PIER Cluster Hire Proposal: Area 4 - Environment, Sustainability, and Climate Resilience:

Enhancing Sustainability through Convergence Research in Food-Energy-Water Security and Sustainability (ESCR–FEWSS)

A strategic collaboration of PVAMU: The College of Agriculture, Food & Natural Resources (CAFNR), The College of Engineering, The College of Arts & Sciences.

Lead Faculty & College: Ali Fares, Regents Professor and Endowed Professor of Water-Security and Food-Energy-Water Nexus
College of Agriculture, Food & Natural Resources

Collaborators & Colleges: Ananda Amarasekara, Professor and Department Chair, Department of Chemistry and Physics, College of Arts and Sciences
Md Jobair Bin Alam, Associate Professor, College of Engineering

1. Executive Summary

Purpose & Scope:

The Environment, Sustainability, and Climate Resilience (ESCR) cluster initiative at Prairie View A&M University seeks to position the university as a national leader in food-energy-water security and sustainability. Anchored by the proposed Ph.D. in Food-Energy-Water Security and Sustainability (FEWSS), the program will address climate resilience, energy and water system sustainability, maintenance, and monitoring, and environmental innovation. This initiative responds directly to national and regional priorities for addressing drought, environmental challenges, and resilience in underserved communities.

Interdisciplinary Team:

This initiative represents a strategic collaboration across multiple colleges and schools at PVAMU: the College of Agriculture, Food & Natural Resources (CAFNR), the College of Engineering (CoE), and the College of Arts & Sciences (CAS). Key investigators include Drs. Ali Fares (CAFNR, Project Lead), Dr. Jobair Bin Alam (the CoE), and Dr. Ananda Amarasekara (the CAS).

High-Level Impact:

The ESCR-FEWSS initiative will directly contribute to Prairie View A&M University's 2025–2035 Journey to Eminence, specifically supporting strategic goals to develop interdisciplinary programs, accelerate research capacity, and foster social responsibility. By training a new generation of systems thinkers and providing practical, scalable solutions to complex engineering and environmental challenges, this initiative will serve the university, the state of Texas, and global communities striving for climate resilience and sustainable development. Furthermore, Texas's manufacturing expansion is directly tied to increased demand for resilient food, water, and energy systems. New semiconductor fabrication plants, EV and battery production facilities, and petrochemical industries require large-scale water and energy inputs while facing climate-related vulnerabilities. By training graduates who understand agricultural and industrial sustainability challenges, the ESCR–FEWSS initiative will extend PVAMU's impact beyond farming communities to include Texas's evolving industrial economy. This dual emphasis strengthens the university's alignment with state workforce needs and enhances

opportunities for industry partnerships.

2. Alignment with Strategic

Plan, Strategic Priorities

Prairie View A&M University's *2025–2035 Journey to Eminence* outlines a bold vision to become a premier, public, research-intensive HBCU and a national model for student success. The proposed Environment, Sustainability, and Climate Resilience (ESCR) initiative, anchored by the **Ph.D. in Food-Energy-Water Security and Sustainability (FEWSS),** is directly aligned with this vision and supports three strategic university goals:

- **Goal #2 – Develop Cutting-Edge Interdisciplinary Programs Aligned with Market Needs:** The FEWSS-PhD is PVAMU's first doctoral degree explicitly focused on the food-energy-water-health nexus, and it marks a transformative step for the College of Agriculture, Food & Natural Resources (CAFNR), which, despite its land-grant mission, remains one of only two colleges at PVAMU without a Ph.D. program. This program will integrate the academic and research strengths of CAFNR's six undergraduate concentrations and two master's programs (Master of Science in Natural Resources and Environmental Science and Master of Science in Nutrition), providing students with advanced training in climate analytics, sustainable food and energy systems, water resource management, and resilience finance. Market demand in Texas is also being reshaped by manufacturing growth. Employment in advanced manufacturing, including clean energy equipment, chemical processing, and semiconductor fabrication, will outpace national averages over the next decade. These industries increasingly require water conservation, energy efficiency, environmental compliance, and climate resilience expertise. The FEWSS Ph.D. will expand its reach into Texas's most dynamic economic sectors by preparing graduates to serve the agricultural and manufacturing sectors.
- **Goal #4 – Accelerate Research Capacity and Increase Ph.D. Completions:** The ESCR cluster will be a powerful research engine for the FEWSS Ph.D. program through its collaboration with Engineering and Arts and Sciences. Doctoral fellows will have access to state-of-the-art core labs, sensor networks, and PVAMU's 778-acre R&D farm, facilitating rapid entry into dissertation research. This state-of-the-art infrastructure was funded by generous NIFA capacity funding, which will shorten time-to-degree, increase completions, and critically elevate PVAMU's research profile for maintaining R2 classification and

building momentum toward R1 status.

