DataFEWSion

Traineeship for Innovations at the Nexus of Food Production, Renewable Energy, and Water Quality

2023 Annual Report

Notes from the Program Director

In our final year of overlapping cohorts, we have conducted our second round of first year workshops, held our third annual symposium, and enjoyed increasing student leadership of the learning community.

Having nearly doubled the number of trainees from last year, including four new disciplines, we've experienced the welcome challenge of finding large enough meeting spaces and the less welcome scheduling headaches.

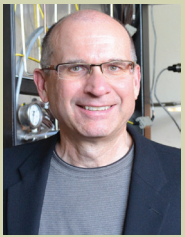
As our thoughts turn towards sustaining program elements after the NSF funding ends, it is gratifying to witness the development of the Graduate College Emerging Leaders Academy, aimed at students with broad career aspirations in industry, government, NGOs, entrepreneurship, and academia, and emphasizing collaboration, diversity, and communication.

The engagement of our trainees and enthusiasm of our external advisors affirm the value of these efforts. Creativity and some resources can keep them going.

Leadership Team

Sarah Ryan, PI
Industrial and Manufacturing Systems Engineering

Operations research; data-driven decision models

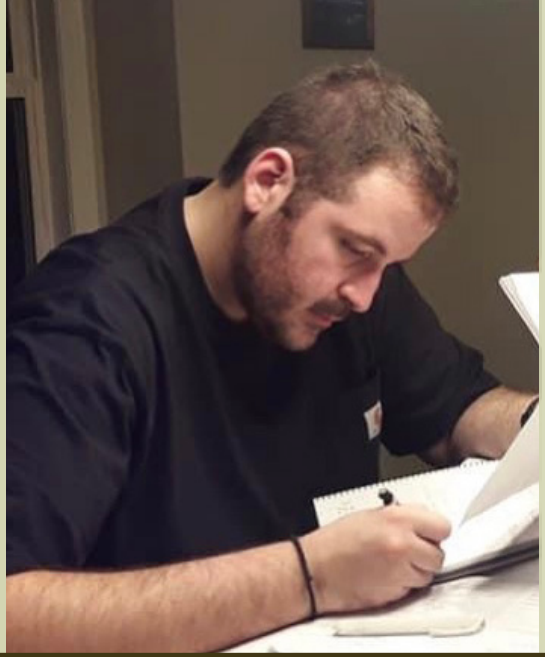


Robert Brown
Bioeconomy Institute

Fuels, chemicals, and power from biomass

Amy Kaleita
Agricultural & Biosystems Engineering

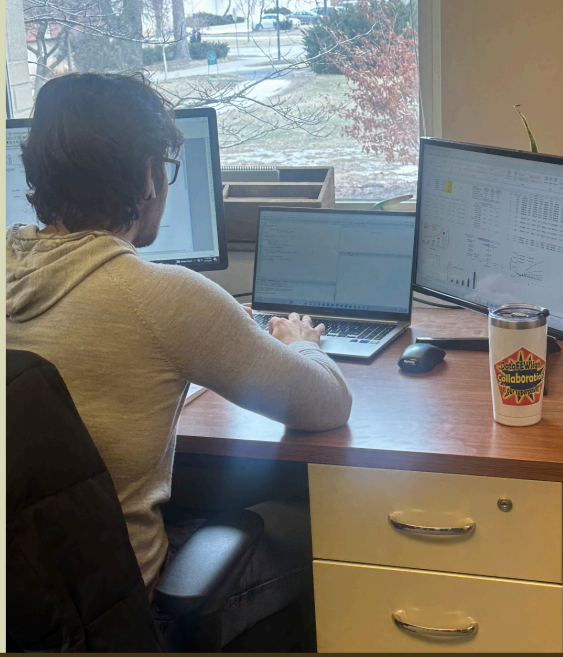
Ag land and water resources conservation engineering



The DataFEWSion program is a National Research Traineeship sponsored by the National Science Foundation Division of Graduate Education.

The project goals are:

- Foster interdisciplinary research based on data-intensive methods
- Educate STEM graduate students for a range of research, research-related and entrepreneurial careers employing data-driven modeling at the FEWS nexus.
- Prepare STEM graduate students to work effectively in multidisciplinary teams, communicate effectively with stakeholders, and identify economically sustainable innovations.



