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 (RE^2AD)

May 31, 2023 to August 1, 2023

List of Research Projects

Project #1: The Impact of COVID-19 Pandemic 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 pandemic and other potential risks. Students will investigate how attributes of the agricultural sector were impacted by the pandemic 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 and 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 Medium to Large Scale 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 Micro-Nano-Plastics 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. Particularly, microplastics (MPs) (<5 mm) and nanoplastics (NPs) (1–1000 nm) pollution and their accumulation in soil and sediments are of special concern due to their harm to these ecosystems. MPs contamination in agroecosystems has been confirmed by several studies. A recent study showed that MPs with sizes up to 2 micrometers are found in edible plants, including vegetables.

ii. Project Description: This project will fill the current regional sediment and micro-nano-plastics (MNPs) data gaps. It will focus on 1) ***conducting field sediment and MNP data collection to contribute to the regional sediment and MNP 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. MNPs content in the collected sediments will be analyzed for size, shape, surface charge, polymer types, and mass concentrations following density extraction using various extraction solutions. 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 MNPs 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, focusing on emerging MNPs pollution.

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 livelihoods, local community viability, food system resiliency, and environmental quality, have gotten worse not better. These 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***: This project will examine the above issues by collaborating with partner ranchers in Texas. Specific cases may include but not be limited to: 1) Erosion rates and water quality degradation arising from solar panel, 2) Grazing management for improved forage productivity and soil health, 3) Modeling land use dynamics to test for high leverage conservation strategies, 4) Wild horse population control in the western U.S., and 5) Nutrient management decision making and the role of heuristics.

iii. ***Undergraduate Research Opportunities***: Two REEU students will work together on this project. Students will likely be work in a variety of research settings in the field and on campus and be exposed to and work with a diversity of critical data sources (field, lab, and modeled) and types (both quantitative and qualitative). Lab members, who have come from a variety of academic backgrounds ranging from,

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's expected that Summer 2022 project also be presented and published widely. It is a productive and dynamic group that welcomes a diversity of backgrounds and perspectives. Previous members have come from agriculture, agribusiness, range management, engineering and biomedicine- what has made us successful is that we've all shared a strong work ethic, attention to detail and communication, and desire above all to learn.