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^{2}AD)

June 6, 2022 to August 5, 2022

Research Project List

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: Physical and Chemical Activation of Crop Products to Manufacture Engineered Adsorbents for Environmental Applications

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

i. Motivation: The production of engineered activated carbon adsorbents from nontraditional crops such as dried beet pulp can provide a two-fold environmental and economic benefit: An innovative use path is created for alternative crops and novel low-cost engineered adsorbents are produced for commercial use in water and air quality control applications. Beet pulp contains an important amount of structural carbohydrates that makes it attractive for the production of activated carbon as an adsorbent to improve water and air quality. This project will use physical and chemical activation methods to manufacture crop-derived activated carbon (CDAC).

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

iii. Undergraduate Research Opportunities: Undergraduate students will learn about the carbonization and activation processes for the manufacture and characterization 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: Modeling Surface-Groundwater Fluxes and Quality in a Region Dependent on Precipitation for Dryland Cropping Systems

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

i. Motivation: South Texas has long been a giant when it comes to crop production with farming and ranching being major contributors to the local economy. Despite the economic importance of crop production, cropland in the South Texas has been decreasing. This project will use process-based models to investigate the relationships among climate variables, land use types, and surface water and groundwater fluxes and quality. The objectives are to 1) examine the effect of land use changes on the surface water-groundwater (SW-GW) interaction under changing climate, 2) determine the effects of seasonal crop rotation on the SW-GW fluxes and quality, and 3) determine how considering SW-GW fluxes will improve the estimation of soil moisture under changing climate, land use, and agricultural activities.

ii. Project Description: The project will use the Coastal Bend Regional Water Planning Group (Region N) as a testbed, which includes portions of three major river basins, i.e., Nueces River Basin, Nueces-Rio Grande Coastal Basin, and San Antonio-Nueces Coastal Basin. Separate models for each basin that link surface water processes and groundwater processes will be developed using SWAT–MODLFOW coupled model and modified to include reservoir-aquifer interaction. The basins will be delineated, i.e., divided into sub-watersheds, by either considering elevation, streams, and the general boundary of each basins, or

using 8/10/12-digit Hydrologic Unit Code from Watershed Boundary Dataset at United States Geological Survey (USGS). Model input data such as Digital Elevation Model, soil data, precipitation data, and crop rotation information will be obtained from various sources. The model will be calibrated using streamflows measured by USGS control points and groundwater heads measured by Texas Water Development Board. Future climate conditions impacts will be evaluated using downscaled climate projections under different greenhouse gas concentrations.

iii. Undergraduate Research Opportunities: Two REEU students will work on this project. Both students will compile surface water and ground water quality data, agricultural information, land use types, and climate data of Region N. One student will focus on conducting preliminary data analysis to examine trends and possible relations among climate variables, land use types, and surface water and groundwater quantity and quality. The other student will focus on identifying data gaps for improved regional water and agricultural resources management.

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.