Sergio Lence
Economics

Ag economics, welfare and market analysis

Michelle Soupir
Agricultural & Biosystems Engineering

Water quality and watershed management

Cameron MacKenzie
Industrial and Manufacturing Systems Engineering

Decision and risk analysis

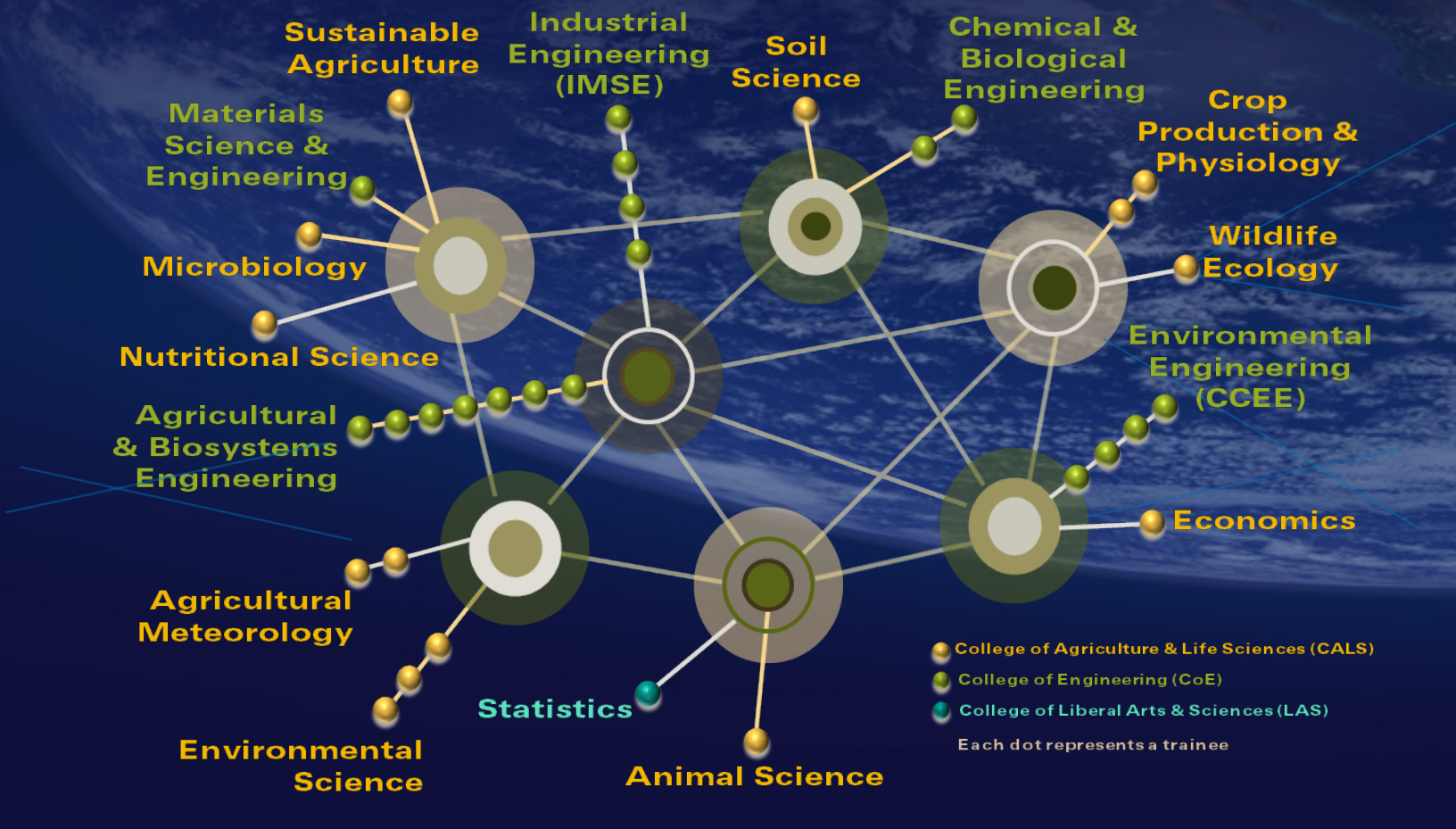
What is a Traineeship?

The DataFEWSion traineeship starts with the strong foundation of the student's research in the FEWS nexus. Layered on top of that is a graduate certificate with a focus on data analytics and decision making. To augment the certificate, a two-year series of workshops are offered, providing unique opportunities for professional development and interactions with stakeholders. The trainees document their learning in an ePortfolio. And finally, the heart of the traineeship is the learning community, where they practice the skills learn and look for collaboration opportunities. The most important part of a traineeship is the trainees, who are highly motivated and talented graduate students with a commitment to interdisciplinary collaboration.

Selected Ph.D. trainees receive funding packages that cover tuition, living expenses, and health insurance for a year. We also have unfunded trainees, who are international or master's students not eligible for this funding.

