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

2020 Annual Report
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
As we complete our first year of traineeship activities, I am grateful to the leadership team, faculty advisors, project manager Cynthia Lidtke and, most importantly, our first cohort of trainees for their hard work and creativity. The Covid19 pandemic has underscored the importance of connection and the privilege of collaboration to solve important problems. Human health requires nutrition, hydration, and many forms of energy. These future engineers and scientists inspire me by their commitment to finding ways to sustainably provide for all of these needs.
Leadership Team

Sarah Ryan, PI
Industrial & Mfg. Sys. Engineering
Operations research; data-driven decision models
What is a Traineeship?

The DataFEWSion traineeship is composed of three core components. The foundation is the student’s dissertation or thesis research. Layered on top of that is a new graduate certificate with a focus on data analytics and decision making. And finally, the heart of the traineeship is the learning community, which we’ve adapted from the very successful undergraduate learning communities at ISU.

Up to six PhD trainees per year receive assistantships that cover tuition, living expenses, and health insurance for a year. We also have unfunded trainees who are mostly international students not eligible for this funding.

The most important part of a traineeship is the trainees. Here is our first cohort, who are completing their first year of the two-year program.
**Garrison Gunter**  
Chemical Engineering  
Research Interest:  
*Developing pyrolysis plants, capable of effectively converting waste biomass into biofuel and value added chemicals*  
Advisor:  
Dr. Robert Brown

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**Lindsey Murry**  
Ag & Biosystems Eng.  
Research Interest:  
*Agricultural practices to improve water quality through agricultural engineering methods.*  
Advisor:  
Dr. Michelle Soupir

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**Matthew Nowatzke**  
Crop Prod. & Physiology  
Research Interest:  
*The intersection of data science, agriculture, and human-centered design to identify models and systems that couple human decision-making with sound agricultural and environmental practices*  
Co-Advisors:  
Dr. Emily Heaton & Dr. Andy VanLoocke

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**Timothy Neher**  
Ag & Biosystems Eng.  
Research Interest:  
*Antibiotic resistance indicators as they relate to quantities used by livestock owners; evaluation of in-field or edge-of-field practices that may reduce resistance indicators; and economic benefits to farmers*  
Advisor:  
Dr. Michelle Soupir
Virginia “Gina” Nichols
Crop Prod. and Physiology
Research Interest:
Quantifing the benefits of diverse crop rotations on environmental, social, and economic scales.
Co-Advisors:
Dr. Matt Liebman
Dr. Satirios Archontoulis

Chin-Yuan “Jeff” Chu
Industrial Engineering
Research Interest:
Data analytic tools that manage supply chain risk in the FEWS nexus to help farmers, companies, and policymakers develop innovative and sustainable solutions
Advisor:
Dr. Gül Kremer

Görkem Emirhüseyinoğlu
Industrial Engineering
Research Interest:
Investigating land use and management decisions to reduce nutrient runoff while maximizing agricultural profit under market and precipitation uncertainty
Advisor:
Dr. Sarah Ryan

Charlie Labuzzetta
Statistics
Research Interest:
Statistical analysis of satellite imagery for monitoring natural resources and best management practices
Advisor:
Dr. Zhenguan Zhu
Diverse Disciplines, Domains, Demographics, and Directions

Cohort 1

- Toxicology
- Chemical Eng.
- Statistics
- Crop Prod & Physiology

Cohort 2

- Sustainable Ag
- Industrial Eng.
- Soil Science
- Ag & Biosystems Eng.
- Civil Eng.
FEWS Collaboration Potentials

- Food Production
- Biorenewable Energy
- Water Quality
- Data Analytics
- Policy, Econ, & Soc

Anticipated Career Paths

- Academia/Extension
- Academia/Research
- Entrepreneur
- Industry
- NGO

Demographics

- Under-represented populations
- International work experience
- First generation college students
- International students

Cohort 1

- Female

Cohort 2

- Male
During our planning year we established a Graduate Certificate, hired a project manager and recruited eight trainees.