- **Goal #5 – Foster Social Responsibility:**
  Consistent with PVAMU's land-grant mission, the FEWSS program is committed to translating research into practice. ESCR findings will be extended to over five million limited-resource Texans via CAFNR's statewide extension network, focusing on smallholder farmers and coastal communities vulnerable to climate change. This hands-on engagement fulfills PVAMU's strategic goal of embedding social responsibility into research and education.

Intercollege Linkages

The FEWSS initiative embodies true intercollege collaboration. Each participating college brings distinctive expertise that collectively fulfills the goals outlined above:

- CAFNR anchors the program with its proven capacity in land-grant research, sustainable agriculture, environmental sciences, and statewide outreach. Faculty within CAFNR are already actively engaged in FEWSS research, and the college's teaching, research, and extension systems provide a seamless pipeline from discovery to application.
- The CoE delivers technical depth in renewable energy systems, sustainable wastewater treatment and reuse processes, life cycle assessments, climate modeling, scalable geophysical interpretation with precision, robotics, and AI-driven analytics, which are critical for advancing precision agriculture and sustainability innovations.
- The College of Arts & Sciences enriches the program with strengths in environmental chemistry, climate science, data analytics, and geospatial modeling, essential for interpreting environmental systems and informing policy.
- Agricultural scientists partner with engineers to develop predictive sensor-driven farm management systems.
- Climate scientists partner with geotechnical engineers to characterize climate-induced subsurface variabilities.
- Agriculture and environmental researchers collaborate to develop sustainable wastewater treatment and reuse processes for agricultural and hydraulic fracking operations.
- Climate scientists collaborate with economists to translate hazard data into actionable investment strategies.
- These partnerships go beyond academic collaboration; they create integrated research ecosystems that attract students, engage communities, and appeal to funding agencies

seeking high-impact, high-return proposals.

Moreover, shared research infrastructure, including laboratories, data platforms, and the R&D farm, reduces duplication and frees up resources for bold, exploratory work. Students benefit from early exposure to convergence research, accelerating skill development and professional readiness. Community stakeholders receive bundled solutions that combine science, technology, and policy insights to provide a one-stop interface for evidence-based decision-making.

The demand for such integrated expertise is rapidly growing. In Texas alone, employment in FEWSS-related fields is projected to grow 15.8% over the next decade, outpacing the state average. Graduates of the FEWSS-PhD will be uniquely equipped to enter academia, industry, government, and nonprofit sectors, advancing sustainable solutions across food, water, energy, and health.

PVAMU is poised to become a national leader in climate resilience, sustainable resource management, and interdisciplinary graduate education by combining a high-impact doctoral program with a collaborative research cluster. The ESCR–FEWSS initiative will expand the university's research capacity, elevate its Carnegie classification, and meet the urgent need for **systems thinkers** in a rapidly changing world.

3. Research Vision and Goals

Big-Picture Vision: To position Prairie View A&M University as a national leader in climate resilience and sustainability by advancing convergence research and workforce development in the Food-Energy-Water Security and Sustainability (FEWSS) framework. The program will empower a new generation of systems thinkers, especially from underserved communities, to tackle the interconnected challenges of food, energy, water, and health while strengthening PVAMU's path toward R1 status and inclusive innovation.

Specific Objectives:

1. Develop and enhance integrated food, energy, and water systems that are sustainable, efficient, and resilient under diverse environmental and resource conditions (CAFNR co-lead with CoE and CAS)
2. Address environmental issues and processes using advanced data analytics approaches (CAFNR co-lead with Arts & Sciences)

3. Assess the Impacts of Energy Transition on Water-Energy-Food-Health (WEFH) Nexus (CAFNR)

Scope of work

We will follow the tasks described in this section to achieve the above-listed objectives.

