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Despite decades of resistance in the USA, agroecology is gaining momentum as a catalyst for food systems transformation, calling for coordinated action between science, practice and movement to dismantle the dominant industrial paradigm.

The alarming convergence of ecological, health and societal crises underpins the urgent need to transform our agricultural and food systems[1]. The global food system, with industrial agriculture at its core, poses a significant threat to our planet's health, contributing to climate change, biodiversity loss and food insecurity, which is known as the triple threat to humanity[1,2]. The hidden costs of a global food system that relies on industrial agriculture is estimated to be US$12.7 trillion, with the vast majority driven by public health crises due to unhealthy foods that disproportionately burden the lowest income people[3].

Given its significant influence on the global food system, the US food and agricultural system undeniably contributes to the staggering challenges we face today. Together, highly mechanized agriculture, monocultures, reduced genetic diversity, growing dependence on chemical and pharmaceutical technologies and consolidation of farms characterize a predominantly industrialized agriculture and food system in the US with high externalized costs to the environment and human health. In light of these impacts, publications by the National Research Council first in 1989 (*Alternative Agriculture*) and again in 2010 (*Toward Sustainable Agriculture in the Twenty-First Century*) expressed the need to transform the US industrial agricultural system[4,5]. These landmark publications noted a rise in sustainable practices by farmers but emphasized limited uptake and significant barriers to adoption. These barriers were re-emphasized and grouped into policies (at the international, national, state and local levels), market structures, and prices, and research and extension in 2011[6]. Despite recognizing these issues for decades, the USA lags significantly behind other industrialized nations in actualizing food systems transformation.

Current US policies continue to perpetuate the social and economic structures that maintain the dominant industrial agriculture regime. US foreign policy, such as the North American Free Trade Agreement[7], undermines efforts to maintain sustainable smallholder farming elsewhere, while food policy designed to support domestic sustainability efforts often fails to confront socio-political inequities that urgently require deep transformation[3]. In the past decade, the United Nations (UN) promoted agroecology as the transdisciplinary solution to resolve the global food system's multidimensional challenges[8] (Fig. 1). What distinguishes agroecology from previous attempts to transform the US agriculture and food system is that agroecology directly addresses the social–political, economic, health and environmental problems ignored by the industrial, corporate-dominated system. In this piece, we define agroecology, describe its current momentum and future prospects, and consider challenges and opportunities for policy to support agroecology as a means to food systems transformation in the USA.

Agroecology as a transdisciplinary global solution

Agroecology is a framework for redesigning agriculture and food systems that intentionally integrates social, ecological and political principles to revitalize nature and foster a more just society. Agroecology is commonly recognized as the intertwining of three spheres: science, practice and movement, merging the scientific discipline, alternative agricultural practices and political movements for food systems change[9]. The High Level Panel of Experts (HLPE) on food security and nutrition of the UN defined 13 principles of agroecology to achieve this transformation in 2019[8], which, as we illustrate here, all require coalitions between the science, practice and movement spheres (Fig. 1).

Agroecology is one of many alternative approaches to agriculture that have emerged globally. Most prominent in the USA are organic and regenerative agriculture[10]. These alternatives emerged in the USA historically alongside back-to-land, environmental and civil rights movements. Today, they are often criticized for focusing primarily on changing agricultural methods, which may target direct drivers of ecosystem decline (for example, soil loss and greenhouse gas emissions) while leaving existing socio-economic structures intact or having less explicit focus on social change[9]. Agroecology differs substantially from these alternatives because it transcends the alteration of agricultural practices, encompassing a broader transformation that purposefully extends to political structures, policies, scientific paradigms, cultural norms and economic models to collectively forge an equitable and just food system. Adopting the core principles of agroecology promoted by the HLPE and UN would be a sea change from past food policy in the USA that has stalled progress.

Towards food systems transformation in the USA

Given that the current institutions, policies and infrastructures of the US agriculture and food system uphold the dominant industrial regime, the wide-scale adoption of agroecology as a transformative paradigm has encountered significant obstacles. For instance, agroecological projects face funding disparities compared with conventional agriculture projects, hindering access to resources[11], while United States Department of Agriculture (USDA) discrimination against Black, Indigenous and other farmers of colour persists[12]. Although agroecological practices have been occurring for centuries in the USA, arguably long before the term was developed, the term 'agroecology' has so far remained predominantly in the confines of academic institutions and non-governmental organizations (NGOs). Agroecological practices include specifics such as biological nitrogen-fixation, biological control, agroecosystem redesign such as diversified farming, perennial agriculture, and food system structures such as community supported agriculture (Figs. 1 and 2)[8,9]. The USA has historically focused on agroecology as a science, which developed from agronomy and ecology disciplines beginning in the 1920s[9]. Without recognition as a

