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Editorial: Food system transformation and the realization of the UN Sustainable Development Goals

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Editorial on the Research Topic
Food system transformation and the realization of the UN Sustainable Development Goals

For over half a century, the international scientific community has increasingly recognized that global and regional agriculture and food systems (agri-food systems) are at a critical crossroads, confronting intersecting biophysical, socio-economic, and ethical challenges [Carson, 1962; Altieri, 1989; National Research Council, 1989; Harwood, 2020; Rockström et al., 2009; Gliessman et al., 2022; Springmann et al., 2018; High Level Panel of Experts on Food Security and Nutrition (HLPE), 2020; IPCC, 2022; Gallardo, 2024]. These pressing issues include, but are not limited to significant greenhouse gas emissions and the impacts of anthropogenic climate destabilization (Porter et al., 2014; Clark et al., 2020; Miles and Hoy, 2023), agroecosystem and environmental degradation (Gliessman et al., 2022; Gallardo, 2024), unsustainable fossil energy use (Pimentel et al., 2005; Crippa et al., 2021), loss of biological and cultural diversity (Swift and Anderson, 1993; Altieri, 1999; Kremen and Miles, 2012), dispossession and marginalization of Indigenous peoples and their foodways (Malli et al., 2023), malnutrition and negative public health outcomes (Fanzo et al., 2022), exposure of non-target organisms and human populations to high-risk agrochemicals (Hayes et al., 2002; Hertz-Picciotto et al., 2018; Coleman et al., 2025), profound social inequalities (Alkon and Agyeman, 2011; Shostak, 2023), exploitation, persecution, and systemic vulnerabilities imposed on human agri-food labor (Blackstone et al., 2023; Bhattacharjee, 2023), commodification and unnecessary harm of sentient non-human animals (Stuart and Gunderson, 2020; Birch, 2024), and the longstanding inequities in access to quality food at the state, regional, national, and international levels [Singleton et al., 2023; Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD), United Nations Children's Fund (UNICEF), World Food Programme (WFP), and World Health Organization (WHO), 2023].

In response to these converging agri-food issues and crises, leading scientists, scientific bodies, NGOs, national governments, and international agencies have issued numerous calls for the fundamental transformation of global agri-food systems (Juri et al., 2024; Abdulai and Béné, 2025) to address social and ecological externalities and promote sustainable human development [Inter Academy Partnership (IAP), 2018; Willett et al., 2019; Webb et al., 2020; Organisation for Economic Co-operation and Development (OECD), 2022; Food and Agriculture Organization of the United Nations (FAO), 2023; United Nations Development Programme (UNDP), 2023]. The scientific literature cited herein identifies the interconnections between agriculture, food systems and a broad set of persistent social, economic, public health, ecological, and ethical challenges that are directly or indirectly aligned with the United Nations Sustainable Development Goals (SDGs). This body of research emphasizes the urgent need for food system change based on the principles of ecological sustainability, social equity, and the promotion of human wellbeing (Gliessman, 2000; Miles et al., 2017; Willett et al., 2019; Webb et al., 2020). Specifically, these calls to action seek to: strengthen the economic viability of regional agri-food systems in the face of agri-food globalization; improve public health outcomes through expanded access to nutritious and culturally-appropriate foods and dietary programs; promote social equity through Fair Trade, improved labor standards and other values-based supply chains; build resilience to natural and human-induced shocks across the agri-food sector; advance environmental sustainability through the scaling of agroecological, certified organic and related production practices; and ensure the widespread adoption of diets that promote human and planetary health (DeLonge et al., 2016; Reganold and Wachter, 2016; Eyhorn et al., 2019; Fanzo, 2019; Herrero et al., 2021; Zurek et al., 2022).

Numerous international science-policy consortia and related frameworks have explicitly and consistently pointed to the United Nations 2030 Agenda for Sustainable Development [United Nations (UN), 2015] as a unifying framework to guide, benchmark, and measure progress in addressing the social and ecological crises originating in, and propagated through, agri-food systems [Inter Academy Partnership (IAP), 2018; Willett et al., 2019; Fanzo et al., 2021; Schneider et al., 2023]. Given that agriculture and food systems influence 16 of the 17 UN SDGs, directly or indirectly, the transformation of the global food system is both urgent and essential to realizing these goals [Béné et al., 2019; High Level Panel of Experts on Food Security and Nutrition (HLPE), 2020; Food and Agriculture Organization of the United Nations (FAO), 2023].