DataFEWSion Graduate Traineeship Framework

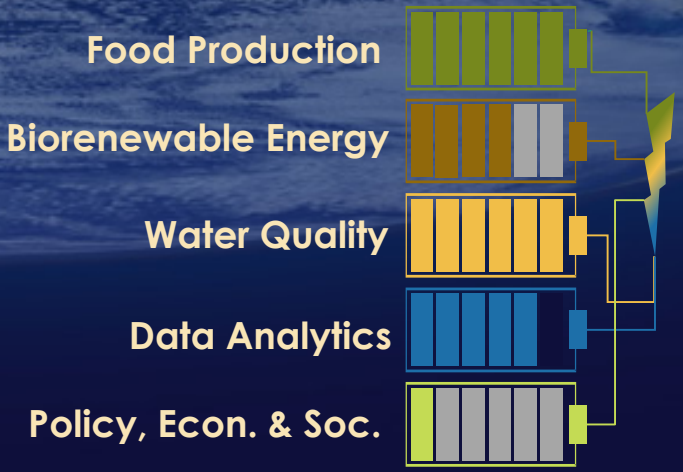
Diverse Disciplines, Domains, Demographics, and Directions



Anticipated Career Paths

Numbers represent actual employment

FEWS Collaboration Potentials



(data represents all cohorts)

Cohort 3

Ghazal Shah Abadi

Industrial & Manufacturing Systems Engineering
Advisor: Dr. Sarah Ryan

My research interests are Operations Research and Mathematical Programming and applying them to real-world problems. Also, I am interested in considering uncertainty in my research. I am currently working on the reliability assessment of scenario sets generated by different scenario generation methods.

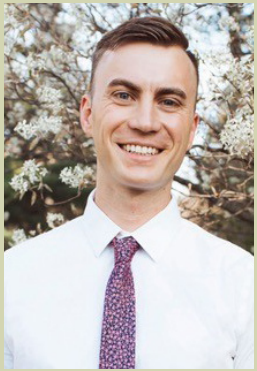
Fatemeh Ganji

Civil, Construction and Environmental Engineering
Advisor: Dr. Lu Liu

My interest areas are climate change and its effects, as well as the Water-climate-energy nexus. I worked on investigating climate change's impact on surface water resources in my master's. Currently, I am exploring integrated assessment modeling (e.g., GCAM) to assess future electricity and water demand under different climate change and socio-economic development.

Logan Johnson

Animal Science
Advisor: Dr. Steven Lonergan



My research interest is discovering and characterizing molecular factors that impact fresh pork quality, including tenderness, water-holding capacity, and color. By understanding these factors, we can select livestock and implement production practices to improve the efficiency of livestock production and the quality, safety, and shelf-life of meat products.

Alexandra Barron

Chemical and Biological Engineering
Advisor: Dr. Robert Brown

Broadly, I am interested in scaling new, environmentally relevant technologies for application in the commercial arena.I am working to produce animal feed from carbon dioxide waste by growing single-cell protein through gas fermentation.

Júlia Brittes Tuthill

Agricultural and Biosystems Engineering
Advisor: Dr. Amy Kaleita

My research is in collaboration with the IFEWs research group, who are developing an Iowa Food-Energy-Water simulation model. We are creating the database and visualization tools to observe the relationship between agricultural products (food, feed, biofuels) and water quality through nitrogen export for decision-making.

Matt Kavanaugh

Agricultural Meteorology
Advisor: Dr. Brian Hornbuckle

My present research focuses on analysis of how the water content in soil and crops changes throughout the growing season. I am using these findings to validate soil moisture measurement tools such as remote sensing satellites around critical times of the year, including the spring planting season and the fall harvest.

Nicole Kling

Interdepartmental Graduate Program in Nutritional Sciences
Advisor: Dr. Lorraine Lanningham-Foster

Consumers already have a lot to consider when buying food, such as cost, nutrition, and personal preference, so education on the environmental impacts of food choices likely won't lead to change. It is my goal to make it easier for consumers to select more nutritious and environmentally friendly options.

Angelos Lagoudakis

Economics
Advisors: Drs. Dermot J Hayes & Elizabeth Hoffman

My research focuses on food and health economics and consumer and producer behavior. I employ applied microeconometrics and experimental economics methods to answer questions relevant to applied economists, data analysts, and policymakers.

Emmanuel Padmore Mantey

Civil, Construction and Environmental Engineering
Advisor: Dr. Lu Liu

My research aims to build an inventory that quantifies the water available for reuse. I will collect data from stormwater, agricultural runoff and return flow, municipal wastewater, and rainwater to combine the data into one body across attributes, like spatial and temporal resolution, for consistency and level of detail in a data structure.

Luke Soko

Agricultural & Biosystems Engineering
Advisor: Dr. Dan Andersen

My research involves increasing the practicality of anaerobic digestion, in particular, investigating how different farm sizes, travel distances, conveyance methods, digester types, and feedstocks impact revenue. I create models to determine the profitability of anaerobic digesters given different scenarios; I assemble and operate lab-scale plug-flow and mixed anaerobic digesters.

Connor Thorpe

Materials Science and Engineering
Advisor: Dr. Shan Jiang

My research focuses on improving the delivery of biological reagents into plant cells using biolistic delivery. Using advanced computational fluid dynamic simulations, I am designing and developing new tools that enhance cell transfection rates while reducing the overall error in the system commonly attributed to experiments with biological tissues.

