



Transforming to a regenerative U.S. agriculture: the role of policy, process, and education

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Abstract

U.S. agriculture is both a major source of global food and a key contributor to multiple interconnected crises. Climate change, biodiversity loss, and severe impacts on soil and water quality are among the challenges caused by U.S. industrial agriculture. Regenerative methods of farming are necessary to confront all these challenges simultaneously, in addition to addressing the increasing challenges to farm labor conditions. Transforming U.S. agriculture to a regenerative system will require a focus on creating traction for the values, beliefs, worldviews, and paradigms that effectively support such transformation while decreasing the friction that works against them. With a focus on creating traction for transformation, we review the factors and processes that tend to promote and maintain ecological improvements on farms. Starting from a case study that points to some of the sources of friction and traction in the current U.S. agricultural system, we use the framework of three spheres of transformation to focus discussion on how processes that form beliefs and values shape and can reshape farming. We develop a series of points of entry for engaging the systemic changes that will offer farmers traction for transformation. We review literature on agricultural networks, polycentric governance, social learning, agricultural education, and farmer characteristics that lend themselves to ecologically mindful change, thereby identifying interventions that tend to provide traction for change. These approaches, and the supports that allow rural communities and the people that work in them to survive and thrive, are necessary to create the traction needed for farms to undergo a shift to regenerative agricultural practices. We link these changes to the promise of the twentieth century New Deal agricultural programs and the potential of the Green New Deal.

Keywords Three spheres of transformation · Agriculture · Friction · Traction · Education · Climate change

Introduction

Two members of the U.S. Congress introduced their version of the Green New Deal to the country in 2019 (Congressional Research Service 2019; Nilsen 2019). One set of provisions in the resolution calls for reducing greenhouse gas emissions from agriculture while supporting family farming. The resolution also calls for close attention to impacts on “front-line and vulnerable communities” in all policies relevant to

addressing climate change (Congressional Research Service 2019, p. 11). The bill signals the need to address the biggest environmental and social challenges of the present. As it applies to the food system, the need for such sweeping approaches is clear. In its current form, the food system’s poor labor conditions, ecologically damaging practices, and inadequate support for agricultural change increasingly lock the system into a configuration that is ill-prepared to address the climate change crisis (Bauer and Stewart 2013; Smith et al. 2014; DeLonge et al. 2016; Calo 2017; Dudley and Alexander 2017; Mateo-Sagasta et al. 2018; U.S. Department of Labor 2018; Medina et al. 2020; Paudel and Crago 2021). In its final provisions, the Green New Deal gestures at the deeply democratic approaches envisioned and, temporarily, enacted toward the end of the original New Deal (Congressional Research Service 2019; Gilbert 2015). In an effort toward a deeply democratic agrarian society, a set of New Deal USDA planners worked to develop a collaborative

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approach among social scientists, farmers, extension, and natural scientists. The program emphasized both cooperative planning and education for all participants (Gilbert 2015). The democratic gestures of the Green New Deal could be similarly fleshed out in farm policy. This article focuses on the processes necessary to produce transformations to sustainability in agriculture with emphasis on the need for more democratic approaches to spur and support such transformations. Such shifts require making sense of the values and beliefs that undergird our current systems.

Although climate change is receiving increased attention from technological managers within the agricultural system (Bassett and Fogelman 2013; Newell and Taylor 2017; Rose and Chilvers 2018; Clapp et al. 2018; Gosnell et al. 2020), far too little attention is paid to the underlying values and beliefs that continue to prop up an untenable farming system. As Gosnell et al. (2019) note, more attention must be focused on the “nonmaterial” aspects of agricultural transformation. The affective and social dimensions of change have received increasing attention from scholars focused on climate transformation (O’Brien 2009, 2018; Adger et al. 2009, 2012; O’Brien and Wolf 2010; O’Brien and Sygna 2013; Veland et al. 2018; Marshall et al. 2019), but with little application to particular sectors, especially those where transformations are most urgent (but see Marshall et al. 2019; Gosnell et al. 2019). The transformation of U.S. agriculture will require deeper engagement with the affective and social aspects of agricultural change (Patnaik and Jongerden 2021; Weis and Ellis 2021). Transformative change, both with and beyond policy, is needed if the core paradigms of agriculture are to shift (Deijl and Duncan 2021). To understand how such change can occur requires investigation of the ingrained values, narratives, beliefs, emotions, and worldviews of farmers and of the larger agricultural community and the processes that shape them.

Agriculture in the United States is ripe for transformation. Its fundamental dependence on human/non-human interactions and cooperation with the natural world makes farmers acutely aware of the challenges presented to them by forces like climate change, even though they may not acknowledge the anthropogenic sources of that change (Mase et al. 2017; Running et al. 2017). The multifaceted nature of the challenges to agriculture, including the need to eliminate nitrogen- and phosphorous-based pollution of water (Paudel and Crago 2021), to recover biodiversity within and beyond the food system (Lin 2011; Dudley and Alexander 2017), to offer sustainable, living wage employment to its workers (Holmes 2013; U.S. Department of Labor 2018), to eliminate its net contributions to greenhouse gas emissions (USGCRP 2018), all while producing adequate, diverse food for people in and beyond the U.S. demands a response that works to address all of these challenges, namely regenerative practices.

