POPULATION HEALTH INITIATIVE
UNIVERSITY of WASHINGTON

Tier 1 Pilot Grant Application: Laying the Foundation
Spring 2024 Cover Sheet

PROJECT INFORMATION

Project Title	Social sensors for slow-onset climate events in Washington State food systems: Laying the foundation through systems engineering and social science research
Budget Request from Initiative	$25,000
Budget Match (if applicable)	$14,500
Total Project Budget	$39,500

APPLICANT INFORMATION

- **Marie Spiker**, PhD, RD. Lead Principal Investigator. Assistant Professor, UW School of Public Health (UW SPH), Department of Epidemiology, mspiker@uw.edu.
- **Christina Mastrangelo**, PhD. Principal Investigator. Associate Professor, UW College of Engineering, Industrial & Systems Engineering, mastr@uw.edu.
- **Sarah Collier,** PhD. Principal Investigator. Assistant Professor, UW SPH, Department of Environmental & Occupational Health Sciences, scollier@uw.edu.
- **Jennifer Otten**, PhD, RD. Principal Investigator. Associate Professor, UW SPH, Department of Environmental & Occupational Health Sciences, jotten@uw.edu.
- **Finance point-of-contact**: Veronica Jones, Department of Epidemiology, epigrant@uw.edu

ABSTRACT

Washington State food producers are already experiencing and adapting to climate change. Real-time data are now essential to represent the heterogeneity of how climate impacts are unfolding across the state to inform initiatives that help farmers adapt and advance farm resilience. However, data from food producers is limited about the impacts of slow-onset climate events—such as gradual changes in temperatures, precipitation, and pest habitats—which may be less visible, but have major cumulative impacts on food security, livelihoods, and population health.

We are seeking funds for foundational, interdisciplinary research to establish the viability of *social sensors* to detect the impacts of slow-onset climate events on WA farms. A sensor is a "device" that detects an event in a physical or real-world environment and translates it into a digital object. However, there is no physical device that can capture a farmer's reaction to small or slow onset climate events. Producer reactions may be captured via newsfeeds and postings on social networks. This is a social sensor. (A fantastic idea coined by us!) This work would lay the foundation for the future development of a *digital twin*—a virtual representation of a complex system that integrates data from multiple real-world sensors. While there are well established physical sensors of climate impacts (e.g., weather or crop sensors), social sensors in this context would be novel. A PHI Tier 1 grant would enable us to explore this potential approach from both a systems engineering perspective and a social science perspective. We will (1) identify possible sources of social sensor data that could detect climate-related impacts on WA food producers and assess the relevance, suitability, and feasibility of the data and data-scraping processes and (2) conduct interviews with WA food producers to learn about both the nature of the slow-onset climate impacts they experience and how they communicate about these impacts both within and outside of social networks.

TIER 1 PROJECT RESEARCH PLAN

Description of the problem: Of the myriad threats climate change poses to population health, many are channeled through food systems: climate change influences the livelihoods and health of agricultural producers, as well as the fundamental viability and nutritional quality of the food supply. The food system is a site of both resilience and vulnerability. Here in Washington (WA), while the state stands out for its high potential for climate adaptability and opportunity to leverage an extended growing season, record-breaking heat in 2021 damaged shellfish, apples, wheat, and many of the state's more than 300 agricultural products. Ideally, policy initiatives to advance the climate resilience of WA food systems would be informed by real-time information on the heterogeneity of how climate impacts are unfolding across the state, and especially in smaller and decentralized operations that may lack the representation and safety nets of larger farms. Real-time data are essential because climate change does not just consist of rapid-onset events and disasters. Slow-onset climate events are less visible; for example, while recovery funds for a major flood may rise to the top of the policy agenda, policymakers may be unaware that farmers are coping with climate impacts in more subtle ways such as changing what or when they plant, seeking new systems of pest management, or reducing workforce. If we want the policy response to climate change to account for geographic and temporal trends in climate impacts, we need systems to detect and communicate these trends.

Project aims: Our long-term goal is to develop *digital twin* technology to enable early detection of climate impacts on WA food systems in order to inform agile and tailored policy responses for climate resilience. A digital twin is a virtual representation of a complex system that integrates data from multiple real-world sensors. While digital twins have been more widely adopted in aerospace and industrial engineering, their application to food systems is nascent. Our future digital twin would include both physical and social sensors. While there are well established physical sensors of climate impacts (e.g., weather data), the development of *social sensors* of how slow-onset climate impacts affect food producers' experiences and behaviors would be novel. While we hypothesize that a social sensor that scrapes news media and social media data could be a viable means to detect climate impacts, we recognize that these data sources may not necessarily capture the diversity of WA producers' experiences across the state's many farming systems, scales, geographies, and demographics. Before embarking on a full proof-of-concept for a social sensor of climate impacts, we seek a Tier 1 grant to explore the best approach from both systems engineering and social science angles. Specifically, we will:

1. Identify possible sources of social sensor data that could detect climate-related impacts on WA food producers and assess the relevance, suitability, and feasibility of the data and data-scraping processes.
2. Conduct interviews with WA food producers and organizations representing WA food producers to learn about both the nature of the slow-onset climate impacts they experience and how they communicate about these impacts.

