distribution, and sediment concentration. Sediment core samples will be analyzed for density, sediment size distribution, and mass/volume fraction and thickness for each layer. Contaminant content such as heavy metals and nutrients in the collected sediments will be analyzed for mass concentrations. In addition, water velocity, turbidity, salinity, and water temperature data will also be collected at each sampling location and at various depths, and 2) ***developing a web-based tool to promote data sharing with regional stakeholders***. A data visualization and management tool will be developed to allow end users to view and download sediment and their associated contaminant data at sampling locations. The tool will be made available to interested stakeholders through the South Texas Water Center website. The project will contribute to the development of a regional sediment management plan and sustainable coastal fisheries in the South Texas area. It will also contribute to the development of comprehensive inventories of regional water quality.

iii. Undergraduate Research Opportunities: Two REEU students will work on this project. Both students will work with Dr. Ren's research team together including undergraduate and graduate students. The two REEU students will work together on this project with separate research activities that match the REEU students' backgrounds.

Project #5: Agricultural management and natural resource conservation: interface between natural, economic, and social systems

By Dr. Benjamin Turner, Associate Professor, Dept. of Agriculture, Agribusiness, and Environmental Sciences

i. Motivation: The nature of agricultural and natural resource systems, including how they feed back and interact with one another, is inherently complex due to biologic, geologic, economic, socio-cultural, political, and climatic characteristics. Delays in these systems, which are significant and oftentimes longer than delays in corporate settings, express powerful influence over the observed dynamics of problems. A function of interconnected feedback structures not easily identified and managed, contemporary management problems, such as farm/ranch livelihoods, food system resiliency, and environmental quality, are all facing increasing stress and vulnerabilities. Such challenges operate at multiple temporal and spatial scales and include problems such as climate variability and change, water resource scarcity, soil erosion and land degradation, biodiversity loss, and limits to agricultural productivity and food security, among others.

ii. ***Project Description***: In Summer 2024, this project will focus on three unique subprojects independently and in collaboration with partner ranchers or landowners in Texas: 1) Rainfall simulator construction (Engineering student). This subproject objectives will be to design, construct, test, and pilot a portable rainfall simulator to be used as a research laboratory instrument in field settings. Upon completion, an experimental design and implementation protocol will be crafted and deployed for initial data collection on varying soils/land uses. 2) Soil health monitoring for ranch management (Agriculture student). This subproject objective will be to continue data collection and analysis on an existing on-ranch monitoring project and expand the project to neighboring sites useful for analyzing soil and rangeland responses to alternative grazing management treatments and consideration of financial outcomes. 3) Watershed monitoring in response to alternative energy development (both students). The subproject objective will be to continue data collection and analysis on an existing watershed conservation project and expand the study by incorporating new data sources and methods to aid in future presentation and publication opportunities.

iii. ***Undergraduate Research Opportunities***: This project will seek two (2) undergraduate students, one from an engineering discipline (industrial, mechanical, etc.) and one from an agricultural discipline (soil science, rangeland ecology, etc.). Both students will work in a variety of research settings (field and lab) both on and off campus and be exposed to and work with a diversity of data sources and types (both quantitative and qualitative). Lab members coming from a variety of academic backgrounds will share in common training opportunities, summer reading discussions, and collaborations with external stakeholders or scientists. Finally, undergraduate research work coming from this lab has been presented at conferences and published in peer-reviewed journals. It is expected that Summer 2024 projects also be presented and published widely. We are a productive and dynamic group that welcomes a diversity of backgrounds and perspectives. Previous members have come from agriculture, agribusiness, range management, engineering, economics, and biomedicine- what has made us successful is that we've all shared a strong work ethic, attention to detail and communication, and above all, desire to learn.