Objective 1. Develop and enhance integrated food, energy, and water systems that are sustainable, efficient, and resilient under diverse environmental and resource conditions (CAFNR co-lead with CoE and CAS)

Task 1.1. Design Pilot-Scale Integrated FEW Systems

This task will involve designing and deploying pilot-scale integrated systems that link food production, renewable energy generation, and water conservation technologies. Systems may include AI-integrated irrigation and nutrient recovery through water recycling, geophysics-informed water redistribution sensing and monitoring, and, consequently, meticulous identification of non-uniformity of cropland. Field trials at CAFNR research farms will integrate expertise from the CoE in hydro-geophysical sensing to address water and food systems and energy systems, as well as from the CAS in environmental monitoring. The pilots will simulate real-world conditions and evaluate system efficiency, cost-effectiveness, and environmental performance. Results will inform the scalability and adaptability of the integrated systems across different landscapes.

Task. 1.2. Integrate Multi-Scale Planning and Stakeholder Engagement in FEW System Design

This task will apply a multi-scale, systems-based planning approach to guide the design and deployment of integrated FEW systems. It will include stakeholder mapping, participatory workshops, and decision-support frameworks that capture trade-offs and synergies across scales from local farms to regional watersheds. CAFNR will lead stakeholder engagement activities, and the CoE and Arts and Sciences will provide modeling tools and visualization technologies. This approach ensures that local needs and knowledge are embedded into technical solutions, improving social acceptance and long-term sustainability. Ultimately, the task will produce a scalable decision framework that balances FEW system development's environmental, economic, and social priorities.

Task 1.3. Evaluate Sustainability Metrics and Develop Adoption Guidelines

Integrated FEW systems will be evaluated using sustainability indicators such as energy efficiency, water-use efficiency, soil health and unsaturated soil metrics, greenhouse gas emissions, and economic return. Data collected from field trials and simulations will inform lifecycle assessments and sustainability benchmarking tools, with probabilistic assessment techniques for system uncertainty quantification. Based on these findings, best practice guidelines and policy briefs will be developed for producers, extension agents, and utility planners. These outputs will ensure the project delivers tangible tools and strategies for widespread adoption.

Objective 2. Address environmental issues and processes using advanced data analytics approaches (CAFNR co-lead with CAS, and CoE)

Task 2.1. Developing an Integrated Environmental Data Repository

To address complex environmental issues, a centralized data repository will be created to compile and curate datasets related to soil health and relevant saturated/unsaturated hydraulic properties, water quality, vegetation indices, atmospheric conditions, and land use. This repository will aggregate data from existing sources, including field sensors, remote sensing imagery, public environmental databases, and historical records. The repository will be a foundational resource for researchers across disciplines, enabling comparative analysis, trend detection, and system modeling.

Task 2.2. Apply Artificial Intelligence (AI) for Environmental Pattern Detection (EPD)

This task will implement advanced machine learning (ML) techniques to identify patterns and anomalies in environmental data. These models will be trained to detect shifts in land use, drought intensity, vegetation stress, water contamination, and other critical indicators. The task will emphasize the interpretability of results to ensure that findings are actionable and policy relevant. This task will enhance expertise in AI algorithms and support statistical validation and ecological interpretation.

Task 2.3. Build Predictive Models for Resource Management

Predictive models will be developed to simulate future environmental conditions and support decision-making for resource management. These models will focus on forecasting water availability, nutrient leaching, soil erosion, and greenhouse gas emissions under various scenarios. Integrating real-time sensor data, weather forecasts, and land management

practices will enhance the accuracy and responsiveness of these models.

Objective 3. Assess the Impacts of Energy Transition on Water-Energy-Food-Health (WEFH) Nexus (CAFNR)

Task 3.1. Establish Baseline Assessments of WEFH Systems under Energy Transition

This task will establish a comprehensive baseline of current WEFH systems, focusing on how the energy transition, decarbonization, electrification, renewable integration, and fossil fuel dependence alter resource flows and vulnerabilities. Data collection will include energy use in agriculture and water systems, water demands of energy technologies, food system dependencies on energy availability and pricing, and public health exposures linked to air quality and energy access. Economic indicators, such as cost structures and market shifts, will be integrated to highlight trade-offs and systemic vulnerabilities, particularly in underserved communities.

Task 3.2. Analyze System Interactions and Resilience under Transition Scenarios

Building on the baseline, this task will investigate how WEFH systems respond to shocks and shifts driven by the energy transition and the system's resilience to those shocks. Examples include variable renewable energy supply, water scarcity in energy production, changing food-energy dependencies, and health risks or benefits linked to cleaner energy adoption. Analysis will focus on the interdependencies across sectors, capturing cascading effects and feedback at multiple scales. Economic dimensions, such as shifts in production costs, household energy burdens, and infrastructure investment needs, will be embedded in the analysis to assess resilience and equity outcomes.