Elmin Rahic

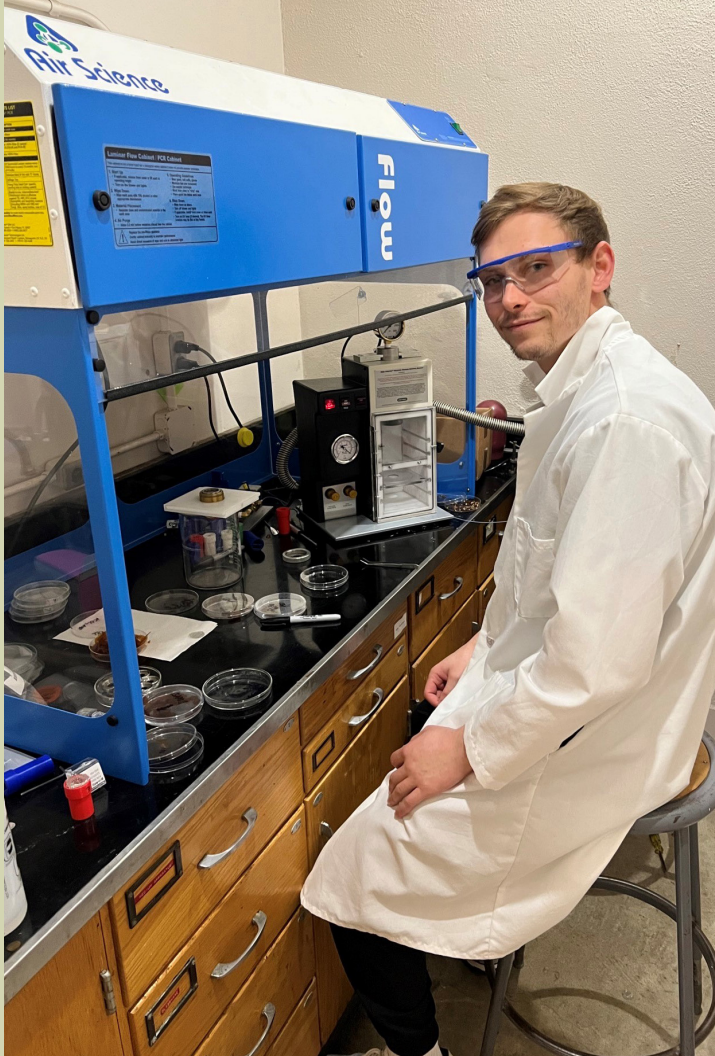
Agricultural and Biosystems Engineering
Advisors: Drs. Zhiyou Wen & Robert Brown

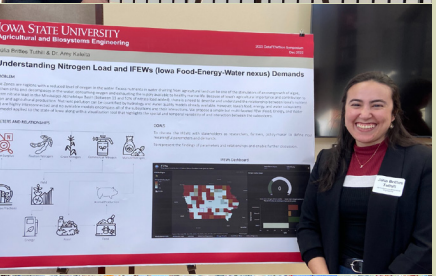
My research focuses on developing value-added coproducts in biomass-based systems, including pretreatment for herbaceous biomass that simultaneously improves its bioavailability for anaerobic digestion and extracts high-value chemicals, enzyme production from pyrolysis waste streams, and developing probiotics for chickens & pigs to mitigate the toxicity of mycotoxins in their feed.

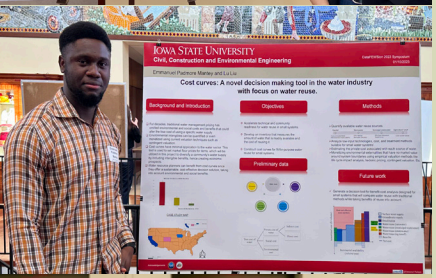
Taylor Vroman

Environmental Science
Advisor: Dr. Michelle Soupir

I am interested in using new technology to combat changes made to freshwater aquatic systems by terrestrial systems. My research focuses on optimizing woodchip bioreactors as an edge-of-field conservation practice. Our goal is to obtain a deeper understanding of how bioreactors' microbial communities operate to develop a more effective system.







Year 1 During our planning year, we established a graduate certificate, hired a project manager and recruited eight trainees. **9/1/2018**

Year 2 The first cohort developed professional skills and built interdisciplinary relationships through the learning community and Workshop Series 1: Your role in the FEWS Nexus. **9/1/2019**

Year 3 The second cohort of six new trainees joined cohort 1 in the learning community, Workshop Series 2, the first Symposium, and the newly developed communication course. During COVID, meetings were held through Zoom. **9/1/2020**

Year 4 The third cohort of seven new trainees joined cohort 2, taking more ownership of the learning community by leading trainings and topical discussions. A fall networking weekend was added to address the lack of connections during COVID. Nine external advisory board members joined students and faculty in person at our second annual symposium. **9/1/2021**