Agri-food systems are central to the achievement of the 17 SDGs and exert direct influence on key targets related to hunger, nutrition, social equity, the sustainable use of land and water resources, biodiversity conservation, ecosystem health, and climate change adaptation and mitigation (Fanzo et al., 2021; Schneider et al., 2023). For example, SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), SDG 14 (Life Below Water), and SDG 15 (Life on Land) explicitly call for sustainable agricultural production, food security, biodiversity conservation, and reductions in agricultural food loss and post-consumer waste [United Nations (UN), 2015; Herrero et al., 2021; Gliessman, 2025]. Further, agriculture and food systems influence progress across multiple UN SDGs. By participating in both large and small markets, the agri-food sector supports rural income and livelihoods, advancing SDG 1 (No Poverty). It also shapes public health and nutrition outcomes, directly contributing to SDG 3 (Good Health and Well-Being). In addition, through its significant impacts on the quantity, quality, and equitable access to freshwater resources, the sector plays a central role in achieving SDG 6 (Clean Water and Sanitation). As a key driver of global GDP, the food and agriculture sector contributes to the realization of SDG 8 (Decent Work and Economic Growth) by providing employment opportunities and promoting overall economic growth. Agri-food systems also impact SDG 9 (Industry Innovation and Infrastructure) as they contribute to, and are shaped by, technological innovation and infrastructure development [United Nations (UN), 2015; Herrero et al., 2021; Gliessman, 2025]. Urban agriculture and food systems can meaningfully contribute to advancing SDG 11 (Sustainable Cities and Communities) by providing food and green spaces, while playing a significant role in climate change adaptation and mitigation SDG 13 (Climate Action) globally (Clinton et al., 2018; Valentini et al., 2019; Li et al., 2024).

In addition, agri-food systems promote progress on SDG 4 (Quality Education) by impacting human nutrition and learning. Transdisciplinary agroecology and sustainable food system education, in particular, play an important role in supporting SDG 4 by fostering a deeper understanding of sustainable farming practices, food security, inequality, environmental stewardship and the structural obstacles and opportunities for realizing sustainability and equity goals aligned with multiple SDGs (Ebel et al., 2020; Bates et al., 2022). SDG 5 (Gender Equality) is advanced by agri-food systems by providing women and girls with access to natural and capital resources, decision-making opportunities and access to quality food. SDG 10 (Reduced Inequalities) is promoted by ensuring safe and equitable labor conditions in the agri-food sector, enabling inclusive market participation, providing access to quality food and promoting healthy diets. Participatory city, regional and state food system planning and governance serve to advance multiple SDGs simultaneously, including SDG 16 (Peace, Justice and Strong Institutions) Zougris et al.. National and international collaboration on agroecology and sustainable food system research and education, along with the promotion of equitable food trade and investment, all promote SDG 17 (Partnerships for the Goals) and can accelerate progress toward achieving the entire 2030 Agenda [European Commission, 2020; United Nations Development Programme (UNDP), 2023; Gliessman, 2025]. Overall, agri-food systems influence at least 16 of the 17 SDGs, underscoring the need to prioritize agri-food system change in policy and planning discourse around the realization of the UN SDGs. Integrated approaches to food system research, planning, policy, investment, and monitoring are necessary to simultaneously address productivity, health, equity, economic viability, sustainability, and resilience [Food and Agriculture Organization of the United Nations (FAO), 2025; Juri et al., 2024; Gliessman, 2025].

Advancing these goals through agri-food system change will require the development of new initiatives and the social intellectual, economic and political infrastructure that fosters interdisciplinary and applied research, supports state and regional planning, advances policy integration, and enables evidence-based governance and scientific monitoring[1] across scales (Feenstra, 2002; Elsner et al., 2023; Miles and Hoy, 2023; Fanzo and Miachon, 2023; Gomes et al., 2024).

1 See for example: Measuring Sustainability in Food Systems: Advancing Scientific Indicator and Metric Systems for Monitoring Progress Toward the UN Sustainable Development Goals. Frontiers in Sustainable Food Systems, Social Movements, Institutions and Governance.

This Frontiers in Sustainable Food Systems Research Topic explores the role of food system transformation in realizing the UN SDGs by highlighting innovations, case studies, challenges, and strategies from diverse global contexts. The following 29 articles are organized thematically to underscore their key contributions to both knowledge and practice. They provide worldwide coverage of key topics, with contributions coming from Asia, Africa, Europe, North and South America, Oceania, and the Middle East.

1 Food waste, diet, and consumption patterns

Al Khatib et al. presented a cross-sectional study of food waste in Al Ahsa, Saudi Arabia, revealing excessive household food loss driven by cultural practices and a lack of awareness, with implications for the country's SDG 12 goal. An et al. assessed the perceived risks and risk-reduction behaviors with seafood consumption in South Korea, identifying key health concerns and behavioral modifications that shape consumer choices. Wyma and Niesing examined how dietary shifts in healthcare systems in the United States, Austria and Taiwan reduce food-related greenhouse gas emissions and offer health co-benefits.

2 Public health, nutrition, and gender equity

Goh et al. conducted a transdisciplinary research project examining global food environments and their effect on diet-related health outcomes, emphasizing the roles of policy, infrastructure, and education in shaping sustainable and healthy diets. Adam et al. evaluate gender equity in aquatic food systems globally through the lens of sustainable food systems, revealing institutional blind spots and a range of strategies to empower women. Dubey et al. highlighted lessons from Odisha, India, where community-based aquaculture initiatives enhance nutrition and women's empowerment through the co-management of natural resources.