Task 3.3. Evaluate Policy and Governance Implications for WEFH Nexus under Energy Transition

This task will evaluate how policies, including renewable energy incentives, carbon pricing, water-use regulations, agricultural support, and public health protections, affect the balance of trade-offs across the WEFH nexus during the energy transition. Policy scenarios will be co-developed with stakeholders to ensure relevance to real-world priorities and constraints. Each scenario will be assessed for its potential to reduce vulnerabilities, enhance equity of access, and promote long-term system sustainability. Both sectoral and cross-sectoral implications will be considered, linking economic, environmental, and social outcomes.

Task 3.4. Develop a Decision Support Framework for Stakeholders

A decision support framework will be developed to ensure actionable outcomes, integrating

data, analysis, and policy evaluations. This framework will allow stakeholders to explore trade-offs and synergies across the WEFH nexus under different energy transition pathways. Interactive components, such as scenario comparisons, impact visualizations, and customizable assumptions, will translate complex interactions into accessible insights. The framework will support evidence-based decision-making for policymakers, industry leaders, and communities seeking to navigate the challenges and opportunities of the energy transition.

Innovation through Convergence

At CAFNR, innovation is driven by the intentional convergence of disciplinary expertise to address complex societal challenges. The intersection of engineering and environmental science yields transformative, systems-based solutions that would not emerge within any discipline.

a) Integrated Food, Energy, and Water Systems

- By merging the technical capabilities of the environmental and agricultural expertise of CAFNR with the technical expertise and capabilities of CoE and the ecological and systems understanding from the CAS, we are developing sustainable, efficient, and resilient Food-Energy-Water (FEW) systems. This interdisciplinary approach allows for designing integrated infrastructure solutions that optimize resource flows, adapt to changing environmental conditions, and enhance food and water security in diverse contexts.

- CAFNR will collaborate to establish a robust hydro-geophysical sensing and modeling platform for advanced field monitoring and decision-making. Leveraging the CoE's expertise in geophysics, sensor integration, and computational modeling alongside CAFNR's deep domain knowledge of soil–water–crop systems, this partnership will deliver a comprehensive field monitoring system capable of capturing spatiotemporal variability in soil moisture, subsurface water redistribution, and nutrient dynamics.

b) Advanced Data Analytics for Environmental Solutions

CAFNR and the CAS collaborate to leverage advanced data analytics, machine learning, and environmental modeling to address pressing ecological issues. This partnership unites domain knowledge in environmental systems with innovative computational techniques, enabling novel insights into ecosystem dynamics, climate resilience, and land-use impacts. Such convergence enhances predictive power and decision-making for environmental policy and resource management.

c) Modeling the Food-Energy-Water-Health Nexus

The convergence of agricultural science (CAFNR), business strategy, and systems modeling enables the development of Food-Energy-Water-Health nexus frameworks that support economic resilience and evidence-based policy. This collaboration allows complex interdependencies between human health, environmental sustainability, and economic outcomes to be analyzed and optimized, informing scientifically grounded and socioeconomically robust policies.

4. Faculty and Postdoc Needs and Contributions

Team Composition

The interdisciplinary team supporting the PIER initiative includes faculty, existing postdocs, research associates, and graduate students from multiple colleges at Prairie View A&M University. Their work supports water treatment, clean energy, large-scale precision monitoring and modeling, and sustainable agriculture applications. These efforts are strengthened by postdocs and graduate students who support core research through lab experimentation and analytical processing. These contributions form the foundation of a truly collaborative and innovative research cluster.

Expertise Matrix

Ali Fares (CAFNR)

Expertise: Water-Energy-Food Nexus, Artificial Intelligence in Agriculture and Natural Resources, Climate Change Impact on Watershed Hydrology, Numerical Modeling at Multi-Spatial and Temporal Scales

As project leader, Dr. Fares coordinates the overarching vision and leads Objective 1, especially Task 1.1 and 1.2, which focus on integrating food, energy, and water systems and stakeholder-driven planning. His background ensures synergy between research outputs and resilience frameworks.

Md. Jobair Bin Alam (CoE)

Expertise: Geotechnical and Geo-Environmental Engineering, Solid Waste Engineering

Dr. Alam leads innovations in geophysical investigation, infrastructure assessment, earth-

system monitoring, and modeling through Tasks 1.1, 1.3, and 2.1. His contributions will build a large-scale field-testing platform that drives data-driven soil health characterization, climate adaptation strategies to shift to innovative, advanced monitoring systems that deliver accuracy, scalability, and a decision framework for sustainable design and resource management.