For our purposes, we define regenerative practices as those that aim to improve the ecological conditions of a farm while also producing food. Such practices include those that rebuild soil, substantially diversify desired species on the farm, fix soil carbon, radically decrease run-off and leaching of soil nutrients, and whose overall intended effect is to create systems that draw down carbon and eliminate practices that pollute (Regenerative Agriculture Initiative and The Carbon Underground 2017; Gosnell et al. 2019). In addition, regenerative practices should have as their goal effective livelihoods for farmers and farmworkers, which is in line with Francis and Harwood’s (1985) call for regenerative systems to value “environmental, social, economic and spiritual wellbeing” (in Gosnell et al. 2019, p. 4). Although they may also encompass definitions such as certified organic, agro-ecological or biodynamic, the key to classifying practices as regenerative is that the practices improve ecological conditions on the farm (not just sustain a status quo) and improve conditions for farmers and farmworkers. While a diverse group of farmers from across the U.S. engage in regenerative practices, they are a minority of farmers, just as organic farmers have long been the exception rather than the rule.

Why have practices like organic and regenerative methods not become a more widespread challenge to the dominant paradigm? There are a number of structural and systemic reasons for this. Federal agricultural programs encourage commodity crops and machine-managed monocultures (Ramey 2014). The top-down nature of agricultural extension has also limited the influence of farmer innovation (Lubell 2004). As agricultural systems face new ecological challenges, a focus on technical fixes has prevented a move toward system-wide changes in beliefs about what agriculture can and should accomplish. Within the U.S. agricultural system, the focus tends to be on “biophysical risks and technical solutions to minimize losses” as it is in many sectors that focus on responses to climate change (Bassett and Fogelman 2013, p. 44). This resilient form of adaptation “allow[s] existing functions and practices to exist” (Pelling 2011, p. 50) but it is “a politically conservative approach to adaptation,” ensuring the maintenance of most prevailing systems (Bassett and Fogelman 2013, p. 44). A move toward regenerative practices necessarily requires a different approach to climate challenges, one that better acknowledges the broader vulnerabilities of the system and that addresses challenges inherent in some ingrained ways of thinking about food production.

This article presents a critical review and synthesis of agricultural change scholarship that points toward rethinking how agricultural transformations come about. We review processes of education and policy-making with the potential to address agriculture’s challenges through attention to the social and affective aspects of change. We frame this paper as a “review,” while acknowledging the epistemological

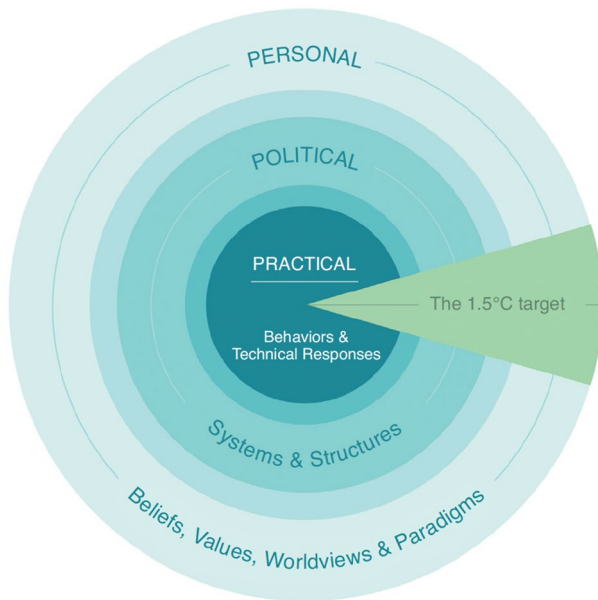


Fig. 1 The Three Spheres of Transformation from O'Brien and Sygna (2013)

restrictions that come with repeatedly revisiting published work. We ground our conclusions in existing scholarship and model the transformational thinking for which we are arguing by making suggestions that contribute to a future aligned with the U.N. Sustainable Development Goals. Below, we begin by assessing the sources of friction and traction in U.S. agriculture that are most relevant to transformative change. We then review the means through which traction for agricultural change is effectively fostered. Working from the assumption that regenerative practices are an important and necessary goal of agricultural transformation, we argue that to engage in a transformation to regenerative methods, closer attention must be paid to processes of transformation.

