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

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2022 Annual Report

Notes from the Program Director

Two highlights of this year were our fall networking weekend and annual symposium.

The fall weekend was aimed at overcoming pandemic isolation as cohort 3 joined the program and we cautiously returned to physical proximity. We enjoyed

- Food, in the form of Friday night pizza, s'mores around a bonfire, and Saturday meals prepared by the trainees;
- Water, which we mostly kept out of our canoes; and positive
- Energy, generated by relaxing and playing together.

In January, our second annual and first-ever face-to-face symposium (with some virtual participants) included two data science workshops, nine advisory board members, and a fascinating keynote by John Crespi titled, "The data revolution is not a knowledge revolution. Yet. How interdisciplinary work will help it get there."

If anyone can pull off a knowledge revolution, it will be this next generation of scholars with their commitment to impactful research. It's a joy to play a part in their preparation.



Leadership Team



Sarah Ryan, Pl Industrial and Manufacturing Systems Engineering

Operations research: datadriven decision models



Robert Brown Bioeconomy Institute

Fuels, chemicals, and power from biomass



Amy Kaleita Agricultural & Biosystems Engineering

Ag land and water resources conservation engineering



Sergio Lence Economics

Ag economics, welfare and market analysis



Michelle Soupir

Agricultural & Biosystems Engineering

Water quality and watershed management



₩ NUSGS



Landsa

Industrial and Manufacturing Systems Engineering

Decision and risk analysis



What is a Traineeship?

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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.

Up to six Ph.D. trainees per year 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



Data Analytics

Policy, Econ. & Soc.

(data represents all cohorts)

Cohort 3



Alex Cleveringa

Agronomy– Crop Production & Physiology Advisor: Fernando Miguez

I am interested in developing tools that provide readily accessible statistical analyses of data generated from on-farm trials across the Midwest. I am also creating an ontology to make the dataset I'm working with findable, accessible, interoperable, and reusable by others.

Kyle DeLong

Agronomy – Agricultural Meteorology Advisor: Brian Hornbuckle

I am highly interested in environmental security, specifically related to the sustainability of agriculture for the use of food, feed for livestock, fiber, and fossil-fuel alternatives. My current research is to validate soil moisture estimators (i.e., microwave satellites and numerical models) in the Corn Belt.

Holly Loper EEOB - Microbiology Advisor: Steven Hall

My research interests lie in improving the ways we study and monitor microbial processes in the environment to help better minimize our detrimental impacts of agriculture on nature. Currently, I am testing the efficacy and sustainability of a novel method of microbial nitrogen fertilization for corn.



Gabrielle Myers

Agricultural & Biosystems Engineering Advisors: Raj Raman & Daniel Andersen

I use technoeconomic modeling and life cycle analysis approaches on three interrelated food, bioenergy, and cropping systems. I am currently engaged in field-work examining the impacts of perennial groundcover systems on water quality from maizeproduction sites.



Jarrett Morrison

Civil, Construction and Environmental Engineering Advisor: Lu Liu

My research focus is on resilience in the water resources sector. I am currently building models to see how implementing new technologies can enhance the resilience of wastewater treatment facilities during increased wet weather events.







Motahareh Kashanian

Industrial and Manufacturing Systems Engineering Advisor: Sarah M Ryan

I am interested in mathematical programming and uncertainties in sustainable energy systems. As an industrial engineer, I want to continue to fill the gaps between Artificial Intelligence, Operations Research, Theories, and Real-World Applications.

Kelly Nascimento Thompson

Agricultural and Biosystems Engineering Advisors: Richard Cruse & Brian Gelder

My research focuses on GIS and Remote Sensing applied to Soil and Water conservation integrating the Daily Erosion Project with the STRIPS project for erosion modeling. Our goal is to ground-truth the Water Erosion Prediction Project (WEPP) model by comparing erosion simulation data collected at the STRIPS h-flumes.





During our planning year, we established a graduate certificate, hired a project manager and recruited eight trainees.

Year 2

Year 3

Year 5

Year 1

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

9/1/2018

The second cohort of six new trainees joined cohort 1 in the learning community, Workshop Series 2: Effecting Change in the FEWS Nexus, the first Symposium, and the newly developed communication course. During COVID, meetings were held through Zoom. Cohort 1 completed the program, with one taking a job in industry, one in academia, and the others continuing in their doctoral programs.

The third cohort of seven new trainees joined cohort 2. The students took more ownership of the Learning Community by leading trainings and topical discussions. The second round of Workshop Series 1: Your Year 4 role in the FEWS Nexus had exceptional presenters. A networking weekend was added in the fall to address the lack of connections during COVID. Nine external advisory board members joined students and faculty in person at our second annual symposium.