3 Food system planning, digital infrastructure, and agri-food governance

Zougris et al. found strong support among U.S. food planning practitioners for a formalized National Community of Practice (NCoP) built around shared governance, trust-based collaboration, and alignment with the UN SDGs. Hyink et al. examined how measuring factors beyond financial resources, such as food access and sovereignty, can provide a more comprehensive understanding of food insecurity and contribute to achieving the UN SDG 2: Zero Hunger. Han et al., in "*Leveraging digital infrastructure for sustainable grain production: evidence from China*" illustrated how digital tools can enhance food productivity and resilience. Del Valle et al. provided a comprehensive analysis of public food security programs in Chile, offering cross-country lessons for policy alignment to effectively address food security challenges.

4 Agroecology, ecosystem services, climate adaptation, and mitigation

Ansari et al. evaluated the potential of climate-resilient agricultural practices in India to sequester atmospheric carbon under different climate and land-use scenarios using the Integrated Valuation of Ecosystem Services Tool (InVEST). Kwapong et al. used a mixed-methods approach to examine climate-smart agriculture (CSA) in Ghana, finding that while adoption is motivated by food security, income, and climate concerns, farmers prefer low-cost, low-labor practices suited to local contexts, exposing a mismatch with funder-driven strategies and interventions. Aryee et al. provided a conceptual framework to understand the interconnections between food insecurity and ecosystem services in Africa. To counter agricultural land degradation, water scarcity, and population growth, Mashatleh et al. explored the role of bacterial biofertilizers as a means to increase both crop yield and ecological sustainability of farming systems in the Kingdom of Jordan. Johansson et al. assessed the climate vulnerability of agroecological and conventional smallholders in Mvomero district, Tanzania.

5 Agriculture and the conservation of heritage landscapes

Medina Hidalgo et al. examined the sugarcane industry in Fiji, balancing cultural identity with adaptation to climate and economic stressors. Du et al. explored ecological compensation strategies to conserve agricultural heritage, focusing on the mountainous *Juglans hopeiensis* planting system in Beijing, China.

6 Industrial development, technological innovation, trade, and land use

Yusheng et al. used provincial data (2006–2021) to show that government-led improvements in farmland infrastructure and quality significantly increase farmer income, highlighting farmland improvements as a key factor in rural income growth and food security in China. Huang and Fu examined the factors affecting the willingness of farmers in Henan Province of Central China to engage in traceability systems—monitoring agricultural products from farm to point of sale—to promote the adoption of sustainable agriculture practices. Zhu et al. assessed land-use conflicts in Yancheng City, China, calling for multifunctional land management strategies to address food insecurity and realize SDG 2: Zero Hunger. Yan et al. conducted a systematic literature review on eco-product value realization and rural revitalization, exploring their potential for controlling karst desertification, with insights spanning from 1997 to 2023. Ajaj et al. highlighted how Industry 4.0 technologies, such as artificial intelligence (AI) and robotics, can revolutionize food and agriculture and contribute to the realization of SDG 1: No Poverty by improving productivity, sustainability, and food security, with a focus on empowering vulnerable populations in Africa.

7 System indicators and frameworks

Shon and Miles prioritized key food security indicators and metrics for the U.S. state of Hawaii, highlighting replicable methodologies for designing context-sensitive SDG indicators and metrics. Yuting and Meng presented a food security indicator system for China with integrative tracking mechanisms, showing that while food security improved from 1961 to 2019, challenges such as low urban wages before 2015, rapid population growth thereafter, and declining dietary diversity remain major threats, and underscoring the need for targeted policies. Wei et al. showed that China's food security improved from 1980 to 2017, with a mostly stable supply—demand balance supported by government policies. However, occasional shortages arose influenced by climate variability, natural disasters, and land use changes.

8 Social innovation and community resilience

Dejene et al. examined subjective resilience among women and youth in social innovation projects in five Ethiopian regions. de Vries et al. presented a study of 52 European food system cases that highlighted the role of inclusive partnerships, including private sector actors, smallholders, and academics, in co-creating sustainable value, identifying public and civil society actors as key to scaling interactions. Nzima et al. examined diversity within smallholder vegetable farming systems in Malawi and its effect on food security and income, offering important insights into achieving food system resilience. To address hunger and increase resilience throughout the food system, Soma et al. investigated whether spirulina protein, a nutrient-rich, blue-green algae, is a suitable alternative to fishmeal protein normally used to feed juvenile Nile tilapia in aquaculture systems.

This Frontiers in Sustainable Food System Research Topic contributes to the scientific and applied foundations for advancing the UN SDGs through food system change at the regional, national and international levels. Taken together, the studies collected here emphasize that meaningful transformation requires agroecological and technological innovation, participatory governance, the development of new social infrastructure, context-specific measurement tools, social innovation, and sustained investment from both the public and private sectors. We hope that this Research Topic will help guide and inspire food system transformations toward the achievement of the UN Sustainable Development Goals.

Author contributions

AM: Writing – original draft, Conceptualization, Writing – review & editing, Supervision, Project administration. BP: Writing – review & editing. EB: Writing – review & editing.

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