Transformations in agriculture: from friction to traction

Framing transformations

To assess how transformations to regenerative and sustainable practices occur and what may be necessary for their application to the U.S. agricultural system, we engage with the concept of transformation through the heuristic of the three spheres of transformation (O'Brien and Sygna 2013) and build on the analysis of Gosnell et al. (2019) that employs a model of friction and traction (Head et al. 2013) to describe when and why transformation unfolds. The three spheres of transformation are visualized as a set of nested spheres (Fig. 1), with the practical sphere of transformation

at the center, the political the next larger sphere, and the personal sphere surrounding the other two. The behavioral and technical changes brought about in the practical sphere are influenced by the systems and structures of the political sphere, and each is influenced by the personal sphere, which includes both individual and shared beliefs, values, worldviews, and paradigms. In agriculture, the choice of new crop varieties or changed farmland management (practical sphere) are affected by the governmental supports, market availability, and social acceptability (political sphere) of a given set of options. Both of those are, in turn, shaped by the ways in which farmers, policy makers, researchers, and extension agents perceive, feel about, and think about the larger system. Although the three spheres interact simultaneously, the most substantial and enduring changes to the system, therefore, happen through transformation in the personal sphere (Meadows 2009; O'Brien and Sygna 2013; Abson et al. 2017).

Friction and traction

The methods and manner of agricultural transformation matter. The personal factors that shape farmer decision-making run deep and inform decisions in ways that are unpredictable, particularly when it is assumed that farmers are merely rational actors. Farmer decisions are shaped based on their “evaluation of [their] capacity for action,” their identities, their sense of what maintains social cohesion, and what represents a “defense of their profession” (Michel-Guillou and Moser 2006, pp. 233–234). In considering the future of their farms, their thinking is shaped by place attachment and ties to their occupation in ways that may limit their propensity to radically transform their systems (Eakin 2005; Marshall et al. 2012). Yet, having developed the skills and abilities to increase their comfort and familiarity with managing complex systems, farmers may feel a greater sense of agency, a stronger internalized locus of control, and the positive self-concept that result in more pro-environmental behavior (Price and Leviston 2014). Conditions that support such changes are forms of traction, and conditions that slow and prevent such changes are forms of friction (Head et al. 2013; Gosnell et al. 2019). Effective agricultural transformation, then, relies on making sense of how farmers think and feel about their systems and incorporating components of educational and policy change that not only acknowledge the need for traction in the personal sphere, but that explicitly frame their goals in terms of existing and emerging beliefs, values, worldviews and paradigms. To approach an understanding of why these affective, cognitive, and social dimensions of transformation matter, we first present two cases that illustrate the need for traction on farms. We then lay out the personal sphere dimensions of agricultural change and their relationships with policy and practice.

Illustrating the need for increased traction

Examples of friction and traction from New Mexico

Two examples from New Mexico help to demonstrate the need for increased traction for transformation through the political sphere. Farmers in New Mexico have experienced increasing challenges from drought and severe weather during the twenty-first century, and modeling suggests the hurdles will only increase as climate change accelerates (Garfin et al. 2013). Despite the heightened difficulty of farming, however, few farmers in New Mexico engage in transformative change. Farmers largely acknowledge a changing climate, but attribute it to long-term natural cycles (Day 2018). In semi-structured interviews undertaken in 2015–2016 with 30 farmers on 25 farms in Doña Ana, Luna, Roosevelt, and Curry Counties in New Mexico, farmers discussed their farm management decisions over the period 2005–2015. Of these farmers, only two of 16 conventional commodity growers and two of three large-scale organic growers undertook some form of transformational change to their systems (Day 2018). Yet, those that did engage in transformative change identified the many sources of friction in the practical and political spheres that tend to prevent transformation from occurring. For example, one farmer, Mateo,¹ described the crisis that led him to adopt organic agriculture along with sources of traction for his choice:

...that's when my first—my son was born and while sitting in the barn with the barn full of poison, you know, herbicides, insecticides and I thought—and then the conventional farming was in the dumps.

You know, we weren't making any money. You'd go a whole year end up just kissing your sister, you know, that's no fun. So, when—about that time, Buhler mills from Switzerland came by looking for an organic grower. And I thought, well, you know, it might be worth a try.

Mateo's case illustrates how transformation through both the personal (emerging ideals of protecting his children) and political spheres (appearance of an organic buyer) simultaneously enabled him to undertake the shift to organic production. Traction in the political sphere helped him further his transformation: the difficulty of cleaning equipment between its use on conventional and organic fields to meet USDA organic regulations encouraged him to convert to fully organic farming. His organic network, including distant national and international market connections, also acted as sources of traction for him to maintain his organic choice. But ultimately, he has not gone further toward regenerative

methods after 20 years as an organic grower. Why? In this author's time researching agricultural change in southern and eastern New Mexico, there were no farmers engaged comprehensively in what we define as regenerative methods. In addition, there were no people in Mateo's network who were advocating for any methods that went beyond the USDA organic regulations. So, Mateo had no influences affecting the personal or political spheres of change beyond those advocating for organic methods.