> Cohort 4 will join cohort 3 in the learning community and workshop activities. The leadership team will focus on planning for the sustainability of program elements.

Wrap up training cohort 4 and implement plans for Year 6 institutionalization

9/1/2021

9/1/2020

9/1/2022

9/1/2023

2022 Symposium:

Harnessing the Data Revolution: Informed Policy for Society and the Environment

The Symposium began with a thought-provoking keynote by John Crespi, Director of the Center for Agricultural and Rural Development, followed by student presentations and posters, two workshops on data science, and many networking opportunities. Most participants welcomed the opportunity to attend in person, but we also had an online option to include remote participants. Five new external advisory board members joined the event along with four continuing ones.









Year 4 Highlights









New and Improved Learning Community

As the program evolved, the students took ownership of the learning community by presenting "teachable topics," leading topical discussions and helping to select workshop and symposium speakers.

Topics Led by Students

Finding connections in our research

Data sharing principles/ontologies

The logic of scientific discovery

Life cycle assessment: Some of the basics

Dimensional analysis for understanding relationships between variables

Students share IE 690 Experience "Incorporating social equity into food-energy-water system assessments across scales: A review"

Building a website for a GitHub depository

Tips and tricks with R

Writing reports with LaTeX

Other Engagement

Screening & discussion of film "Kiss the Ground'

Author Beth Hoffman discussed her book "Bet the Farm"

ISU Librarian Megan O'Donnell discussed the ethics of data

Cohort 3 Orientation

Networking Weekend









<u>Orientation</u>

Cohort 3 began the year with a one day program orientation. Jen Liepten from CELT guided them through the results of the Clifton Strengths Finder. Science communication with Sara Merritt from Reiman Gardens was next; and for lunch, they met up with their faculty advisors. And finally, they spent the afternoon finding each other's offices and taking pictures with props.

Networking Weekend

The connections continued during the networking weekend near Pine Lake State Park. Games, a campfire, cooking and canoeing provided opportunities to become better acquainted. They also learned more about each others' research to explore collaboration potentials, and got a little more clarification on the DataFEWSion program expectations. Fortunately, everyone went home dry and happy.









Workshop Series 1: Your Role in the FEWS Nexus					
Fall 2021	Торіс	Presenters			
Sept	Career Paths & Planning	Panel: Erin Webb (Oak Ridge National Lab) & Lawrence Mosely (ISU grad, Omni Analytics Group)			
Oct	Branding & Social Media	Panel: Julianne Kellogg (Ph.D. Candidate, Washington State U.) & Adam Janke (NREM) Branding training: Erin Wilgenbusch, Greenlee School of Jour. and Comm.			
Nov	Collaboration: Your Role	Melissa Miller (NIAMRRE Associate Director of Operations)			
Spring 2022					
Feb	Water Quality Roundtable	Rick Cruse (IA Water Ctr.) & Matt Helmers (IA Nutrient Research Ctr.) & Sean McMahon (IA Ag Water Alliance)			
Mar	Renewable Energy Roundtable	Anne Kimber (Dir. ISU's Electric Power Research Ctr.) & Bernie del Campo (ISU PHD grad, who started a biochar company in Iowa)			
Apr	Data Science: Advanced Topics	Brian Gelder (ABE)			



Workshops are the Cornerstone of the Program

The workshops began as hybrid meetings, with Drs. Erin Webb on Zoom and Lawrence Mosely attending in person.



Erin Webb, Oak Ridge National Laboratory



Lawrence Mosely, Omni Analytics Group



Everyone enjoyed meeting fully in person during the spring semester in the new Student Innovation Center.

The conversations after the presentations are the best!



Sean MacMahon, Iowa Water Alliance, talks with Loulou Dickey & Tiffanie Stone



Rick Cruse, Iowa Water Center, talks with Alex Cleveringa and Kyle DeLong

Cohort 4

In August, 2022, we will welcome DataFEWSion's fourth and final funded cohort. These trainees come to us from agricultural & biosystems engineering, animal science, chemical and biological engineering, civil engineering, environmental science, industrial engineering and materials science & engineering.