Year 5 The final cohort of thirteen new students joined the program. The students continued to plan and lead activities, including designing the successful symposium, providing guidance on workshops, and offering student-led trainings. The strong bonds made during orientation and networking weekend continued throughout the year. **9/1/2022**

Year 6 Wrap up training cohort 4 and implement plans for institutionalization. **9/1/2023**

Workshop Series 2: Effecting Change in the FEWS Nexus

Fall 2022	Topic	Presenters
Sept	Decision Analysis	Cameron MacKenzie, IMSE, ISU
Oct	Stakeholder Engagement	Carmen Bain, CALS Associate Dean of Academic Innovation
Nov	Entrepreneurship in the FEWS nexus	Kevin Kimle: Director, Start Something College of Agriculture and Life Sciences David Sly: Director, Start Something College of Engineering
Spring 2023		
Feb	Data Visualization	Anabelle Laurent, Corteva
Mar	Radical Interdisciplinary Collaboration	Robert Brown, ISU Bioeconomy Institute
Apr	FEWS Policy Roundtable	Brian Campbell, Executive Director, Iowa Environmental Council Shawn Richmond, Conservation & Natural Resources Policy Advisor, Iowa Farm Bureau Adam Schnieders, Iowa DNR, Water Quality Resource

Cohort 4 Orientation

Orientation

Cohort 4 learned about leadership style with Jen Leptien from CELT, who guided them through the results of the Clifton Strengths Finder. After lunch with the leadership team, Cohorts 1, 2, & 3, and their faculty advisors, they put it into practice at an escape room.

Learning Community

The students continued with ownership of the weekly meetings by planning and taking the lead on the symposium, workshops and the learning community.

Topics Led by Students

Introduction to Web of Science

Sustainability Professional and why

Nutritionist link to FEWS

Chat GPT what you should know

Strategies for science using board games

Data analytics

Documentary and discussion: Cowspiracy & Rotten

Service Project: Food at First

Facility Tours: Ames Resource Recovery, ISU Brewery Lab, & Ames Wastewater Treatment Plant

Fatemeh Ganji, Michelle Soupir, Kyle DeLong, and Nicole Kling represented DataFEWSion at the 2022 NRT Conference in Blacksburg, VA.

Cohort 3 & 4 Networking Weekend

The connections continued during the networking weekend near Pine Lake State Park. Games, a campfire, cooking, and canoeing, combined with research talks, provided opportunities to learn more about each other's research to explore collaboration potentials.

2023 Symposium: Harnessing the Data Revolution

Highlights

Keynote:
Sustainable Technology DiFEWSion: Case Studies in Irrigation, Solar Power, and Diet, by Rob Anex, University of Wisconsin-Madison.

Workshops:
- Data: Structure and Management in a Multi-Agency Project, by Brandon Schlautman and Bo Meyering from The Land Institute.
- Project Management: It's Not All About the Math, by Michael Helwig from ISU.

Networking:
The students proposed a "connection board" similar to those from crime scene dramas, resulting in multiple conversations extending beyond the conference. The final connection board is displayed on the next page.

Poster Session:
Titles listed to the right.

Alexandra Barron	Utilization of Waste Biogenic Carbon Dioxide for Production of Single Cell Protein
Alex Cleveringa	Absolute Yield Instead of Relative Yield for Fertilizer Recommendations?
Angelos Lagoudakis	Food Access Inequality: Store Choices, Distance from Retailers, Food Away from Home, and Health Outcomes
Connor Thorpe	Identifying Factors that Determine Effectiveness of Delivery Agents in Biolistic Delivery Using a Library of Amine-Containing Molecules
Elmin Rahic	Valorization of Biomass Through Pretreatment and Coproducts: A Biorefinery Approach
Emmanuel P. Mantey	Cost curves: A novel decision-making tool in the water industry with focus on water reuse.
Fatemeh Ganji	Implications of climate change mitigation and socioeconomic development on the US electric power sector
Gabrielle Myers	Can perennial groundcover (PGC) decrease nutrient export through subsurface drainage without negatively impacting corn yields?
Ghazal Shah Abadi	Reliability Assessment of Scenarios for CVaR Minimization for energy management system of microgrids in a chemical industry
Holly Loper	How Well Can We Predict Nitrous Oxide Emissions? A Mesocosm Test
Jarrett Morrison	Modelling the resilience of Houston's wastewater treatment system under wet weather conditions
Júlia Brittes Tuthill	Iowa Food-Energy-Water nexus (IFEWs) – a Data Synthesis, a Model Update, and a Visualization Tool
Kelly Thompson	Daily Erosion Project Ground-Truth Analysis Through Its Application on Strips Sites
Kyle DeLong	Validating Soil Moisture with Farmers in Mind: A New Validation Approach for Soil Moisture Remote Sensing in the Corn Belt
Logan Johnson	Utilizing Proteomic and Metabolomic Data to Predict Fresh Pork Loin Quality
Luke Soko	Farm size impacts economic feasibility of impermeable cover to biogas systems
Matt Kavanaugh	Developing a Dynamic Planting and Harvesting Algorithm in order to Improve SMAP Soil Moisture Retrievals
Motahareh Kashanian	Chemical supply chain network design from biomass using green electrochemistry
Nicole Kling	Assessment and Promotion of Environmentally Sustainable and Healthy Dietary Patterns
Richard Magala	Using APSIM to model soil carbon and GHG emissions Agricultural landscapes to evaluate best practices
Taylor Vroman	Microbial Communities as a Pathway to Improved Woodchip Bioreactor Design and Performance