Ananda Amarasekara (CAS)

Expertise: Sustainable Biofuels & Bioenergy, Development of catalytic methods for converting energy crops, algae, and agricultural waste to sustainable biofuels. Catalysis, Renewable Energy Storage & Green Technologies.

Dr. Amarasekara will contribute to objectives 1 and 2.

List of collaborators and their expertise

Raghava Kommalapati

Expertise: Energy and environmental sustainability, Membrane processes for wastewater treatment, Anaerobic digestion and energy recovery, and Lifecycle Analysis (LCA) of energy and environmental technologies.

Dr. Kommalapati contributes to objectives 1, specifically tasks 1.1 and 1.3.

Gerard D'Souza

Expertise: Agricultural economics, sustainability, resource management, agricultural risk management, health economics, and environmental and water economics.

Dr. D'Souza contributes to objective 3, specifically tasks 3.3 and 3.4.

Ripendra Awal

Expertise: Groundwater modeling, Water-related hazards, AI in Agriculture, Dam failure analysis, Water management

Dr. Awal contributes significantly to Task 1.1 by leading the implementation of sensor-based irrigation and monitoring technologies. He also supports data-driven modeling in Objective 2 (Task 2.1 and 2.3), focusing on resource availability and predictive analytics.

Ahmed Ahmed

Expertise: Precision Agriculture using AI & IoT, Remote Sensing, Predictive Management, and Smart Field Monitoring

Dr. Ahmed contributes to objective 1 by designing energy-efficient systems and evaluating energy transition technologies for net-zero applications across urban and agricultural settings.

Gao Yunxiang

Expertise: Environmental Chemistry, Nanomaterials, CO_2 Capture and Conversion.

Role: Dr. Gao contributes primarily to Objective 2: Address environmental issues and processes using advanced data analytics approaches and Objective 3: Design, implement, and evaluate a new living environment based on a nature-based and net-zero approach. His work aligns with Task 2.3 by supporting laboratory-based water and soil chemistry investigations and advancing materials used in real-time sensing.

Andres Pech Cervantes

Expertise: Animal production, animal nutrition, rumen microbiology, Precision livestock production (AI applied to animal production)

Dr. Cervantes supports Objective 3 (Task 3.2) by evaluating the role of wastewater-grown microalgae in circular biofertilizer systems, contributing to both field and lab-based experimental designs.

Jayant Lohakare

Expertise: Animal Nutrition, Poultry Science, Nutrigenomics.

Dr. Lohakare brings specialized expertise in poultry nutrition, sustainable feed systems, and animal science to support multiple components of the PIER initiative. He will contribute to Objective 1 by developing efficient, algae-based, low-impact feed systems that enhance productivity while conserving water and energy. Under Objective 3, he will support the evaluation of integrated poultry-livestock systems as part of circular bioeconomy and net-zero infrastructure efforts.

Sunil Dhoubhadel

Expertise: Agricultural Economics, Market Analysis

He co-leads Objective 3and contributes to Tasks 3.1 and 3.2 by building economic models to assess the system's resilience under various scenarios. He also supports Task 3.3 for evaluating the impact of proposed FEWH policies.

Alfred Parks

Expertise: Agribusiness Management, Financial Systems

Dr. Parks contributes to Objective 3, particularly Task 3.3 and 3.4, by modeling policy

impact scenarios and helping design the decision-support tool for economic resilience.

Jennifer Quinlan

Expertise: Food Safety, Public Health, Community Access

Dr. Quinlan will contribute to the social dimensions in Objective 4, including baseline vulnerability analysis (Task 3.1) and community engagement for equitable outcomes.

Laura Carson

Expertise: Nutrition, Nano-fertilizers, Biochemistry

Dr. Carson contributes to Task 2.2. Also, I will co-lead lab-based assessments and provide student mentorship in sustainability research.

Atikur Rahman

Expertise: Waste Management, Wastewater treatment, and Algae-Biofertilizer Systems

He co-leads Task 1.2 and 1.3. Atikur supports circular bioeconomy innovations by developing sustainable fertilizer systems from livestock waste and algal cultivation.

