frontiers | Frontiers in Sustainable Food Systems

TYPE Editorial
PUBLISHED 17 January 2023
DOI 10.3389/fsufs.2022.1126013



OPEN ACCESS

EDITED AND REVIEWED BY
Rachel Bezner Kerr,
Cornell University, United States

*CORRESPONDENCE
Albie Miles
albie@hawaii.edu

SPECIALTY SECTION
This article was submitted to Social Movements, Institutions and Governance, a section of the journal Frontiers in Sustainable Food Systems

RECEIVED 16 December 2022
ACCEPTED 28 December 2022
PUBLISHED 17 January 2023

CITATION
Miles A and Hoy C (2023) Editorial: Achieving food system resilience and equity in the era of global environmental change. *Front. Sustain. Food Syst.* 6:1126013. doi: 10.3389/fsufs.2022.1126013



# Editorial: Achieving food system resilience and equity in the era of global environmental change

Albie Miles[1]* and Casey Hoy[2]

[1]Sustainable Community Food Systems Program, Division of Social Sciences, University of Hawaii–West Oahu, Kapolei, HI, United States, [2]Agroecosystems Management Program, Department of Entomology, College of Food, Agriculture, and Environmental Sciences, The Ohio State University, Wooster, OH, United States

KEYWORDS

**food systems, resilience, social equity, global environmental change, climate change adaptation**

Editorial on the Research Topic
Achieving food system resilience and equity in the era of global environmental change

National governments and international agencies are forcefully warning that society is in the midst of a global climate crisis with grave risks to human welfare and natural systems (Pörtner et al., 2022). Recent IPCC reports have issued what has been called a "code red for humanity," delivering, once again, dire warnings of the profound risks of unmitigated anthropogenic climate forcing on human welfare, the limitations of ecosystems and human societies to adapt to climate change, and the risks to social and ecological stability (Sellers et al., 2019; IPCC, 2021, 2022). Further, recent analyses support the conclusion that the current national climate targets and international policy efforts are insufficient to limit anthropogenic warming to 1.5°C above pre-industrial global temperatures (Kemp et al., 2022; Matthews and Wynes, 2022). The full extent of the potentially catastrophic impacts of climate destabilization remains to this day scientifically underexplored and poorly understood (Kemp et al., 2022).

Food systems will continue to play a defining role in global environmental change, human welfare and socio-economic stability. The world's agri-food systems are a primary driver of global ecological change and negative public health externalities while simultaneously being vulnerable to the impacts of climate destabilization (Steffen et al., 2015; Meybeck and Gitz, 2017; Willett et al., 2019; Benton et al., 2021; Crippa et al., 2021; Slater et al., 2022). Severe weather events and their impacts to global agriculture, fisheries, and related food system infrastructure have steadily increased over the last decade and are projected to increase in severity over the remainder of this century (Brown et al., 2015; Watts et al., 2021; de Perez et al., 2022). Such negative impacts on yields from crop, livestock and fisheries, as well as damage to food processing, storage, transportation, and retail infrastructure could significantly diminish the security of the global and regional food supplies, drive food price spikes, and negatively impact the availability of high-quality foods, especially to low-income countries and marginalized and vulnerable communities, exacerbating food insecurity and malnutrition (Myers et al., 2017; Harris and Spiegel, 2019; Romanello et al., 2021; IPCC, 2022; Pörtner et al., 2022).

Deadly pathogens emerging from and amplified through agriculture are also anticipated to increase along with human population and the expansion and intensification of production strategies (Rohr et al., 2019; Wallace et al., 2021; Brooks et al., 2022; Trivellone et al., 2022). The global syndemic of climate destabilization, chronic illness, the COVID-19 pandemic, food insecurity, economic shocks, and the loss of ecosystem services must be simultaneously

accounted for in attempts to transform food systems to achieve stability, health, equity, resilience, and sustainability (Fanzo, 2020; Webb et al., 2020; Petersen-Rockney et al., 2021; Zurek et al., 2022).