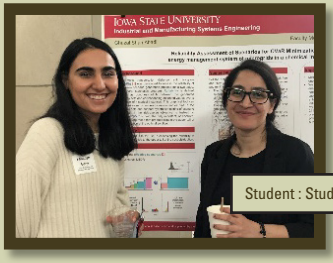
n: Informed Policy for Society and the Environment

Student : Leadership

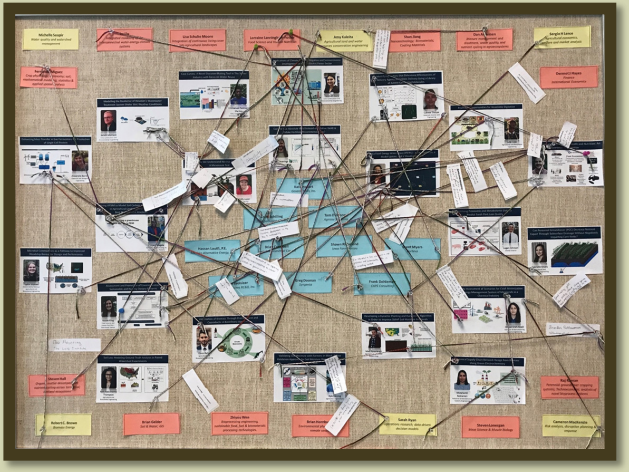
Faculty : Leadership

Alumni : Alumni

Board : Leadership



Student : Student



Student : Student

Student : Workshop Presenter

Faculty : Board

Student : Board

Publications

Stone TF, Thompson JR, Rosentrater KA, Liebman M. Modeling a localized metropolitan food system in the Midwest USA: Life cycle impacts of scenarios for Des Moines, Iowa. Sci Total Environ. 2023 Mar 20;865:161095. doi: 10.1016/j.scitotenv.2022.161095. Epub 2022 Dec 29. PMID: 36587659.

Congilosi, J., Wallace, J., Neher, T., Howe, A., Soupir, M., & Aga, D. (2022). Co-occurrence of antimicrobials and metals as potential drivers of antimicrobial resistance in swine farms. Frontiers in Environmental Science. Volume 10 - 2022 | https://doi.org/10.3389/fenvs.2022.1018739

M Kobiyama, MR Fagundes, B T. M., TF Stone, CW Corseuil, Integrative approach for risk and disaster reduction: the Water-Energy-Food-Disaster-Ecosystem Nexus, November 2022. In book: Ensino de Geografia e a Redução do Risco de Desastres em espaço rural e urbano (pp.https://doi.org/10.57243/BHUG1272)

McEachran AR, Dickey LC, Rehmann CR, Isenhart TM, Groh TA, Perez MA, Rutherford CJ. Groundwater flow in saturated riparian buffers and implications for nitrate removal. J Environ Qual. 2023 Jan;52(1):64-73. doi: 10.1002/jeq2.20428. Epub 2022 Dec 21. PMID: 36333932.

Kazaz, B., Schussler, J. C., Dickey, L. C., & Perez, M. A. (2022). Soil Loss Risk Analysis for Construction Activities. Transportation Research Record, 2676(6), 503–513. https://doi.org/10.1177/03611981221075027

G. Emirhüseyinoglu & S. M. Ryan (2022) Farm management optimization under uncertainty with impacts on water quality and economic risk, IISE Transactions, 54:12, 1143-1160, DOI: 10.1080/24725854.2022.2031351

Magala, R., Tyndall, J., Schulte-Moore, L., Learning About Ecosystem Services with PEWI: Student Reflections, https://doi.org/10.31274/dr-20221018-0

Hjort, R., Soares, R., Li, J., Jing, D., Hartfiel, L., Chen, B., Belle, B., Soupir, M., Smith, E., Mclamore, E., Claussen, J., & Gomes, C. (2022). Hydrophobic laser-induced graphene potentiometric ion-selective electrodes for nitrate sensing. Microchimica Acta. 189. 10.1007/s00604-022-05233-5.

