frontiers | Frontiers in Climate

TYPE Editorial
PUBLISHED 04 January 2023
DOI 10.3389/fclim.2022.1113825

OPEN ACCESS

EDITED AND REVIEWED BY
Sirkku Juhola,
University of Helsinki, Finland

*CORRESPONDENCE
Ka Ming Fung
✉ kamingfung@link.cuhk.edu.hk
Eri Saikawa
✉ eri.saikawa@emory.edu
Amos P. K. Tai
✉ amostai@cuhk.edu.hk

SPECIALTY SECTION
This article was submitted to Climate Risk Management, a section of the journal Frontiers in Climate

RECEIVED 01 December 2022
ACCEPTED 15 December 2022
PUBLISHED 04 January 2023

CITATION
Fung KM, Saikawa E and Tai APK (2023) Editorial: Agriculture and food supply challenges in a changing climate. *Front. Clim.* 4:1113825. doi: 10.3389/fclim.2022.1113825

Editorial: Agriculture and food supply challenges in a changing climate

Ka Ming Fung[1,2]*, Eri Saikawa[3]* and Amos P. K. Tai[4,5]*

[1]Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, MA, United States, [2]Graduate Division of Earth and Atmospheric Sciences, The Chinese University of Hong Kong, Shatin, Hong Kong SAR, China, [3]Department of Environmental Sciences, Emory University, Atlanta, GA, United States, [4]Earth and Environmental Sciences Programme, Faculty of Science, The Chinese University of Hong Kong, Shatin, Hong Kong SAR, China, [5]State Key Laboratory of Agrobiotechnology, and Institute of Environment, Energy and Sustainability, The Chinese University of Hong Kong, Shatin, Hong Kong SAR, China

KEYWORDS

agriculture, sustainable, food security, climate change, food supply

Editorial on the Research Topic
Agriculture and food supply challenges in a changing climate

Painting a hopeful future was our goal when we started curating this Research Topic and we gladly see that the contributing authors to this topic have shown us the silver lining.

First of all, we must acknowledge that climate change is not the sole challenge facing agriculture and food supply. Food security has been an increasingly difficult challenge because of supply chain issues amid the COVID-19 pandemic (e.g., leading to a world food price surge of ∼13% in Mar 2022 vs. previous month[1]), and disruption of global food production due to international affairs (e.g., ∼10% of the world's wheat is exported from Ukraine[2]). All these evolving problems, alongside the changing climate, would likely worsen the food crisis in regions that are disadvantaged socioeconomically. Hence, it is more urgent than ever to replace conventional farming methods, which are largely detrimental to the environment and exacerbate climate change, with more sustainable approaches to secure food supply to the global population.

Our authors have demonstrated the multi-facets of the journey to tackle these challenges:

Factors limiting crop yields due to climate change vary depending on regional environmental features. Sihi et al. presented a machine-learning approach to understanding climate impacts on soil properties and crop yields across the Coterminous United States (CONUS) using an explainable random forest framework. Their work revealed that comparing crop yields (of corn, soybean, cotton, and wheat) together

1 US Global Leadership Coalition. *COVID-19 Brief: Impact on Food Security*. Available online at: https://www.usglc.org/coronavirus/global-hunger/ (accessed October 16, 2022).

2 FAO. *The Importance of Ukraine and the Russian Federation for Global Agricultural Markets and the Risks Associated With the War in Ukraine*. Available online at: https://www.fao.org/3/cb9013en/cb9013en.pdf (accessed October 16, 2022).

with both climatic (e.g., growing degree day), environmental (e.g., slope), and soil-related (e.g., water holding capacity) variables could result in a better model with higher explainability. This framework could also be replicated to investigate the interactions of crop yield and the soil-environment-climate system in other geographic regions and for other crop types, to generate actionable insights for local/regional stakeholders for more effective crop management.

Advanced analytical tools are also crucial to understand how crops respond to environmental stresses under the changing climate. Mdlalose et al. showed us how nuclear magnetic resonance spectroscopy (NMR) could be used to understand how potato plants react under various soil moisture conditions, specifically drought and flooding. Through tracking the abundance of various chemicals (e.g., sugars and armatics), they found that the metabolic processes in potatoes are different across cultivars and water treatments. Their study has showcased the use of biomarkers for selective breeding of crop cultivars that could have better odds to survive various environmental stresses under the changing climate, with ramifications for regional food security.

Farming is responsible for the majority of nitrogen pollution to the environment, e.g., 80–90% of atmospheric ammonia, warranting proper pollution control measures. Smerald et al. showed that optimizing fertilizer input could supplement soil fertility and maximize crop yields of maize while limiting environmentally harmful *N* losses. They also proposed different strategies in closing the maize yield gap at the global, regional, and smaller scales. For instance, their model results show that, in some regions such as Eastern Europe, Western Africa, and parts of Central and Eastern Africa, maize production can be increased by 20–25% without increasing the *N* losses, offering insights on how farmers everywhere can practically embark on sustainable yield increases.

Cover crop establishment is believed to be a strategy to offset greenhouse gas (GHG) emissions due to intensive land management, but the effectiveness of its variation is seldom quantified. Wang et al. measured the effects in reducing emissions of CO_2, N_2O, and CH_4 by incorporating three cover crops: crimson clover, cereal rye, and white clover. They not only found that white clover, which was a living mulch unlike other dead mulches, helped reduce emissions of GHG and has, among the three, the highest potential to mitigate climate change. Their results could help benchmark the efficacy of other sustainable farming alternatives.

Convening farmers to adopt new farming approaches requires deep understanding of their hesitation, which could vary by region. Truong et al. helped us better understand the situation in Vietnam, *via* a case study on the popularization of climate smart agriculture (CSA). Their focus group discussions uncovered that the major obstacles for adopting CSA include the "lack of capital, information, technical support, and land ownership institutions," exemplifying the wide variety of challenges (and corresponding solutions needed) of leveraging the sustainable farming alternatives that each administrative region may face.

Away from the rural areas, urban farming also poses an opportunity to help alleviate the food crisis and climate change. For instance, Buckley et al. discovered that reusing the CO_2-enriched indoor air (e.g., exhaust air from a classroom) could help enhance spinach growth on a rooftop next to an exhaust fan by 4-fold, compared to plants grown in the open air. Though other environmental factors, such as wind, might offset the CO_2-enhanced growth, their findings have showcased another innovative way to foster more sustainable food production.

We hope that this special Research Topic has sparked conversations around innovative solutions to the vast challenges of sustainably supplying food for the current and future generations. Such an exchange of ideas is poised to substantiate tangible impacts on combating the emerging food crisis.

Author contributions

KMF drafted the article. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note