Another farmer, Zach, offers a different perspective. Like Mateo, Zach was a farmer intent on transforming his system, and on building an agricultural community that offered strong economic support to his workers as well as ecological improvement to his farm. Zach, like Mateo, had a strong national network influencing his on-farm decisions. In his case, the national network was made up of acquaintances from the US Farmers and Ranchers Alliance meetings and from social media. And he was making substantial positive environmental contributions, like cleaning up past harms from area farming:

And [a previous chicken farm on the site] ended up contaminating the ground water because they couldn't get rid of all the chicken litter and so Land O'Lakes ending up buying this company and Land O'Lakes said this does not meet our code at all, stopping production now, and it sat for almost 10 years. And it killed this whole community of Berino. I mean, it just [created] unemployment and it really hurt us....

And so our plan for cleaning up the contaminated groundwater is to pump a limited amount of that up and mix it with clean water. And the groundwater that's contaminated has high nitrates, which is perfect for growing. It's free nitrogen. So we're going to utilize that and here we go.

Zach's example demonstrates how the damage from poor policy and enforcement can be transformed by a farmer who experiences such damage as inspiration to right a wrong. With traction derived in part from peer support, Zach developed a farm business plan that capitalized on past environmental damage. But most of his methods were carbon-intensive and generated soil erosion (e.g., through tractor use, greenhouse cooling and heating systems, extensive use of heavy machinery). Why were his methods of regeneration limited? Again, no one in his agricultural networks was practicing nor advocating for regenerative change. Both farmers plow their soils and make extensive use of heavy machinery, practices known to cause soil loss and create greenhouse gas emissions. Yet these were farmers who cared deeply about their communities and the environmental impact of their farms. Without a model of effective regenerative change, and without a supportive network to offer traction for changes they are

¹ Names used are pseudonyms.

inspired to make, even farmers who care about environmental improvement are unlikely to engage in regenerative practices. Farmers in the studied areas of New Mexico lacked traction for regenerative change through all three spheres of transformation.

Achieving transformational traction

According to Gosnell et al. (2019), a farmer's move toward transformative adaptation gains traction through an iterative process involving interactions with both the farm and with the wider agricultural community (the political sphere of transformation). At the same time, other on-farm and community factors may cause friction with a farmer's changing beliefs and practices and draw a farmer's actions back toward the status quo (Gosnell et al. 2019). Since the deeper goals of transformative adaptation are to consciously create alternatives (O'Brien 2012) to systems that intensively emit greenhouse gases while also reducing the vulnerability of systems and people most affected by climate change, system-wide approaches are necessary. Counseling individual farmers through such transformation processes appears untenable simply because of the scale and rapidity of necessary change. Industrial agriculture must undergo a substantial and systemic change, which will depend on the beliefs and values held by farmers as well as farm advisors, policy makers, and others who constitute elements of the political sphere of transformation. In terms of leverage on an individual's decisions, the personal sphere offers the most substantial leverage for change, but as Gosnell et al. (2019) describe, friction in the political sphere must be decreased to enable farmers (and others) to envision and sustain necessary change.

So, if policy makers want to find an effective means of intervention, perhaps their most important point of entry will be in decreasing the "friction" and reinforcing sources of "traction" that farmers experience (Gosnell et al. 2019). Within the U.S. context, major sources of friction include the political influence of large agricultural corporations and conventional farm organizations that limit possible policy changes toward sustainability (Carolan 2016), as well as farmer isolation (Roy et al. 2017), an agricultural education system mired in old paradigms (Cramer et al. 2019), an extension system that most often follows agribusiness-funded research rather than supporting on-farm innovation (Lubell et al. 2014), and policy narratives that undervalue supporting essential needs (e.g., healthcare and education) and that block immigration, with profound consequences for farm labor availability and health (Taylor et al. 2012; U.S. Department of Labor 2018). Building traction requires support in overcoming these and other important sources of friction, while also building processes that result in new traction for on-farm change.

Entry points for transformational traction

In Sects. 4 and 5, we lay out six entry points to improve traction for transformation within U.S. agriculture. We outline a series of important entry points for moving from friction to traction, based on a review of the literature on agricultural change. Since much has been written about the extensive challenges and crises in the conventional food system, we focus instead on opportunities for transformational change.

The practical outcomes that we are interested in each point to aspects of transformation in the personal sphere, but all require transformation in the political sphere to offer farmers, educators, and policymakers sufficient traction for change. To increase transformational traction in the personal sphere, agriculture needs opportunities for new and strengthened network connections, increased polycentric governance, expanded social learning, improved formal agricultural education, better attention to the ways that farmers make decisions, and increased supports for new farmers. As Sect. 5 will address, transformation will also require reforming the social supports for farmworkers and rural people more generally and creating funding for the programs that support personal sphere transformation.