Conference Papers

H Loper, CG Tenesaca, and SJ Hall, Environmental Controls on Mid-western Agricultural Nitrous Oxide. https://agu.confex.com

G Myers, DS Andersen, DR Raman, Cost assessment of centralizing a swine manure and corn stover co-digestion system for biogas production, 2021 ASABE Annual International Virtual Meeting

KN Nascimento Thompson, DE Herzmann, BK Gelder, RM Cruse, & DC Flanagan, The Daily Erosion Project Going Global: Analyzing Distinct Precipitation Datasets, 2023, Conference: Soil Erosion Research Under a Changing Climate

Other

Brighenti, T., T. Stone, P. Gassman, and J. Thompson. 2022. "Increasing Local Production of Table Food in Iowa to Improve Agricultural Sustainability: A Food-Energy-Water Systems (FEWS) Project Case Study." Agricultural Policy Review, Fall 2022. Center for Agricultural and Rural Development, Iowa State University. Available at www.card.iastate.edu/ag_policy_review/article/?a=150.

Zimmerman, Emily & Magala, Richard & Schulte, Lisa & Tyndall, John & James, David. (2022). Carbon Science for Carbon Markets: Emerging Opportunities in Iowa. Chapter 8. Agricultural Carbon Planning.

Products Supported by Travel Grants

Jarret Morrison, L Liu, P Ali, L Stadler, I Musaazi, J Delgado-Vela, D Christenson, and A Shaw, Modeling the enhanced resilience of Houston's wastewater system under wet weather enabled by emerging technologies, Association of Environmental Engineering and Science Professors (AEESP) conference 2022

DeLong, Kyle, Hornbuckle, B. K., Wang, J., Herzmann, D., & Cosh, M. (2022) Validating Soil Moisture with Farmers in Mind: A New Validation Approach for Soil Moisture Remote Sensing in the Corn Belt [Abstract]. ASA, CSSA, SSSA International Annual Meeting

Fatemeh Ganji, Implications of Climate Change Mitigation and Socioeconomic Development on the US Electric Power Sector, AGU Fall Meeting 2022

Alex Cleveringa, Absolute Yield Instead of Relative Yield for Fertilizer Recommendations? 2023 MEA (Midwest Economics Association) Annual Conference

Alexandra Barron, Carbon Management by Gas Fermentation of Single Cell Protein, Water for Food Global Conference, 2023

Gabrielle Myers, First year outcomes of field trials to evaluate N export from perennial groundcover corn systems, Iowa Water Conference 2022

Holly Loper, CG Tenesaca, SJ Hall, How Well Can We Predict Nitrous Oxide Emissions from Common Nitrogen Measurements? A Mesocosm Test, American Geophysical Union (AGU) Fall 2022 Meeting

Lindsey Hartfiel, Spatial Pollutant Interactions within a Dual-Chamber Denitrification Bioreactor American Society of Agricultural and Biosystems Engineers (ASABE) Annual International Meeting, 2022

Timothy Neher, Prediction of an antibiotic resistance gene with random forest in an agricultural watershed, American Society of Microbiology 2022

Dissertations

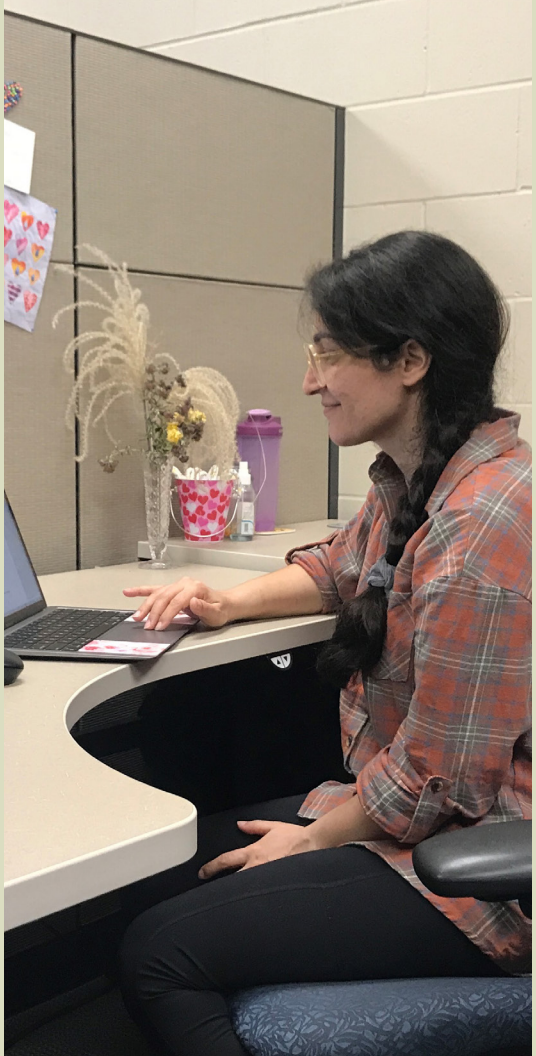
Charles Jacob Labuzzetta, Practical methods for the advancement of precision conservation via land cover classification and conformal prediction, 2022

Lindsey Marie Hartfiel, Influence of denitrification bioreactor design on cost, performance, and potential for pollution swapping, 2022