Even with significant and coordinated efforts to limit global greenhouse gas emissions, all regions must plan for climate-induced shocks from more frequent and severe weather events resulting in the disruption of agricultural production, fisheries and supply chains, food price spikes, increased food insecurity, and the catastrophic loss of livelihoods, property and infrastructure (Harris and Spiegel, 2019; Duvat et al., 2021; Hasegawa et al., 2021). How food systems are planned, structured, and managed will, therefore, have a profound influence on the ability of society to sustain critical ecosystems services, mitigate and adapt to climate change, respond to future social and ecological crises, and ensure food security, public health, human rights and social stability into the future (Agyemang and Kwofie; Sampson et al.; Rockström et al., 2020; Rosenzweig et al., 2020; Queiroz et al., 2021; Watts et al., 2021).

With the possibility of significant destabilization of the Earth's climate system this century (Mora et al., 2013; Trisos et al., 2020; IPCC, 2022) educators, researchers, NGO leaders, planners, and elected officials must work together on transdisciplinary research, education, state and regional food system planning and policy efforts toward building more healthy, equitable, resilient, and ecologically sustainable food systems that are strategically aligned with state, national, and UN Sustainable Development Goals (Eyhorn et al., 2019; Valentini et al., 2019; Fanzo et al., 2021).

Food system resilience is the capacity over time of a food system to provide sufficient, appropriate and accessible food to all (i.e., food security) in the face of various and unpredictable biophysical, social, or economic disturbances (Tendall et al., 2015; Schipanski et al., 2016; Chodur et al., 2018; FAO, 2020). Food system resilience requires both sufficient stability to maintain needed capacity through disturbances as well as sufficient adaptive capacity to alter system structure and function when environmental changes render existing structure and function incapable of maintaining needed capacities (Hoy, 2015). Therefore, existing food systems can be hypothesized to be more or less resilient only to known or expected shocks and disturbances, but we can't say they are resilient until capacity has been maintained after disturbances occur. The performance of current food systems during the COVID-19 pandemic leaves some doubt about their resilience. Food system equity is a goal, outcome or condition of the food system where the benefits and risks of how food is grown and processed, transported, distributed, and consumed are shared equitably by society (Allen, 2010; Gottlieb and Joshi, 2010; Alkon and Agyeman, 2011; Smith, 2019). Based on the concept of resilience described above, equity could be viewed as both an essential condition for food system resilience and sustainability and an outcome of sustainable and resilient food systems. Achieving food system resilience and equity in the era of global environmental change will require integrated and reinforcing research, education, public policy, investment, and normative goal setting (Blay-Palmer et al., 2021; Zurek et al., 2022), all of which exist within varying cultural, political, and economic systems.

The objective of this Frontiers Special Research Topic is to provide academics, elected officials, government agencies, urban and regional planners, community leaders, and other food system practitioners with an up-to-date scientific analysis of the systemic risks of anthropogenic climate destabilization and other stochastic shocks to agriculture, food security, human health, and economies. Papers submitted to address this topic provide key theories principles, case studies and actionable strategies for achieving food system resilience and equity (Figure 1).

The articles throughout the special edition have enriched the conceptual and practical definitions of resilience and equity in food systems, consistent with the description above. A particular focus of a review of published resilience studies in the Indo-Pacific region (Friedman et al.) was in how resilience was defined or described, compared with standard definitions in previous literature. The conceptual views most prevalent in the papers reviewed were adaptation, adaptive capacity and response to disturbance, although only about half of the papers selected for analysis cited specific definitions. Although resilience is more than response to disturbance and environmental change, the importance of climate change in stimulating studies of food system resilience was clearly evident. Papers that identify observable qualities or operational/mechanistic characteristics of food systems to propose metrics or indicators give further insight into evolving models and definitions and how they can be operationalized in research and practice.

In multiple submissions, the measurable qualities of resilience and equity were focused on one of a few key food systems concepts: sustainability, sovereignty or security, and in some cases all three, as in the human right to food. Although many of the papers describe metrics and/or indicators, several articles in the collection focused on them specifically. For example, Jernigan et al. propose a series of indicators and sub-indicators of food sovereignty with a particular focus on the food systems of indigenous communities, and which are potentially generalizable to a wide range of cultural contexts. Agyemang and Kwofie selected 5–6 indicators from the literature for each of 4 areas that are important in food system failure analysis: production, nutrition, social equity, and environmental damage mitigation. In contrast, Sampson et al. focus on particular characteristics of equity, food sovereignty and the human right to food, and test their association with food security, an outcome of sustainable and resilient food systems. Rather than propose specific indicators, Springer et al. propose a malleable workflow for selecting the indicators and issues that are most useful and relevant to a particular community or context in measuring food system sustainability. Remaining papers in the special edition, case studies of both challenges to resilience or equity and of food system qualities that may favor resilience and equity, collectively enrich the conceptual understanding of key concepts and the metrics and indicators used to measure and compare specific systems and geographic regions.