Networks and polycentric governance

Networks

Farmer networks are an important arena for developing traction for change. Nonetheless, local networks that are dominated by the industrial agriculture paradigm tend to keep farmers within conventional farming, rather than encouraging exploration of new solutions (Gray and Gibson 2013). Such stagnant networks may benefit from the intentional introduction of what Olsson et al. (2006) refer to as "shadow networks." These are entities, and even unofficial groupings of individuals, who experience sufficient independence from politics and regulation to allow new ideas to arise and flourish. In agriculture, they may include communities of practice among farmers (Cross and Ampt 2017), but also include networks that span the broader agricultural landscape influencing policy and markets. In Table 1, we draw together examples of such shadow networks. We chose examples of organizations that offer a representative cross-section of the voices that often go unheard within conventional agriculture. Pelling et al. (2008) suggest that one of the necessary elements of climate change adaptation is increasing the connections among such shadow networks and between innovators. Building such connections in farming is a necessary element for system-wide transformation.

Table 1 Example shadow network organizations, curated by the authors and based on each organization's online mission statement, reflect diverse foci and regions

Organization and focus	Potential polycentric role
Federation of Southern Cooperatives Black farmers	Raise awareness of issues in black family farm communities; Offer ideas for federal and state policies that better support a diversity of farmers, including black farmers; Advocate for the development of cooperative enterprises within agriculture and rural areas, including influence on federal and state policies;
National Young Farmers Coalition New and young farmers	Lobby at federal level for policies necessary to support young and beginning farmers (current focus areas include land access, student loan debt, labor, sustainability/climate, racial equity) Connect individual state and regional chapters to national body for unified message and advocacy Offer training for young farmers in response to federal policy changes (example: Food Safety Modernization Act)
Native American Agriculture Fund Native American farmers	Raise awareness of indigenous food security challenges Support preservation and viability of indigenous foodways and agriculture Educate allies and advocate on behalf of Native American farmers Uniquely, NAAF funds <i>cannot</i> be used for lobbying or political activity
Native Seeds/SEARCH Southwestern US food system	Maintain a seed bank of ~ 2000 crop varieties adapted to arid SW US landscapes Offer Indigenous individuals priority access to their traditional seed varieties Provide training in seed saving and farming techniques to regional farmers
Regeneration International Regenerative agricultural practices	Develop and provide information about regenerative agriculture to producers, consumers, and policy makers Build networks of organizations and individuals committed to regenerative agriculture through Regeneration Alliance initiatives Offer online hub to connect individuals, funders, and communities
Women, Food, and Agriculture Network Women farmers	Strengthen the leadership role of women in food systems transformation through "Plate to Politics" training program Support women landowners in making conservation-minded land management decisions through "Women Caring for the Land" program Represent needs and voices of women farmers to local and national governing bodies
The Land Institute Perennial, regenerative agriculture (mid-US prairie)	Develop and promote "Natural Systems Agriculture" Breed and domesticate perennial staple crops Bridge human culture, agriculture, and ecosystems through Ecosphere Studies research Build capacity for regenerative perennial grain agricultural economy through education
Union of Concerned Scientists Scientists, analysts, policy experts	Conduct research on specific sustainable agriculture topics including soil preservation, climate resilience Propose policy solutions for a more resilient agricultural system based on research Activate networks of supporters to push for transformation and communicate with media
Farmworker Association of Florida Hispanic, Haitian, and African American farmworkers in Florida	Build capacity of farmworkers to advocate on their own behalf in decision-making processes Develop partnerships with other farmworker organizations to organize around labor issues Raise broader awareness of issues concerning farmworker rights

In agriculture, transformations within sub-sectors, including organic farming, have arisen partly because of the influence of such shadow networks, such as the Natural Farming and Back-to-the-Land Association in 1920's Germany and later the Rodale Institute in the U.S (Heckman 2006; Vogt 2007). However, they have failed to create the system-wide transformation necessary to renovate conventional agriculture and turn its goals toward ecological regeneration and human well-being. Drawing on information from varied and distant sources whose advice may differ substantially from that of family and neighbors can encourage the adoption of transformative practices (Dowd et al. 2014), as it changes the way farmers think about

what is possible on their farms (the personal and practical spheres). Increasingly, the availability of information from Internet resources allows farmers to access information from widely dispersed sources and to participate in active, online networks that offer support and shared identities to farmers whose neighbors may not share their farming philosophies (Laforge and McLachlan 2018). Local knowledge and local development of practices can also yield important insights when farmers engage in social learning with mentors and peers (Laforge and McLachlan 2018).

Agricultural networks vary widely precisely because of the diversity of elements from which they are constituted. Some farmers depend heavily on paid agricultural advisors

or family mentors while others seek out peer-reviewed literature available to them on the internet. Thus, the shadow networks likely to influence a farmer will vary as well. Consequently, we argue that transformational change to the U.S. agricultural system will require identifying and connecting organizations and entities who have been operating in relative unawareness of one another. A wide diversity of organizations (e.g., those in Table 1) must be aligned in the work of agricultural transformation, including and perhaps especially groups who can identify methods of change that are outside of the mainstream. Such networks and connections can provide traction for personal transformations.