Görkem Emirhüseyinoglu, Insights from stochastic programs on aligning farmer profit motive with environmental goals, 2022

Meyer Patrick Bohn, Precision land surface analysis and machine learning for enhanced soil maps: Strengthening the foundation for agroecosystems research, 2022

Chih-Yuan Chu, Text analytics for supply chain risk management, 2022



Awards

NSF Graduate Research Fellowship Program Award

Alexandra Barron

Taylor Vroman (honorable mention)

SWCS 2022 Annual Conference, Select Student Moderator

Kelly Nascimento Thompson

2022 Council for Agricultural Science and Technology (CAST) Science Communication Scholars

Angelos Lagoudakis

Holly-Loper

ISU 3MT finalist

Holly Loper

2022 ASABE Student Competition

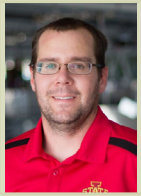
Lindsey Hartfiel

Gabrielle Myers

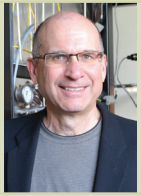
International Foundation for Research in Experimental Economics (IFREE) Research Grant

Angelos Lagoudakis

Faculty Advisors



Dan Andersen
ABE

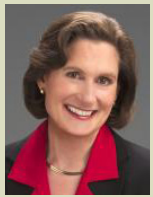


Robert Brown
CBE

Brian Gelder
ABE

Steven Hall
EEOB

Dermot Hayes
Economics



Elizabeth Hoffman
Ecomonics

Brian Hornbuckle
Agronomy

Shan Jiang
MSE

Amy Kaleita
ABE

Lorraine Lanningham-Foster
FS HN

Lu Liu
CCEE

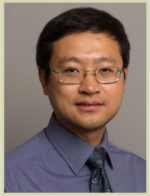
Steven Lonergan
Animal Science

Fernando Miguez
Agronomy

Raj Raman
ABE

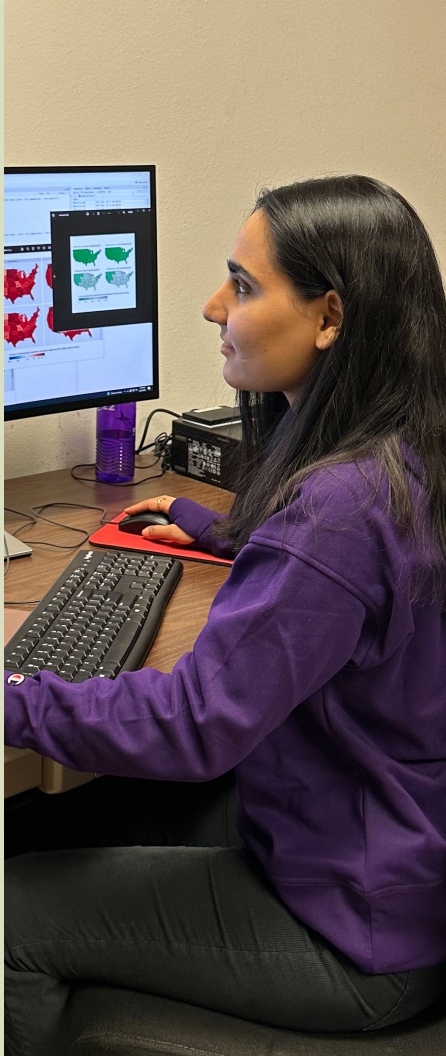
Sarah Ryan
IMSE

Michelle Soupir
ABE



Zhiyou Wen
FS HN

ABE: Agriculture and Biosystems Engineering, CBE: Chemical and Biological Engineering, EEOB: Ecology, Evolution, and Organismal Biology, MSE: Materials Science and Engineering, FS HN: Food Science and Human Nutrition, CCEE: Civil, Construction, and Environmental Engineering, IMSE: Industrial & Manufacturing Systems Engineering



External Advisory Board

Tom D'Alfonso
Agmine

Brian Campbell
Iowa Environmental Council

Frank Dohleman
Climate, Agriculture and Partnerships Solutions Consulting

Ross Evelsizer
Northeast Iowa Resource Conservation and Development

Kara Hobart
General Mills

Hassan Loutfi
Roeslein Alternative Energy

Brent Myers
Corteva Agriscience

Shawn Richmond
Iowa Farm Bureau Federation

Keith Schilling
State Geologist - Iowa

Akash Vidyadharan
Infralytics

With gratitude:

Vice President for Research

College of Engineering

College of Agriculture and Life Sciences

Graduate College Career Services and Center for Communication Excellence

Bioeconomy Institute

Department of Industrial and Manufacturing Systems Engineering

ISU Learning Communities

Iowa State University

The NSF National Research Traineeship (NRT) program encourages the development of bold, new, & transformative models for STEM graduate education training.

This material is based upon work supported by National Science Foundation (NSF) under Grant No. 1828942

For more information
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