Structural obstacles to food system resilience and equity were a major focus of papers describing resilience-related research in the Indo-Pacific region (Friedman et al.), where climate change and environmental disturbance were the most prevalent forms of disturbance appearing in the literature analyzed. Likewise, climate change impacts and adaptation strategies were a focus of a comparison between rural communities in the global north and south by Raj et al. in this collection. However, several other important challenges appear in the articles published in this special edition. Hutchins and Feldman, for example, compared individual farmer responses to COVID-19 in Hawaii. Industry conditions, such as consolidation or lack of diversity in both production (Howard et al.), and supply chain components or actors (Miller) were described as key

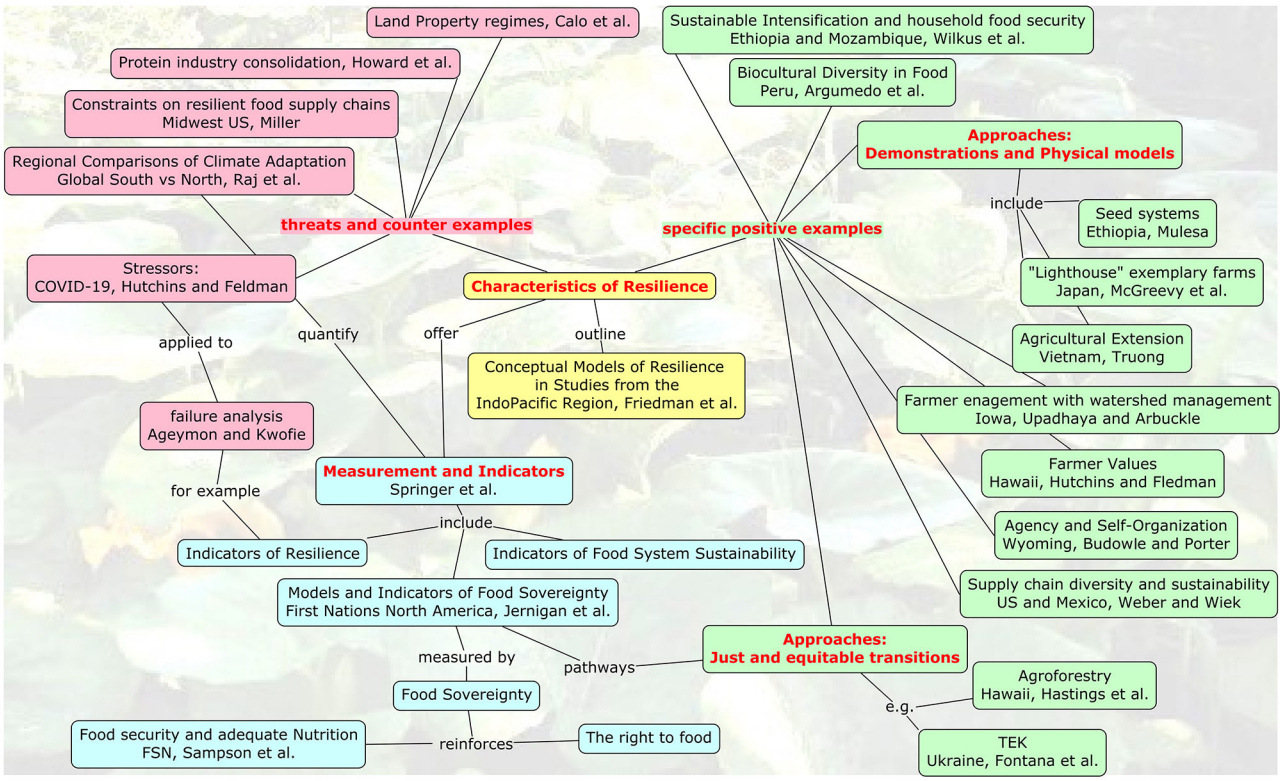


FIGURE 1
Concept map of the papers submitted to address the special Research Topic on food system resilience and equity under global environmental change.

constraints to realizing food system resilience and equity, in each case with diversification as a clear means of addressing these challenges. As a serious obstacle to both food system resilience and equity, Calo et al. examined dominant land property regimes, which can have a direct bearing on both food sovereignty and security.