Polycentric governance

As the examples of Mateo and Zach in the case study illustrate, the most innovative people and organizations that are oriented toward transforming the agricultural system are often poorly connected to those working closer to the conventional agricultural paradigm. Connecting organizations and people who have succeeded with regenerative methods with others to whom the methods are new is a vital element in creating traction for personal sphere change among farmers, extension agents, and policy makers (Gosnell et al. 2019). To reinforce expanded network connections, an expansion of polycentric governance can play a key role in the transformation of U.S. agriculture (Carlisle and Gruby 2019). Polycentricity “connotes a complex form of governance with multiple centers of decision making, each of which operates with some degree of autonomy” (Carlisle and Gruby 2019, p. 928). Decision-making units overlap across multiple jurisdictions from the local to the national and interact with one another to resolve conflicts, taking account of the needs and interests of others in the system. Ideally, they adapt well in the face of social and ecological change and can offer good institutional fit for a given governance problem (Carlisle and Gruby 2019).

A wide range of organizations are already involved in the governance of agriculture, particularly since every farm operator ultimately determines much of the governance of her own landscape. However, drawing more connections among farmers and farm entities is necessary for the transformation of agriculture for several reasons. With multiple, intersecting entities at different scales involved in agri-system governance, polycentric governance provides opportunities to magnify the voices of farmers as citizen-governors of the system. The highlighting of farmer voices, particularly the voices of marginalized farmers and of farmers who have made substantial strides in regenerating their systems (e.g., farmers represented by organizations in Table 1), will require intentional goal-setting, focused on supporting the voices of such farmers by more powerful members of networks. Such goal-setting may be supported by polycentric

governance that provides more opportunity for citizens to collaboratively set new agricultural objectives (e.g., citizens assemblies as discussed below), especially if some key governing entities work close to the scale of the resource being governed (i.e., the farm) (Carlisle and Gruby 2019). Such choices can allow for the better integration of the voices of aspiring, trainee, and new farmers, particularly in processes of special interest to them like land financing and access, access to capital, access to equipment and labor, and cooperative arrangements (Carlisle et al. 2019). Showcasing those voices will be especially important to agricultural transformation as newer, younger, and diverse farmers are more likely to engage in conservation practices (Prokopy et al. 2019).

Polycentric governance can be used to create new cross-linkages between conventional and alternative agriculture networks, allowing stories of farm-management-as-led-by-ecological-example to become part of the vocabulary of all agricultural land managers. Such connections must be intentionally created to share success stories from regenerative paradigms. Further, increased polycentric governance can magnify the voices of farmers in policy making at the county, state, and federal levels. Processes akin to citizens’ assemblies are needed to amplify the voices of those farmers whose interests are more poorly represented in farm legislation. By drawing from a representative swathe of the farm constituency, citizens’ assemblies can provide a more “informed, collective opinion on the issue that is independent of politicians, government, and other institutions” (Hayward 2014, p. 15). The organization New Mexico First, for example, has engaged throughout the state in iterative town hall meetings on New Mexican agriculture that bear a resemblance to such assemblies (one author has participated in these meetings). However, evidence suggests that to be effective, such groups must have prior agreement from legislative bodies that their decisions will be enacted based on a clear and limited set of recommendations on which a citizens’ assembly has voted (personal communication, Mira Pütz, May 29, 2020). Carefully enacting citizens’ assemblies for agricultural policy change is an important means of providing traction for agricultural transformation. In allowing the voices of new, socially marginalized, and innovative farmers to emerge, new institutional pathways may be forged provided the rules of the system are set up to enable such change (Carlisle and Gruby 2019). Thus, polycentric governance can reinforce itself. What does an increase in polycentric governance look like? It requires making active use of existing networks while also intentionally building bridges between those networks to form connections that do not currently exist or whose connections are weak. Organizations like USDA and extension must more purposefully seek out and create bridging connections to and between organizations like those in Table 1. For example, with the

2023 Farm Bill on the horizon, there is potential to expand mission elements of Climate Hubs (USDA n.d.), that already include “outreach” and “engagement,” to more comprehensively include social learning (see Sect. 4.2.1), governance discussions, and web-based linkages (USDA About Us). In collaborations with extension and non-profits, Climate Hubs could become key organizers of events that offer farmer-led training for climate adaptation and transformation as well as governance events like agricultural citizens’ assemblies. To further facilitate new connections, the Climate Hub web space could also become a clearinghouse for information on existing organizations. Such connections may shift, but the new ties between these networks must not be transitory or token. It also requires deliberately creating processes that highlight those voices and that allow for deep interaction of farmers and organizations that do not ordinarily encounter one another to an appreciable extent.