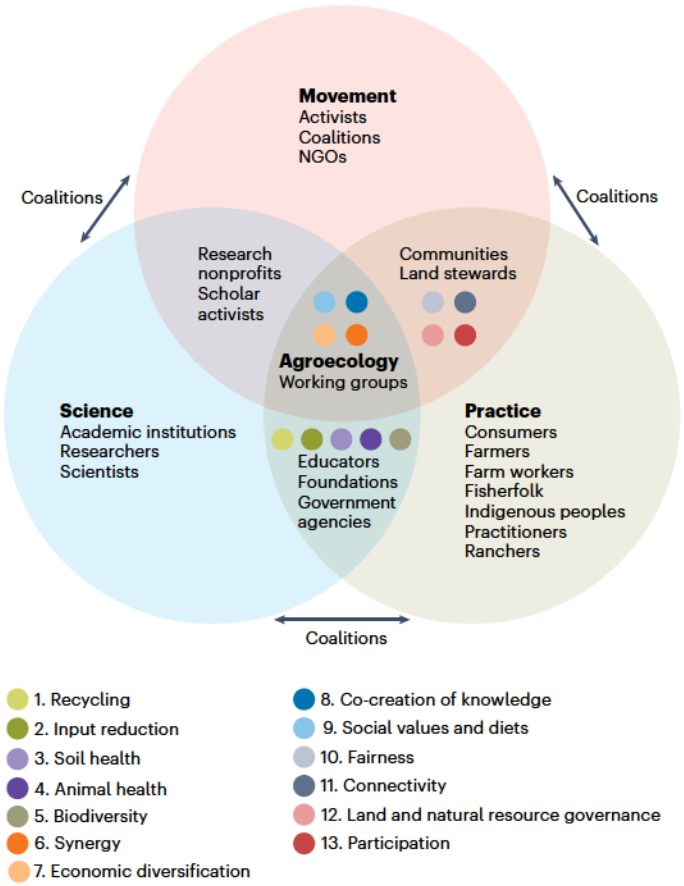

Fig. 1 | HLPE principles of agroecology and how coordination across spheres of agroecology (science, practice and movement) are necessary to achieve them. The 13 HLPE principles of agroecology are indicated by circular icons positioned in relation to agroecology spheres (science, practice and movement). Arrows indicate coordination between spheres necessary to achieve the principles. Text indicates key actors working within and across main spheres.

legitimate alternative to industrial agriculture, the scalability of agroecology practices in the USA remains restricted and US farmers remain disconnected from the global agroecology movement.

In the past 15 years, however, grassroots recognition and support for agroecology as a catalyst for food systems transformation in the USA grew considerably. The US Food Sovereignty Alliance was established in 2010, with its expressed mission to "connect our local and national struggles to the international movement for food sovereignty." La Vía Campesina, the international peasant movement, coined 'food sovereignty' in 1996 as the right to define, produce and consume healthy and culturally appropriate foods in an ecologically sustainable way that protects farmer rights and ways of life. Vía Campesina has long advocated for agroecology as the means of achieving food sovereignty, with this terminology later picked up by the World Bank and the Food and Agriculture Organization. Sedgwick, in Maine, passed the first US food sovereignty ordinance in 2011, followed by seven additional states within six months (VT, MA, GA, NC, UT, WY and MT)[13]. Vía Campesina organization member the Farmworker Association of Florida began a series of agroecology encounters between farmer groups based in the USA and international agroecology organizations as well as several regional conferences in the US mid-Atlantic, Pacific Northwest, west, and northeast from 2014–2023. Attendees included the Family Farm Defenders, Small and Heritage Black Farmers & Southeastern African-American Farmers Organic Network, National Family Farm Coalition and Migrant Justice. The diversity of advocates, from small- to large-scale operations, new to multi-generational farmers, farm workers to farm owners, and urban to rural farms together illustrate agroecology's broad appeal in the USA.

Institutional legitimacy for agroecology may also be rising in the USA. There are three centres or institutes for agroecology held at major universities in the USA: the Center for Agroecology at UC Santa Cruz, established in 1967, and most recently, the Lola Hampton-Frank Pinder Center for Agroecology at the University of Florida A&M established in 2022 and the University of Vermont Institute for Agroecology in 2023. They join more than 80 academic degree programs in the USA with coursework on agroecology. These institutions are poised to support the rise and diversity of grassroots movements seeking to differentiate themselves from status quo industrial agriculture and align with global movements of food systems transformation that currently champion agroecology. In addition, the USDA itself seems primed to pivot towards agroecology. Its programme for Sustainable Agriculture Systems encourages transdisciplinary research, education and extension for transforming the US food system, and has already distributed more than US$11 billion towards agriculture-related science since its establishment in 2018[14].