Finally, approximately half of the papers in this special Research Topic described case studies of system qualities that are expected to be positively associated with food system resilience and equity. These include examples of environmental, social, and economic elements of food systems, as well as transition pathways within each of these three important dimensions of food system sustainability. Production ecosystem-oriented examples include biocultural diversity (Argumedo et al.) and sustainable intensification (Wilkus et al.) with programmatic transition pathways (Fontana et al.; Hastings et al.; McGreevy et al.; Mulesa) proposed through similar traditional knowledge and agroecological approaches. Social dimensions of food systems were addressed through analysis of farmer values (Hutchins and Feldman), collaborative approaches to watershed scale management (Upadhaya and Arbuckle), and agency for self-organization (Budowle and Porter), with extension educational programs among the transition pathways analyzed (Truong). An example of supply chain diversity (Weber and Wiek) is given to support the proposed solutions (e.g., Miller) for more resilient economic elements of food systems.

Overall, the special edition contains examples and points of view from all hemispheres and from various perspectives on key aspects of food system resilience and equity. The papers collectively help to clarify conceptual definitions of food system resilience and equity as well as operational processes and observable, measurable qualities associated with those conceptual definitions. We hope that the collection will both enable and encourage more focused research on resilience and equity in food systems internationally and across cultures.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## Acknowledgments

INFAS paid for manuscript publications costs for this special topic. INFAS: https://asi.ucdavis.edu/programs/infas/about.

## 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



## References

Alkon, A. H., and Agyeman, J. (2011). *Cultivating Food Justice: Race, Class, and Sustainability*. MIT Press.

Allen, P. (2010). Realizing justice in local food systems. *Cambridge J. Regions Econ. Soc.* 3, 295–308. doi: 10.1093/cjres/rsq015

Benton, T. G., Bieg, C., Harwatt, H., Pudasaini, R., and Wellesley, L. (2021). "Food system impacts on biodiversity loss," in *Three Levers for Food System Transformation in Support of Nature* (London: Chatham House).

Blay-Palmer, A., Santini, G., Halliday, J., Malec, R., Carey, J., Keller, L., et al. (2021). City region food systems: building resilience to COVID-19 and other shocks. *Sustainability* 13, 1325. doi: 10.3390/su13031325

Brooks, D. R., Hoberg, E. P., Boeger, W. A., and Trivellone, V. (2022). Emerging infectious disease: an underappreciated area of strategic concern for food security. *Transbound. Emerg. Dis.* 69, 254–267. doi: 10.1111/tbed.14009

Brown, M. E., Antle, J. M., Backlund, P., Carr, E. R., Easterling, W. E., Walsh, M. K., et al. (2015). *Climate Change, Global Food Security, and the U.S. Food System*. 146 pages. Available online at: http://www.usda.gov/oce/climate_change/FoodSecurity2015Assessment/FullAssessment.pdf

Chodur, G. M., Zhao, X., Biehl, E., Mitrani-Reiser, J., and Neff, R. (2018). Assessing food system vulnerabilities: a fault tree modeling approach. *BMC Public Health* 18, 817. doi: 10.1186/s12889-018-5563-x

Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., and Tubiello, F. N. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nat. Food* 2, 198–209. doi: 10.1038/s43016-021-00225-9

de Perez, E. C., Berse, K. B., Angelico, L., Depante, C., Easton-Calabria, E., Pierre, E., et al. (2022). Learning from the past in moving to the future: invest in communication and response to weather early warnings to reduce death and damage. *Climate Risk Manage.* 38, 100461. doi: 10.1016/j.crm.2022.100461

