NRT-INFEWS: The DataFEWSion Traineeship Program for Innovations at the Nexus of Food Production, Renewable Energy and Water Quality

ABSTRACT

Agriculture lies at the heart of interactions among food, energy and water systems. It is an increasingly energy-intensive enterprise, but it is also a growing source of energy. Agriculture places large demands on water supplies while poor practices can degrade water quality. Each of these interactions creates opportunities for modeling, driven by sensor-based and qualitative data collection, to improve the effectiveness of system operation and control in the short term as well as investments and planning for the long term. The large volume and complexity of the data collected creates challenges for decision support and stakeholder communication. This National Science Foundation Research Traineeship (NRT)
award to Iowa State University will build a community of researchers that explores, develops and implements effective data-driven decision-making to efficiently produce food, transform primary energy sources into energy carriers, and enhance water quality. The project anticipates training forty-eight (48) MS and PhD students, including twenty-four (24) funded PhD trainees, from agricultural and biosystems engineering, agronomy, industrial engineering, mechanical engineering and natural resources ecology and management. The project aims to prepare trainees for multiple career paths such as research scientists, bioeconomy entrepreneurs, agribusiness leaders, policy makers, agriculture analytics specialists, or professors.

Sustainable provision of food, energy and clean water requires understanding the interdependencies among systems as well as the motivations and incentives of farmers and rural policy makers. Effective innovation at the nexus of these food, energy and water (FEW) systems requires data-rich system modeling with analytic capabilities for diverse types of data. The traineeship has four key components. First, trainees will complete a new graduate certificate to build competencies in fundamental understanding of interactions among food production, water quality and bioenergy; data acquisition, visualization, and analytics; complex systems modeling for decision support; and the economics, policy and sociology of the FEW nexus. Second, they will conduct interdisciplinary research on (a) technologies and practices to increase agriculture's contributions to energy supply while reducing its negative impacts on water quality and human health; (b) data science to increase crop productivity within the constraints of sustainable intensification; or (c) decision sciences to manage tradeoffs and promote best practices among diverse stakeholders. Third, they will participate in a new graduate learning community consisting of a two-year series of workshops that focus in alternate years on the context of the Midwest agricultural FEW nexus and professional development. Fourth, they will have small-group experiences to promote collaboration and peer review. Each trainee will create and curate a portfolio that combines artifacts from coursework and research with reflections on the broader impacts of their work.

The NSF Research Traineeship (NRT) Program is designed to encourage the development and implementation of bold, new potentially transformative models for STEM graduate education training. The program is dedicated to effective training of STEM graduate students in high priority interdisciplinary research areas through comprehensive traineeship models that are innovative, evidence-based, and aligned with changing workforce and research needs.

This award reflects NSF’s statutory mission and has been deemed worthy of support through evaluation using the Foundation’s intellectual merit and broader impacts review criteria.

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