In 2021, USDA staff reached out to agroecologists seeking guidance about research agendas and funding needs to improve support for agroecology. In response to this request, a group of 10 scientists (primarily from public universities) organized a US-focused Agroecology Summit in 2023, selecting a group of 100 people spanning academia, civil society, farmers and other food-system stakeholders to attend and offer their perspectives. Conveners sought to develop a comprehensive agenda for agroecological research priorities and delineate strategic pathways for an agroecological transformation in the USA.

While the summit was intended to focus on research, participants brought a wide range of concerns about promoting agroecology in the USA, including critiques of the exclusivity, lack of participation and unequal benefits of standard research processes for key actors engaged in and across agroecology's spheres (Fig. 1). Ultimately, rather than a single agenda for research, a number of outcomes emerged: a 'community of practice' for agroecological researchers and collaborators; a working group on 'data sovereignty' for communities whose lives and work are subject to agroecological investigation; a journal special issue gathering diverse voices from the summit; conversations addressing the 'scaling out' of agroecology (and associated research agendas); suggestions for allocation of USDA funding towards research that prioritizes equitable participation for grassroots actors such as farmers, farmworkers, food insecure communities and Indigenous peoples; a call for future summits where the three spheres of agroecology (Fig. 1) are more carefully balanced; and the development of this perspective piece oriented towards a broad scientific audience for whom we call on to co-develop the ethical transdisciplinary research (and policy) critical to agroecology's success.

Plurality and legitimacy moving forward

Uptake of agroecology in the USA will require increased scientific and political legitimacy while maintaining a broad pluralism that honours diverse constituencies, ways of knowing and political visions for food systems transformation. As agroecology attempts to gain legitimacy in

Fig. 2 | Diversified farm field illustrating agroecological practices. A community farm in Grafton, New York, United States. The farm is Black, Indigenous, and People of Colour-centered and uses organic and ancestral farming techniques to combat racism and injustice in the food system. (Used with permission): Soul Fire Farm.

the USA, there is a need to engage with mainstream scientific, political and social institutions to deconstruct structural barriers. To be clear, seeking convergence and alignment with 'more powerful' entities does not inherently require assimilation with, subordinance to or co-optation of agroecology by the dominant paradigm — but it is a risk. For instance, large corporate farm managers seeking to adopt a few agroecological techniques while otherwise maintaining the status quo may receive institutional advantages over smaller efforts that prioritize food systems reorganization. While agroecology may benefit from the support of powerful scientific, policy-making or political institutions, cultivating plurality and decolonizing ways of knowing will be key to generating the equity and justice goals embedded in agroecology. For example, agroecology gained momentum within the larger sociopolitical context of anti-racist and anti-colonial movements in the USA[15]. At the same time, conservative middle America increasingly seeks alternative food futures that can restore rural autonomy, which has precipitously declined with climate change and pandemic-induced reductions in commodity prices, increased contract farming and reliance on government subsidies, and continued consolidation and loss of multi-generational family farm operations. Thus, an intentional alliance between the plurality of alternative agricultures, the legitimacy conferred by powerful institutions and the upsurge of mission-aligned social movements may magnify momentum and create solidarity in US agroecology.

To establish equity among the three spheres of agroecology, we must acknowledge and work towards dismantling structures that elevate science above the rest. Regarding science as more objective or legitimate than other ways of knowing denies the veracity and usefulness of farmer, traditional ecological and Indigenous knowledge. Instead, we acknowledge that pluralistic thinking is standard for people outside of the dominant — western — paradigm and that plural visions of agroecology already exist worldwide. Only when science, practice and movement exist on equal footing can conditions for trust emerge, fostering the coordination between diverse actors necessary to bring agroecology's transformative potential to fruition. Our shared vision for US agroecology is one where a diversity of key actors work collaboratively to identify and resolve complex food systems challenges, where practitioner research and experiences are recognized as valid science and legitimate ways of knowing, and an agroecology where activists, farming practitioners and scientists fairly negotiate and share decision-making power. Moving forward, coordination across diverse actors may serve to foster plural visions of agroecology with the grounding support of institutions and the power of multiple aligned social movements for change, ultimately bridging activism, science and practice to advance agroecology in the USA.

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Competing interests

The authors declare no competing interests.

Additional information

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