Duvat, V. K. E., Magnan, A. K., Perry, C. T., Spencer, T., Bell, J. D., Wabnitz, C. C. C., et al. (2021). Risks to future atoll habitability from climate-driven environmental changes. *Wiley Interdiscipl. Rev.* 12, e700. doi: 10.1002/wcc.700

Eyhorn, F., Muller, A., Reganold, J. P., Frison, E., Herren, H. R., Luttikholt, L., et al. (2019). Sustainability in global agriculture driven by organic farming. *Nat. Sustainabil.* 2, 253–255. doi: 10.1038/s41893-019-0266-6

Fanzo, J. (2020). "No food security, no world order," in *COVID-19 and World Order: The Future of Conflict, Competition, and Cooperation*, eds F. J. Gavin and H. Brands (Baltimore, MD: Johns Hopkins University Press). doi: 10.1353/book.77593

Fanzo, J., Haddad, L. K., Schneider, R., Béné, C., Covic, N. M., Guarin, A., et al. (2021). Viewpoint: rigorous monitoring is necessary to guide food system transformation in the countdown to the 2030 global goals? *Food Policy* 104, 102163. doi: 10.1016/j.foodpol.2021.102163

FAO (2020). *FAO Regional Office for Near East and North Africa*. Rome: The Food and Agriculture Organization of the United Nations (FAO).

Gottlieb, R., and Joshi, A. (2010). *Food Justice*. MIT Press.

Harris, J., and Spiegel, E. J. (2019). *Food Systems Resilience: Concepts & Policy Approaches*. South Royalton, VT: Center for Agriculture and Food Systems, Vermont Law School.

Hasegawa, T., Sakurai, G., Fujimori, S., Takahashi, K., Hijioka, Y., Masui, T., et al. (2021). Extreme climate events increase risk of global food insecurity and adaptation needs. *Nat. Food* 2, 587–595. doi: 10.1038/s43016-021-00335-4

Hoy, C. (2015). Agroecosystem health, agroecosystem resilience, and food security. *J. Environ. Stud. Sci.* 5, 623–635. doi: 10.1007/s13412-015-0322-0

IPCC (2021). "Climate change 2021: the physical science basis," in *IPCC Sixth Assessment ReportWorking Group 1: The Physical Science Basis*. Available online at: https://www.ipcc.ch/report/ar6/wg1/

IPCC (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Available online at: https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/

Kemp, L., Xu, C., Depledge, J., Ebi, K. L., Gibbins, G., Kohler, T. A., et al. (2022). Climate endgame: exploring catastrophic climate change scenarios. *Earth Atmos. Planet. Sci.* 119, e2108146119. doi: 10.1073./pnas.2108146119

Matthews, H. D., and Wynes, S. (2022). Current global efforts are insufficient to limit warming to 1.5°C. *Science* 376, 1404–1409. doi: 10.1126/science.abo3378

Meybeck, A., and Gitz, V. (2017). Sustainable diets within sustainable food systems. *Proc. Nutr. Soc.* 76, 1–11. doi: 10.1017/S0029665116000653

Mora, C., Frazier, A. G., Longman, R. J., Dacks, R. S., Walton, M. M., Tong, E. J., et al. (2013). The projected timing of climate departure from recent variability. *Nature.* 502, 183–187. doi: 10.1038/nature12540

Myers, S. S., Smith, M. R., Guth, S., Golden, C. D., Vaitla, B., Mueller, N. D., et al. (2017). Climate change and global food systems: potential impacts on food security and undernutrition. *Annu. Rev. Public Health* 20, 259–277. doi: 10.1146/annurev-publhealth-031816-044356

Petersen-Rockney, M., Baur, P., Guzman, A., Bender, S. F., Calo, A., Castillo, F., et al. (2021). Narrow and brittle or broad and nimble? Comparing adaptive capacity in simplifying and diversifying farming systems. *Front. Sustain Food Syst.* 5, 564900. doi: 10.3389/fsufs.2021.564900

Pörtner, H.- O., Roberts, D. C., Tignor, M., Poloczanska, E. S., Mintenbeck, K., Alegría, A., et al. (2022). Climate Change 2022: *Impacts, Adaptation and Vulnerability Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*.