Education and social learning

Social learning

Another key point of entry for creating traction for transformation is learning processes. Extension systems in the U.S. have long relied on a top-down model for conveying information from university research to farmers (Carr and Wilkinson 2005; Lubell et al. 2014). Moreover, little of the focus of the USDA budget for extension and research has been on sustainable or agroecological methods (DeLonge et al. 2016). Yet, much sustainable, agroecological, and regenerative innovation has come from farmers themselves (Kroma 2006; Kummer et al. 2012; McKenzie 2013; Cross and Ampt 2017). Given these realities and the changes called for in the methods that extension services uses to build skills, knowledge, and expertise in agriculture (Lubell et al. 2014), grower knowledge, values, and worldviews must be leveraged to create transformation in the larger farming system. Social learning provides a context for nurturing innovation through such interaction between farmers and cooperators, as farmers are most likely to accept learning when it comes from fellow farmers, especially farmers they perceive as peers (Kilpatrick and Johns 2003; Wood et al. 2014; Laforge and McLachlan 2018; Gosnell 2021). Communities of practice, with their shared learning among innovators, represent an important example of where such learning can create effective traction for change (Cross and Ampt 2017; Gosnell 2021), although bridging learning to those practicing or advising on conventional agriculture is also a key element of the change we envision.

Social learning is “a process where learning occurs at multiple governance levels, bringing together stakeholders with diverging initial perceptions with the intention to learn together and form a common understanding with respect to

taking a planned course of action that they jointly implement by working in iterative cycles of action and reflection” (Phuong et al. 2017, pp. 6–7). Social learning can include on-farm experimentation in collaboration with supportive networks where farmers gain experience with evaluating new practices, developing new perspectives on their systems, and advancing their understanding and management of complex systems (Navarrete et al. 2018). It can also include participatory video (Fry and Thieme 2019) and role-playing games (Salvini et al. 2016) to intentionally created social learning communities that help to demonstrate the feasibility of new ideas and build trust among participants (Schneider et al. 2009; Salvini et al. 2016). Modes of social learning that involve farmers in knowledge production and give farmers opportunities to shape narratives about the means of effectively adopting new practices can be a powerful tool for reshaping farmer beliefs about a method (Fry and Thieme 2019).

Effective social learning in agriculture will (1) have goals set out collaboratively by stakeholders, (2) involve cycles of action and reflection as in the video and role-playing activities mentioned above, as well as through on-farm experimentation, online forums, and town-hall style discussions, (3) be an element of an engaged polycentric governance. Having an opportunity to dig into details with other farmers and ask difficult questions about what works, what does not, and why reshapes farmer perceptions, and can be transformative. In short, farmer-to-farmer learning is an important means of communicating the viability of new methods to farmers, as well as the possibility that they may succeed with the methods on their own farms. However, such learning requires intentionality: identifying farmers succeeding with locally appropriate methods of regenerative agriculture, building new network connections, and carefully crafting processes that can allow for thoughtful change. As Lubell et al. (2014) argue based on successful examples in California, social learning processes succeed when extension professionals are trained in learning together with farmers and move beyond the model of information passing “down” from universities to farmers. Such change requires funding for training extension professionals, development of “information and communication technology tools,” training-of-trainer programs that allow a wide variety of actors to learn the methods of social learning, and intentionally spanning boundaries among grower types by bringing different types of growers together at meetings (Lubell et al. 2014, p. 1100). As discussed in Sect. 4.1.2, Climate Hubs could usefully act as a key locus for funding and training.

The intentional implementation of social learning, with goal setting centered on regenerative methods, is vital for giving farmers and agricultural cooperators the opportunity to approach and explore new methods. Additionally, the systems to do so can be very effectively built on the existing

networks and organization of agriculture but require a change in focus as well as cross-sector discussion, planning, and implementation. Changing agricultural values about what is important and beliefs about what is possible requires giving farmers and others the opportunity to try out methods, seek help for challenges, and to discuss their reasoning. Social learning is an important source of creating traction (Gosnell et al. 2019) for agricultural transformations.

Formal education

The transformation of U.S. agriculture necessitates the intentional transformation of formal agricultural education as well. Presenting prospective and new farmers with the methods, networks, and mindsets of regenerative agriculture offers a relatively easy entry point to creating traction for transformation compared to changing the practices of current farmers. However, agriculture as an industry is unquestionably rigid and slow to change, and the standardization and institutionalization of the U.S. education system present an additional barrier to timely transformation (Cramer and Ball 2019). The task of transforming education to support agricultural transformations faces myriad-specific challenges in addition to the overarching rigidity just mentioned. These challenges include the conventional agricultural paradigm of both youth (e.g., 4H and FFA) and university agricultural education, the involvement of agribusiness in curriculum development, disciplinary silos, and an industrial-era mindset that favors productivity over agroecological processes. This paradigm is arguably “educating people to adapt to change, rather than building their capacity to shape and create change” (O’Brien et al. 2013, p. 50). Even within overtly *sustainable* agriculture education there persists a positivist-informed resistance to engaging explicitly with instructor or student values in curricula and pedagogy (Galt et al. 2012). As described above, engagement with values and beliefs is a critical component of transformation within the personal sphere (O’Brien and Sygna 2013; Gosnell et al. 2019), so its absence in primary, secondary, and university agricultural education precipitates a lack of capacity for transformation in practice on the farm. This inattention to values stunts potential transformation, and keeps efforts locked within a “circular revolution,” as O’Brien et al. (2013) frame it, rather than launching them into the needed “axial revolution.” The former encourages exploring solutions within existing knowledge and power structures, while the latter changes both what we do in response to global environmental challenges and how we think about them.