Research Interests

future career plastic waste current research interest data analysis climate change machine learning technolog ichine learning model research experience researchers impact of land large amount data science water nexus data land usage water quality research interest geo science phd degree energy research groduate sche purified water opportunities amount of data water quality skills data analytics future generatio data science field energy efficienc research scientists wastewater treatment carbon dioxide students working environment machine learning new technology networking edite chnical language policymakers data set food production valuable resources er opportunitie decision modelina wastewater treatment facili











Dan Andersen ABE

Brian Gelder ABE



Bradley Miller

Agronomy







Raj Raman



Lisa Schulte Moore

NREM



Janette Thompson John Tyndall NREM NREM





EEOB

Fernando Miguez ABE Agronomy



Faculty Advisors

Brian Hornbuckle Agronomy



Chris Rehmann CCEE



Lu Liu CCEE



Sarah Ryan IMSE



Emily Zimmerman NREM



2021 Publications

Labuzzetta, Charles; Zhu, Z.; Chang, X.; Zhou, Y. A Submonthly Surface Water Classification Framework via Gap-Fill Imputation and Random Forest Classifiers of Landsat Imagery. Remote Sens. 2021, 13, 1742. https:// doi.org/10.3390/rs13091742

Neher, Timothy, Michelle Soupir, Rameshwar S Kanwar, (2021) "Lake Atitlan: A Review of the Food, Energy, and Water Sustainability of A Mountain Lake in Guatemala." Sustainability. DOI to the paper: https://doi.org/10.3390/ su13020515

Hartfiel, A. Schaefer, A.C. Howe, M.L. Soupir. 2021. Denitrifying Bioreactor Microbiome: Understanding Pollution Swapping and Potential for Improved Performance. Journal of Environmental Quality. doi: 10.1002/jeq2.20302

Hartfiel, L., M.L. Soupir, K.A. Rosentrater. 2021. Technoeconomic analysis of woodchip bioreactors. Transactions of the ASABE. 64(5): 1545-1554. doi: 10.13031/trans.14300

Pasley, Heather, Virginia Nichols, MMichael J Castellano, Matthew J Helmers, Mitchell E Baum, Eileene J Kladivko, Sotirios Archontoulis (2021). Rotating maize reduces the risk and rate of nitrate leaching. Environmental Research Letters.https://doi.org/10.1088/1748-9326/abef8f Thompson J, Ganapathysubramanian B, Chen W, Dorneich M, Gassman P, Krejci C, Liebman M, Nair A, Passe U, Schwab N, Rosentrater K, Stone Tiffanie, Wang Y and Zhou Y (2021) Iowa Urban FEWS: Integrating Social and Biophysical Models for Exploration of Urban Food, Energy, and Water Systems. Frontiers in Big Data, 4:662186. doi: 10.3389/fdata.2021.662186

Summers, Haleigh., Karsten, H.D., Curran, W., Malcolm, G.M. Integrated Weed Management with Reduced Herbicides in a No-till Dairy Rotation. Agronomy Journal. 2021;00:1-16. https://doi.org/10.1002/agj2.20757

2020 Publications

Nichols, Virginia, Lydia English, Sarah Carlson, Stefan Gailans, Matt Liebman. (2020). Effect of long-term covercropping on weed seedbanks. Frontiers in Agronomy 2:20 https://doi.org/10.3389/fagro.2020.591091

Sorensen RM, Jovanovi B. 2021. From nanoplastic to microplastic: A bibliometric analysis on the presence of plastic particles in the environment. Mar Pollut Bull. 163:111926. PubMed PMID: 33348287. DOI: 10.1016/j. marpolbul.2020.111926

McEachran, A.R., Dickey, Loulou C., Rehmann, C.R., et al. Improving the effectiveness of saturated riparian buffers for removing nitrate from subsurface drainage. J. Environ. Qual. 2020; 49: 1624–1632. https://doi.org/10.1002/ jeq2.20160 Hartfiel, Lindsey, M. Soupir, and R.S. Kanwar. "Malta's Water Scarcity Challenges: Past, Present, and Future Mitigation Strategies for Sustainable Water Supplies." Sustainability 12.23 (2020): 9835. The DOI is doi:10.3390/ su12239835

Neher, Timothy P. and Ma, Lanying and Moorman, Thomas B. and Howe, Adina and Soupir, Michelle L.. "Seasonal variations in export of antibiotic resistance genes and bacteria in runoff from an agricultural watershed in Iowa," Science of The Total Environment, v.738, 2020.

Ryan, Sarah M and Soupir, Michelle L and Kaleita, Amy and Lence, Sergio H and Brown, Robert. "NRT-INFEWS: The DataFEWSion Traineeship Program for Innovations at the Nexus of Food Production, Renewable Energy, and Water Quality," 2020 ASEE Virtual Annual Conference, 2020.