Queiroz, C., Norström, A. V., Downing, A., Harmáčkov,á, Z. V., Coning, C., De Adams, V., et al. (2021). Investment in resilient food systems in the most vulnerable and fragile regions is critical. *Nat. Food* 2, 546–551. doi: 10.1038/s43016-021-00345-2

Rockström, J., Edenhofer, O., Gaertner, J., and DeClerck, F. (2020). Planet-proofing the global food system. *Nature Food.* 1, 3–5. doi: 10.1038/s43016-019-0010-4

Rohr, J. R., Barrett, C. B., Civitello, D. J., Craft, M. E., Delius, B., DeLeo, G. A., et al. (2019). Emerging human infectious diseases and the links to global food production. *Nat. Sustain.* 2, 445–456. doi: 10.1038/s41893-019-0293-3

Romanello, M., McGushin, A., Napoli, C., Di Drummond, P., Hughes, N., Jamart, L., et al. (2021). The 2021 report of the *Lancet* Countdown on health and climate change: code red for a healthy future. *Lancet* 398, 1619–1662. doi: 10.1016/S0140-6736(21)01787-6

Rosenzweig, C., Mbow, C., Barioni, L. G., Benton, T. G., Herrero, M., Krishnapillai, M., et al. (2020). Climate change responses benefit from a global food system approach. *Nat. Food*. 1, 94–97.

Schipanski, M. E., MacDonald, G. K., Rosenzweig, S., Chappell, M. J., Bennett, E. M., Kerr, R. B., et al. (2016). Realizing resilient food systems. *BioScience.* 66, 600–610. doi: 10.1093/biosci/biw052

Sellers, S., Ebi, K. L., and Hess, J. (2019). Climate change, human health, and social stability: addressing interlinkages. *Environ. Health Perspect.* 127. doi: 10.1289./EHP4534

Slater, S., Baker, P., and Lawrence, M. (2022). An analysis of the transformative potential of major food system report recommendations. *Global Food Secur.* 32, 100610. doi: 10.1016/j.gfs.2022.100610

Smith, B. J. (2019). Food justice, intersectional agriculture, and the triple food movement. *Agric. Hum. Values* 36, 825–835. doi: 10.1007/s10460-019-09945-y

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., et al. (2015). Planetary boundaries: guiding human development on a changing planet. *Science* 347. doi: 10.1126./science.1259855

Tendall, D. M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q. B., et al. (2015). Food system resilience: defining the concept. *Global Food Secur.* 6, 17–23. doi: 10.1016/j.gfs.08, 001.

Trisos, C. H., Merow, C. A., and Pigot, L. (2020). The projected timing of abrupt ecological disruption from climate change. *Nature* 580, 496–501. doi: 10.1038/s41586-020-2189-9

Trivellone, V., Hoberg, E. P., Boeger, W. A., and Brooks, D. R. (2022). Food security and emerging infectious disease: risk assessment and risk management. *R. Soc. Open Sci.* 9. doi: 10.1098./rsos.211687

Valentini, R., Sievenpiper, J. L., Antonelli, M., and Dembska, K. (2019). *Achieving the Sustainable Development Goals Through Sustainable Food Systems*. Cham: Springer International Publishing.

Wallace, R. G., Liebman, A., Weisberger, D., Jonas, T., Bergmann, L., Kock, R., et al. (2021). "Industrial agricultural environments" in *Routledge Handbook of Biosecurity and Invasive Species*, eds K. Barker and R. A. Francis (London: Routledge), 368.

Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Beagley, J., Belesova, K., et al. (2021). The 2020 report of the *Lancet* Countdown on health

and climate change: responding to converging crises. *Lancet* 397, 129–170. doi: 10.1016/S0140-6736(20)32290-X

Webb, P., Benton, T. G., Beddington, J., Flynn, D., Kelly, N. M., Thomas, S. M., et al. (2020). The urgency of food system transformation is now irrefutable. *Nat. Food* 1, 584–585. doi: 10.1038/s43016-020-00161-0

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., et al. (2019). Food in the anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *Lancet*. doi: 10.1016./S0140-6736(18)31788-4

Zurek, M., Ingram, J., Bellamy, A. S., Goold, C., Lyon, C., Alexander, P., et al. (2022). Food system resilience: concepts, issues, and challenges. *Annu. Rev. Environ. Resour.* 47, 511–534. doi: 10.1146/annurev-environ-112320-050744