Richard Griffin

Expertise: Soil Science, Landscape Hydrology

Dr. Griffin supports Tasks 1.3 and 2.1, quantifying the hydrological and carbon impacts of transitioning to renewables and contributing data to the integrated environmental repository.

Binod Khanal

Expertise: Applied economics, Food security, Agricultural economics, and Development economics.

Dr. Khanal contributes to Objective 3, specifically tasks 3.1 and 3.2.

Nabila Shamim

Expertise: Polymeric Thin Films and Nanofibers, Gel polymer electrolyte

She leads AI model development in Task 2.2 and supports Task 2.4 by engineering robust, interpretable pattern detection tools for environmental data dashboards.

Rania Labib

Expertise: Artificial Intelligence (AI) & Big Data, Building Performance & Energy Modeling.

Dr. Labib contributes to Objective 2.

Oluwagbemiga Ojumu

Expertise: Applied Economics & Econometric Modeling, Economic Development & Policy Analysis. Dr. Ojumu contributes to objective 3.

Sameh Abdelwahed

Expertise: Organic & Medicinal Chemistry, Heterocyclic Compounds, Enzyme Catalysis, Spectroscopy & Advanced Instrumentation, and Sustainable Materials for Energy Conversion and Catalysis.

Objective 2 – Advanced Data Analytics and Environmental Solutions. Dr. Abdelwahed will contribute by applying advanced spectroscopic and chemical analysis methods to environmental systems research. He will support the development of sustainable chemical strategies, molecular characterization, and material design that enhance predictive modeling and sustainability metrics within the FEWSS framework. His expertise bridges chemistry, agriculture, and materials science, strengthening interdisciplinary collaborations.

Anoop Valiya Veettil

Expertise: Watershed management, Applications of AI in agriculture & natural resources. Dr. Veettil contributes directly to Objective 2 by leading Tasks 2.1 and 2.3. He will organize and analyze large-scale environmental datasets and support predictive model development to inform sustainable practices.

Capacity Gaps & Hiring Plans

Although the current faculty and research team provide a solid foundation, several strategic hires are necessary to support the proposed initiative fully. We propose hiring four postdoctoral researchers under the PIER program, with plans to add more under cost-sharing agreements. These postdocs will be vital in mentoring graduate students, managing lab operations, and expanding interdisciplinary research capacity.

5. Support and Resources

Existing Infrastructure:

The proposed PIER initiative will be housed in CAFNR, located in the Agriculture-Business Multipurpose Building (ABMB) on the main PVAMU campus. The College of Agriculture, Food, and Natural Resources (CAFNR) supports research through facilities, such as the Cooperative Agricultural Research Center (CARC), the International Goat Research Center

(IGRC), and the Poultry Center. CAFNR also maintains a 778-acre research farm equipped with eddy covariance flux towers, UAVs, soil and plant health sensors, and field instruments for environmental monitoring. The CARC has Field/In-Situ Equipment, analytical laboratories, and computer simulation labs. The CAS contributes high-end instrumentation such as NMR, HPLC, LC-MS, and SEM housed in the New Science Building, supporting chemistry, materials science, and environmental analysis research. The CoE operates geotechnical and geophysical engineering labs with extensive soil and subsurface testing tools, including advanced triaxial testing systems, a multichannel electrical resistivity imaging system, and advanced unsaturated soil characterization equipment. These collective resources support interdisciplinary research and training. The list of resources and facilities is summarized in Table 1.

Table 1. Summary of Facilities and Resources Across Colleges

College/Unit	Facilities & Equipment	Purpose/Use
CAFNR	Cooperative Agricultural Research Center (CARC); International Goat Research Center (IGRC); Poultry Research Center; 778-acre Research Farm; Agriculture-Business Multipurpose Building (ABMB); Eddy Covariance Flux Towers; Smart Classrooms; Unmanned Aerial Vehicles (UAVs); Greenhouses; Controlled-Environment Growth Chambers; Weather Stations; Soil Moisture Sensors; Gas Chromatograph–Mass Spectrometry (GC-MS); High-Performance Liquid Chromatography (HPLC); Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES); Feed Mill; Molecular Biology Laboratory	Agricultural and environmental field research, livestock nutrition, poultry performance testing, crop growth experiments, soil and plant health assessment, water cycle and carbon flux measurement, extension training, and molecular analysis