Plan, design, methods: In summer 2024, our interdisciplinary faculty team will hire two graduate students—one from engineering and one from public health or a social science—to carry out the data source identification and farmer interviews, respectively. In fall 2024, we will synthesize insights from both components to assess the viability of a social sensor and plan for a future proof-of-concept. For the data source identification, we will: Develop a literature-driven taxonomy to establish the climate-related phenomena of interest; identify news media and social media platforms with an Application Programming Interface (API) structure that can be used for data acquisition; acquire 5 years of data from the selected sources, scraping web data through APIs that work with Python; use natural language processing to identify relevant keywords in the data; and sample and assess the validity of the scraped data, including data congruence, data uncertainty, validation against geotags, and validation against confirmed weather events. For the farmer interviews, we will: Develop a semi-structured, in-depth interview guide; recruit at least 20 food producers in WA that represent diverse products, geographies, and scales; conduct 30-60 minute interviews via Zoom or telephone; qualitatively code and analyze interview transcripts; and establish insights on the variety of ways farmers communicate about climate impacts.

Tier 1 Project Evaluation Plan

If the project is successful, we will…

- Establish a taxonomy of climate-related phenomena of interest that should be captured by a social sensor of slow-onset climate change impacts on WA food systems; assess a range of ways that WA farmers communicate about their experiences with climate events; and assess whether news media, social media, or other identified data sources are suitable, relevant, and feasible as potential inputs for a social sensor (for example, would these data sources overlook key populations or experiences?).
- Cultivate team science and collaboration between students and faculty in Engineering (PI Mastrangelo) and Public Health (PIs Spiker, Collier, and Otten), including early-career faculty (Spiker and Collier).
- Disseminate findings to scientific, agriculture, and policy communities, such as the WA Food Policy Forum.

As a result of these findings, we will be able to develop a proof of concept for developing a social sensor that would be part of a future digital twin that informs the policy response to slow-onset climate impacts on WA food systems.

Project Timeline

Activity	Timing
Hire graduate students	June 2024
Obtain IRB approval for all activities	June 2024
Component 1: Data source identification	July - Sep 2024
Component 2: Farmer interviews	July - Sep 2024
Integration: Establishing the viability of a future proof of concept	Oct - Nov 2024
Dissemination: Peer-reviewed article and research brief	Oct 2024 - Feb 2025

Biographies: This highly interdisciplinary team includes expertise in digital twin development (Mastrangelo), agriculture and climate change (Collier), food systems (Spiker, Otten, Collier), and social science, policy, and qualitative research methods (Spiker and Otten).

Marie Spiker, PhD, RD; Assistant Professor, UW Department of Epidemiology. Dr. Spiker has expertise in survey, qualitative, and mixed methods research as well as simulation modeling. She has conducted research with WA food systems stakeholders related to food security, hunger relief, and food systems resilience.

Christina Mastrangelo, PhD; Associate Professor, UW Industrial & Systems Engineering. Dr. Mastrangelo has expertise in industrial and systems engineering, including the development of digital twin technology.

Sarah Collier, PhD, Assistant Professor, UW Department of Environmental and Occupational Health Sciences. Dr. Collier specializes in agricultural climate change mitigation and adaptation. She has conducted research and outreach on carbon sequestration, soil quality, and farm resilience, as well as producer perceptions and decision-making in the context of climate change.

Jennifer Otten, PhD, RD; Associate Professor, UW Department of Environmental and Occupational Health Sciences. Dr. Otten specializes in food systems policy analysis as it relates to public health outcomes. She has conducted research on the policy actions and priorities of food systems actors and producers.

Tier 1 Project Budget

	Requested from Initiative	Funding Match
Salaries		
Faculty	$1,147	$11,615
Staff	$0	$0
Student	$19,080	$0
Benefits Based on Payroll Load Rate in Effect	$3,473	$2,884
Supplies and Materials Supplies, Equipment Under $2,000, etc.	$0	$0
Equipment Equipment Over $2,000	$0	$0
Tuition	$0	$0
Other	$1,300	$0
Total Direct Costs (PHI-requested funding cannot exceed $25K)	**$25,000**	**$14,500**

Budget Justification

A total of $39,500 is requested ($25,000 from PHI and $14,500 from matched funders) to cover faculty, staff, and student salaries and fringe benefits. The Principal Investigators (Spiker, Mastrangelo, Collier, Otten) will collaborate to oversee all aspects of the study design and protocols including data source identification and farmer interviews; ensuring that research goals are met in a timely manner and with scientific rigor; ensuring compliance with UW protocols, Human Subjects review, and the budget; and leading dissemination of findings. Budget details are as follows:

- Marie Spiker: 3% FTE for 8 months at $11,066/month and 22.6% fringe (faculty rate)
- Christina Mastrangelo: 3% FTE for 8 months at $16,221/month and 22.6% fringe (faculty rate)
- Sarah Collier: 3% FTE for 8 months at $11,477/month and 22.6% fringe (faculty rate)
- Jennifer Otten: 3% FTE for 8 months at $13,243/month and 22.6% fringe (faculty rate)
- Hourly grad student, engineering: 200 hours at $43.20/hour and 18.2% fringe (student rate)
- Hourly grad student, public health: 200 hours at $43.20/hour and 18.2% fringe (student rate)

We request $300 to cover monthly subscription pricing for scraping news media and social media data, and $1,000 to cover modest incentives of $50 for each of the 20 interview participants.

Matching funds: We are requesting matched funds from the UW School of Public Health ($7,500), the UW Department of Epidemiology ($5,000), and the UW Center for Studies in Demography and Ecology ($2,000), totaling $14,500 in matched funds.