## Year 1
2018-19

### Graduate Certificate in Data-Driven Food, Energy, and Water Decision-Making

#### Core Courses (required)
- ABE 615: Biosystems for Sustainable Development
- GR ST 566: Communications in Science
- AGRON/BCB/EE/ENGR/ME 693: Entrepreneurship for Graduate Students in Science and Engineering

#### Data acquisition, visualization & analytics (select 1)
- ABE 504: Instrumentation for Ag. & Biosystems Engineering
- E E 525X: Data Analytics in Elect. & Comp. Engineering
- IE 583: Data Mining
- IE 592X: Analytics Projects for Improved Decision Making in the Service Sector
- STAT 575: Methods of Multivariate Analysis
- STAT 585: Methods of Multivariate Analysis

#### Complex systems modeling for decision support (select 1)
- ABE 580: Engineering Analysis of Biological Systems
- IE/E AER E 565: Systems Engineering & Analysis
- IE 564: Decision Analysis in System Design
- IE/AER E 568: Large-Scale Complex Engineered Systems
- ME 525: Optimization Methods for Complex Design
- AGRON 525: Crop & Soil Modeling

#### Economics, Policy & Sociology of FEWS (select 1)
- BRT/POL 516: Biorenewables Law & Policy
- ECON 580: Intermediate Environmental & Resource Economics
- M E 510: Econ. & Policy of Engineering Energy Systems
- SOC 544: Sociology of Food & Ag Systems
- SOC 549: Sociology of the Environment
- JL MC 574: Communication Tech & Social Change
- NREM 570: Advanced Decision-Making in Natural Resource Allocation
A two-year alternating series of monthly workshops compose part of the learning community. This past year, we focused on professional development and communication in the fall. In the spring, we brought in panels of experts on water quality and bioenergy.

Weekly small group sessions form the second component of the learning community. Students conduct peer review on writing projects, discuss their research, and take turns chairing the meetings.

### Workshop Series I

<table>
<thead>
<tr>
<th>Year 2 2019-20</th>
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<tbody>
<tr>
<td><strong>Fall: Your Role in the FEWS Nexus</strong></td>
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<tr>
<td>• Career Paths and Planning</td>
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<td>• Establishing Your Brand</td>
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<td>• Interdisciplinary Communication</td>
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<td><strong>Spring: Stakeholder Listening Sessions</strong></td>
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<tr>
<td>• Agriculture &amp; Water Quality</td>
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<td>• Agribusiness &amp; Bioenergy</td>
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<td>• Policy Impacts (canceled by COVID19)</td>
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Year 2 Highlights

Water Quality Workshop

Stakeholder Meetings

Orientation Team Building

Branding Workshop

BioEnergy Workshop

Workshop
Pandemic Challenges

1. Creative approaches to connecting and collaborating
2. Alternative symposium format
3. Intellectual closeness with physical distance
We will welcome six new trainees, offer the graduate communication class for the first time and present the second workshop series to focus on Effecting Change in the FEWS Nexus.

The students will continue to meet in small groups, leading discussions, and providing training to each other in their fields of expertise.
Faculty Advisors
(Cohort 1)

Robert Brown
BEI

Michelle Soupir
ABE

Emily Heaton
Agronomy

Gül Kremer
IMSE

Matt Liebman
Agronomy

Sarah Ryan
IMSE

Andy VanLoocke
Agronomy

Sotirios Archontoulis
Agronomy

Zhengyuan Zhu
Statistics
Industry Advisory Board

Karen Crosby, Southern U and A&M
Zahed Siddique, U of Oklahoma
Tonya Smith-Jackson, N. Carolina A&T
Heidi Taboada, U of Texas at El Paso

Diversity Advisory Board

Akash Vidyadharan
Founder and Chief Technology Officer

Greg Doonan
Head of Novel Algorithm Advancement

Hassan Loutfi
R&D Manager

Frank Dohleman
Open Innovation Lead

Tom D’Alfonso
President

Kara Hobart
Senior R&D Engineer
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
Iowa Nutrient Research Center
Iowa Water Center
Learning Communities
Predictive Plant Phenomics (P3) Traineeship
Reiman Gardens
Workspace
The NSF National Research Traineeship (NRT) program encourages the development of bold, new, & transformative models for STEM graduate education training.

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Photo by Jack and June Schmidt