CoE	Geotechnical Engineering Laboratory; Geophysical Engineering Laboratory; Advanced Triaxial Testing Systems; Multichannel Electrical Resistivity Imaging System; Automatic Soil Compactors; Direct Shear Test Apparatus; Soil Permeability Test Setups; Smart Sensors for Geo-Environmental Monitoring; Soil and Water Instrumentation; Soil Water Characteristic Curve (SWCC) estimating equipment	Research in soil stability and foundation analysis, subsurface profiling, real-time monitoring of environmental conditions, supporting civil and agricultural engineering studies
Chemistry Department (CAS)	400 MHz NMR Spectrometer; High-Performance Liquid Chromatography (HPLC); Liquid Chromatography-Mass Spectrometry (LC-MS); Gas Chromatography-Mass Spectrometry (GC-MS); Fourier Transform Infrared (FT-IR); Raman Spectroscopy; Thermogravimetric Analysis (TGA); Differential Scanning Calorimetry (DSC); X-ray Photoelectron Spectroscopy (XPS); UV-Visible Spectrophotometers; Fluorescence Spectrophotometers; Surface Area Analyzers, Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)	Chemical and biochemical characterization, analysis of environmental samples, polymer research, and thermal stability studies
Physics Department (CAS)	Raman-AFM (Atomic Force Microscopy); Four-Point Probe Systems; Scanning Electron Microscope (SEM); Bath Sonicators; Zeta Potential Analyzer; Microcentrifuges; Vacuum Systems	Nanoscale surface and material analysis, semiconductor research, material conductivity, and particle charge behavior studies
Electrical Engineering	Hitachi SU3500 SEM; Bruker EDS System; EBIC Detectors; STEM Detectors; Microtest 200 VT; Parametric Analyzers; Thermal Test Chambers	Microelectronics and semiconductor device characterization, material interface analysis, and component reliability testing

Computing & Administrative Support	High-Performance Computing Clusters; Student Computer Labs; Smart Classrooms; Laptops for Research; Projectors; Digital Whiteboards; Remote Monitoring Stations; Centralized IT Services	Data analysis, modeling and simulation, real-time sensor data visualization, student training, cross-department collaboration, and administrative management of research activities

Institutional Commitments

PVAMU demonstrates a strong institutional commitment to this initiative by providing dedicated physical space, technical services, and personnel support. The ABMB offers faculty offices, research and teaching labs, smart classrooms, computer labs, and meeting rooms. CARC supports lab operations and outreach, while the Poultry Center and IGRC offer molecular and field-based animal research facilities. In-kind support includes using greenhouses, a feed mill, molecular biology tools, and equipment like GC-MS, ICP-OES, and climate-controlled plant growth systems. PVAMU also provides administrative support for procurement, compliance, and event coordination through centralized research services and college-level staffing. Students and faculty can access a full suite of digital tools, including analytical, statistical, and environmental modeling software.

Cross-Unit Coordination

Governance Structures: To ensure seamless interdisciplinary collaboration, PVAMU will establish a Steering Committee composed of members from CAFNR, CoE, and Arts and Sciences. This committee will oversee strategy, compliance, and progress monitoring. Complementing the committee, thematic Working Groups will manage activities in key areas like sustainability research, molecular biology, and student training. These groups will coordinate lab usage, field deployment, and data sharing. This governance framework enables the university to leverage its full research capacity and achieve the proposed initiative's interdisciplinary goals. These groups will comprise faculty experts, research staff, program coordinators, and technical personnel who meet regularly to coordinate fieldwork, lab activities, data management, and community engagement.

Routine interdepartmental meetings, centralized data management systems, and shared access to equipment and vehicles further enhance coordination. Administrative staff across the units assist

in procurement, scheduling, and compliance reporting, ensuring efficient operations. This integrated governance model fosters collaboration and transparency, enabling PVAMU to maximize institutional resources, promote interdisciplinary research, and deliver impactful outcomes in agricultural sciences and student development.

6. Budget Outline

Cost sharing: We request three postdoctoral fellows, one in each critical domain of climate and soil and energy transition, net-zero design, economic policy, and advanced data analytics. Each fellow fills a non-redundant expertise gap that directly aligns with the proposal's three objectives and provides hands-on mentorship for the FEWSS PhD students. CAFNR will share costs on a 50–50 basis with PIER funds. Each college will provide field instrumentation and extension outreach logistics for the successful completion of the project. Requesting more than two postdocs is justified because each objective requires deep, discipline-specific expertise to meet the deliverables proposed in the research. The budget justification is provided in the table below.

