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Climate change challenges require collaborative research to drive agrifood system transformation

Gabrielle E. Roesch-McNally[1], Andrea Basche[2] and Rebecca Schewe[3]

[1]USDA Northwest Climate Hub, 3200 SW Jefferson Ave, Corvallis, OR 97331, USA; [2]University of Nebraska-Lincoln, Plant Sciences hall 279G, Lincoln, NE 68583, USA and [3]Maxwell/Syracuse University, 426 Eggers Hall, Syracuse, NY 13244-1020, USA

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Author for correspondence:
Gabrielle E. Roesch-McNally,
E-mail: groeschmcnally@fs.fed.us

The recent Climate Science Special Report released as part of the Fourth National Climate Assessment confirms that we are living through the warmest period in modern civilization and that human activities are the primary driver of this warming (Wuebbles et al., 2017). These climatic changes have and will continue to impact global agricultural production, with food security and production consequences that will be felt unequally across the planet. Agricultural activities contribute to global warming emissions, while also offering opportunities for greenhouse gas mitigation. It is clear that the agrifood system will have to adapt to a changing climate. To better assess climate influences on agricultural systems in this themed issue of *Renewable Agriculture and Food Systems*, we challenged authors to submit interdisciplinary research that examines climate change adaptation and mitigation in agriculture and subsequent interconnected impacts to the food system. Indeed, agrifood systems provide a fertile context for examining climate change from multiple disciplines.

In this issue

Authors in this special issue addressed climate change from a range of agrifood contexts, including the impact of climate change on producer decision-making, vulnerable populations, communities, crop ecology, soil health and food systems policy. Several papers in this themed issue build upon important work exploring agricultural stakeholder views and decision-making relative to climate change. Lane et al. (2018) suggest that skepticism towards anthropogenic climate change among farmers, structural influences such as financial and economic pressures, and broader risk perceptions associated with non-climate concerns limit adaptive and mitigative actions among farmers in New York and Pennsylvania. In Castellano and Moroney's (2018) preliminary research on Idaho farmers, they find that additional factors, including the presence of an heir and location *vis a vis* the rural–urban interface, might influence farmers' adaptation strategies. Examining other actors in the agrifood system, Schattman et al. (2018) conducted a survey of over 4000 U.S. Department of Agriculture Farm Service Agency field staff and outline opportunities to increase employee exposure and proficiency with weather and climate information to meet the needs of American farmers.

It is also critically important to examine climate change in the context of the most vulnerable global populations. To address this need, Reyes et al. (2018) highlight outcomes from a 2017 National Adaptation Forum working group examining how federal partnerships can be strengthened to support tribal agricultural and natural resource management strategies. They argue that working across the thematic areas highlighted by the working group will improve collaboration with Tribes and improve Native food security as well as production opportunities in the face of climate change. Heckelman et al. (2018), using a participatory method of stakeholder engagement, compared the resilience of organic and conventional small-scale rice farmers in the Philippines and found that organic systems improved farmer adaptive capacity but argued that government and non-governmental interventions are needed to reduce vulnerability. Bezner Kerr et al. (2018) examined how Malawian smallholder farmers learn, perceive, share and apply knowledge about a changing climate and found that participatory agroecological approaches supported the development of smallholder farmer adaptation strategies; however, changing the dominant narrative about farming and climate change remained a greater challenge.

The interdisciplinary study of climate change and agrifood systems requires novel methodological approaches. Osterhoudt (2018), in her commentary piece, investigated the role of oral histories in a specific agrarian community in Madagascar that suffered a devastating cyclone in 2011, noting that such histories can promote climate adaptation through shared stories and memories of severe events which are expected to become more common due to climate change. Franzen (2017) demonstrates the importance of using ethnographic film as a methodology that can complement existing cultural research on climate change perceptions and knowledge processes.

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This themed issue also examines agriculture and climate change using biophysical data to answer crucial questions about changes across the agrifood system. McGranahan and Polling (2018) used an ecological approach to evaluate how physiologically diverse field crops perform under drought conditions and rising atmospheric carbon dioxide levels. Contrary to other work that has not found strong impacts of near-term carbon dioxide increases, they conclude that atmospheric CO_2 of < 575-ppm had significant negative effects on plant physiological responses associated with crop yields. DeLonge and Basche (2017) conducted a global meta-analysis of 37 rangeland experiments and found that improved grazing practices such as increasing complexity and reduced stocking rates significantly increased water infiltration rates, which may offset the impacts of rainfall variability as a result of climate change.

While field trials can reveal differences in climate responses that result from various best management practices, identifying such patterns at a larger scale could help answer questions about regional resilience. Alvarez-Berrios et al. (2018) paired data on drought mitigation conservation practices and drought frequency across the island of Puerto Rico from 2000 to 2016. They found that the most drought-prone regions did not often overlap with the greatest prevalence of drought mitigation management, highlighting a need for increasing the accessibility of programs that support conservation practice adoption.

Recognizing the importance of addressing the role of policy on climate change, Jordan et al. (2017) described models from the Upper Midwest where preliminary programs aim to support a thriving bioeconomy alongside positive environmental outcomes. The authors propose that if programs are properly designed and coordinated on farm and watershed scales, production of diverse bioproducts can efficiently enhance farm profit, bioproducts and water-related services relevant to increased rainfall variability in that region. Further addressing the need for system-wide analyses, Niles et al. (2018) argued that utilizing a food systems framework to assess climate change and its related impacts and opportunities are critical to address the needs of and threats to a global food system in the 21st century.

A call for transformative climate and agrifood systems research

There is still far to go to achieve the vision of truly transdisciplinary and multi-scalar climate change research. Combining social and biophysical data requires researchers to move beyond disciplinary silos to create collaborative research teams and datasets. Transdisciplinary researchers must create shared theoretical frames and build foundations of mutual respect across disciplinary boundaries, including practitioners and diverse research methodology. They must also address pragmatic concerns of combining data that spans a variety of methods, measurements and scales. We applaud the authors in this themed issue who have faced these challenges and offered pioneering work on climate change and the agrifood system. We hope that there will continue to be space for climate change research that works across social and natural science disciplinary boundaries and multiple scalar levels to address the real challenges of climate change.

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