Chu, Chih-Yuan and Park, Kijung and Kremer, Gül E.. "Applying Text-mining Techniques to Global Supply Chain Region Selection: Considering Regional Differences," Procedia Manufacturing, v.39, 2019.

Chu, Chih-Yuan and Park, Kijung and Kremer, Gül E.. "A global supply chain risk management framework: An application of text-mining to identify region-specific supply chain risks," Advanced Engineering Informatics, v.45, 2020.

2020 Conference Presentations / Papers

Timothy P. Neher, Lanying Ma, Thomas B. Moorman, Adina C. Howe, Michelle L. Soupir (2020). Seasonal Variations in Export of Antibiotic Resistance Genes and Bacteria in Runoff from an Agricultural Watershed in Iowa. Midwest AMR Consortium.

Matthew Nowatzke, Luis Damiano, Gabe McNunn, Andy VanLoocke, Jarad Niemi, Lisa Schulte-Moore, Emily Heaton (2020). Foresite: Identifying unprofitable farmland for environmental and economic benefit. Soil and Water Conservation Society International Annual Conference.

2019 Conference Presentations / Papers

Timothy Neher (2019). Catchment-scale export of antibiotic resistance genes and bacteria from an agricultural watershed in central lowa. American Society of Agricultural and Biological Engineers.

Awards

2022 Symposium Student Posters and Presentations

2022

Brown Graduate Fellowships Tiffanie Stone, cohort 2 Guy Graduate Fellowship Tim Neher, cohort 1 Lindsey Hartfiel, cohort 1 ISU Graduate College 3MT: Finalist

Holly Loper, cohort 3

Rachel Sorensen, cohort 2

2021 Sposito Computing Award Charles Labuzetta, cohort 1 Brown Graduate Fellowships Meyer Bohn, cohort 2

2019 Guy Graduate Fellowship Tim Neher, cohort 1 **Brown Graduate Fellowships** Virginia Nichols, cohort 1

Travel Grants Awarded

Year	Student	Name of Conference		Location
2022	Gabrielle Myers	ASABE 2022 Annual International Meeting	Presenting	Houston, Texas
2022	Timothy Neher	American Society of Microbiology - Microbe	Presenting	Washington D.C.
2022	5 trainees	Big Data Summer School	Training	ISU campus
2021	Gina Nichols	OpEd Project's 'Write to change the world' seminar	Training	Virtual
2021	Lindsey Hartfiel	GeneralR workshop	Training	Virtual
2021	3 trainees	Big Data Summer School	Training	Virtual
2020	Loulou Dickey	IStorm 2020	Participant	Virtual
2020	Virginia Nichols	Directed Acyclic Graphs for Causal Inference	Training	Virtual

Posters Gabrielle Myers Alex Cleveringa Jarrett Morrison Motahareh Kashanian Holly Loper Presentations Meyer Bohn Kelly Thompson **Richard Magala** Loulou Dickey Kyle DeLong Haleigh Summers

Tiffanie Stone

Emerging Technologies Supply chain design for chemicals from biomass Oxide Emissions from Maize Cropping Systems

Validation of Three Microwave Satellite and Three Reanalysis Soil Moisture Products in the U.S. Corn Belt Considering the Periods when Farmers Make Key Management Decisions Driven by Crop Development Stages. Examining the Potential of Conservation Practices to Maximize Subfield Profitability and Environmental Benefits Modeling Metropolitan Food Systems in the Midwest US: Life Cycle Assessment of Current and Local Scenarios NOTE: more information and videos of each poster or presentation can be found at www.datafewsion.iastate.edu

Cost Assessment of Centralizing a Swine Manure and Corn Stover Co-Digestion System Univariate Analysis of End-of-Season Corn Stalk Nitrate Test Dataset

Enhancing the Resilience of Houston's Wastewater System Under Wet Weather Using

Soil Block Mesocosms: A New Approach for Quantifying Nitrate Leaching and Nitrous

Site-Specific Digital Soil Maps Inputs in Simulating Maize Biomass and Yield VS. the Soul Survey Geographic (SSURGO) Database

The Daily Erosion Project Going Global: Analyzing Distinct Precipitation Datasets

Modeling Ecosystem Services for a New Education Paradigm

Stormwater management opportunities and challenges

External Advisory Board

Tom D'Alfonso Agmine

Brian Campbell Iowa Environmental Council

Frank Dohleman Climate, Agriculture and Partnership Solutions Consulting

> **Greg Doonan** Syngenta

Ross Evelsizer Northeast Iowa Resource Conservation & 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



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