Budget Justification for Postdocs

	Year 1	**Year 2**	**TOTAL**
Person Months	36	36	
# of Postdocs	3	3	
Salary	$180,000	$185,400	$365,400
Fringe	$35,460	$36,523	$71,983
Insurance	$37,188	$37,188	$74,376
Total Fringe	$72,648	$73,711	$146,359
Total Requested Amount (Salary + Fringe + Insurance)			$511,759

The total amount requested for four postdocs for two years is $511,759.

Leverage & Matching: Currently, most CAFNR faculty are funded through the NIFA Evans-Allen program, which will amplify the ECSR research at PVAMU. The Evans-Allen Grant is listed below.

- A Food-Energy-Water-Health Nexus Program for Climate Resilient Limited Resources Communities in Texas (PI: Ali Fares).
- Management of Agriculture, Natural Resources, and Environment using Innovative Approaches (PI: Ripendra Awal).
- Livestock waste management for microalgae and crop cultivation as sustainable agriculture (PI: Atikur Rahman).
- Electrical Conductivity (EC) Variability by Soil Texture and Landscape Position in Texas (PI: Richard Griffin).
- Assessing the U.S. Goat Meat Demand and Consumers' Willingness to Pay (PI: Sunil Dhoubhadel).
- Developing slow-controlled release coated nano-fertilizers and edible coatings (PI: Laura Carson).
- Food Access, Food Safety, and Nutritional Quality: A Comparison of Food and Food Retailers in Rural and Urban Communities of Low Income/Low Food Access (PI: Jennifer Quinlan).
- Dietary incorporation of plant and marine feedstuffs on performance, rumen microbiome, methane emissions, and meat quality of goats (PI: Andres Cervantes).
- Optimize Biochar Application Rate and Crop Production using a Precision Agriculture Approach under South Texas Environment (PI: Ram Ray).

7. Evaluation and Metrics

A robust, multi-tiered evaluation will keep the ESCR cluster, postdoctoral researchers, and the FEWSS Ph.D. program on track. The evaluation process will assess performance and provide feedback to improve the project, and a summative evaluation will be conducted to evaluate and document project impacts and outcomes. Dr. Fares (PI) will assess overall project activities, including contributions from the collaborating colleges, conducting experiments, data collection, and modeling efforts. The project team and the evaluator will meet every six months to monitor and evaluate the timely implementation of project tasks, identify workflow constraints, and document progress toward achieving specific objectives.

Success Indicators: Quantitative metrics capture research productivity, training output, and translation.

- Peer-reviewed publications: ≥ 5 articles (cumulative) in high-impact journals within two years, with at least one-third co-authored across two or more colleges.
- Presentations and conference proceedings: Ten conference presentations and proceedings within two years, with at least one-third co-authored across two or more colleges.
- External funding: $1 million in new competitive awards for ESCR-related projects during the initial two-year period.
- Cross-listed courses developed: ≥ 2 new or redesigned courses that enroll students from at least three collaborating colleges.
- Student mentoring: Each postdoc will mentor at least one graduate and one undergraduate student during their tenure.
- Community workshops & extension bulletins: ≥ 2 workshops and ≥ 5 extension bulletins disseminating best practices to producers and local agencies.
- Technology adoption: Documented uptake of at least two ESCR prototypes, e.g., AI-based micro-irrigation by external partners.
- Interdisciplinary culture: Faculty and postdoc feedback indicates increased comfort and frequency of cross-college collaboration.
- Media & public engagement: ≥ 3 positive media stories or invited talks highlighting PVAMU's leadership in integrated food-energy-water research.

Timeline & Milestones

The proposed project will be conducted over two years, and the proposal's timeline is listed below.

Items	**Year 1**				**Year 2**			
Objective 1 - 3								
Launch ESCR cluster								
Recruit Postdocs								
Midpoint summit								
Workshops								
Annual Evaluation								
Final evaluation summit and close-out report								

Continuous Improvement: After each annual review or summit, the ESCR–FEWSS team will synthesize findings into a concise "lessons learned" memo that documents successes, bottlenecks, and emerging opportunities. Action items, such as reallocating seed funds, revising course content, rebalancing graduate-assistant lines, or updating project timelines, will be assigned owners and due dates and then tracked in a shared project-management dashboard. Midpoint feedback from community workshops and extension agents will trigger rapid-response adjustments. Institutional learning will be captured through seminars hosted by PVAMU's Office of Research & Innovation, ensuring that methods, data standards, and stakeholder engagement protocols are retained and propagated across future projects.