What does an “axial revolution,” look like in the context of agricultural education? O’Brien et al. (2013) state the following:

“An axial revolution rests first and foremost on creating conditions for transformation through non-conventional tools and approaches that allow individuals (including academic staff, administrators, researchers and policy-makers) to question current assumptions and beliefs, whether about the future of education or the future of the planet.” (p. 49)

If the purpose of an education is to prepare individuals for the future, as well as empower them to create the future, then the transformation of education must track with the necessary transformations in practices, policies, and processes we have addressed so far. Experiential agricultural education, like agriculture itself, is ripe for fostering an axial revolution. This call echoes that of Galt et al. (2012) for values-based sustainable agricultural education, and can be seen in the basic tenets of educational theorists such as Dewey and Freire (Freire 2000; Luff 2018). Within this values-based regenerative agricultural education, transformation requires the inclusion of formerly silenced or marginalized voices, a welcoming of non-traditional educators, and a willingness to critique curricula, knowledge, or educational systems and change them accordingly. Though the very nature of axial revolution somewhat precludes the existence of concrete models, there are nonetheless examples to look to for inspiration, such as Montana State University’s courses in holistic management (Montana State University 2021), or the University of Wisconsin-Madison’s program in agroecology (University of Wisconsin-Madison 2021). Additionally, the expansion of agriculture and related programs at “non-traditional” liberal arts institutions and community colleges (a database of these programs is maintained by the Sustainable Agriculture Education Association on their website) illustrates further the potential for transformation in higher education.

Though agricultural education as a subject area is not often invoked in broader conversations about the successes of the Finnish education system, the lessons learned from Finland’s intentional process of transforming their education policies provides a helpful framework for re-imagining U.S. agricultural education. Current U.S. education policy reflects global trends in that it prioritizes standardization, literacy, mathematical thinking, and outside accountability in the form of high-stakes testing. These priorities have not yielded desired student learning outcomes (Sahlberg 2007; Jordan 2019). Moreover, the inflexibility of this system hinders transformative potential or capacity building. In contrast, the Finnish system relies upon loose and locally developed standards, broad learning with an emphasis on creativity, and a culture of trust that respects the professional capabilities of teachers. By applying these tenets to the context of agriculture, we can begin to imagine an education system that reflects the needs of both current and future

farmers, an understanding of how they learn and how this learning is shaped by values and beliefs, and the urgency of transformation towards a regenerative paradigm. A system of regenerative agricultural education must be flexible and adaptable, it must prepare students for creative problem solving in an uncertain future, and it must promote regionally appropriate ecological practices. Additionally, it must equip students with the tools to actively question the status quo, challenge the assumptions of those in power, and engage in transformational policy-making processes that are aligned with universal values associated with sustainability (Sharma 2017).

Decisions and demographics

While improved modes of connection and education will offer farmers improved traction for transformation, policymakers themselves will need to consider the ways that farmers think and understand their systems so that policies can respond to on-farm realities. Policies that influence farm size, educational opportunities, and farmers' ability to experiment with conservation practices, for example, can strongly shape the kinds of decisions farmers make (Stuart and Gillon 2013; Prokopy et al. 2019). And policies that better support new farmers will directly determine the availability of new conservation-oriented farmers to undertake transformations of the agricultural system (Carlisle et al. 2019).

Decision-making

Farmer decision-making is shaped by cultural context, individual views on adoption of new practices, and mental models of what constitutes effective farm practices. Contrary to popular belief, economic considerations are often secondary to farmer decision-making processes (Carlisle 2016). Consequently, approaches to change that acknowledge the diversity of influences on farmers offer a greater possibility of entraining farm system transformation.

Among the influences shaping farmer decisions about whether to undertake substantive change in on-farm practices is perception of the current and likely impacts of climate change on production (Mase et al. 2015, 2017; Som Castellano and Moroney 2018). Farmer perceptions of the nature of climate change vary from beliefs that it is a non-anthropogenic process (Gramig et al. 2013) to beliefs that it is anthropogenic and may pose substantial risk to one's own farm (Mase et al. 2017) through impacts such as severe weather events (Gramig et al. 2013). Variations in belief, in turn, shape on-farm decisions. Those who are concerned that the on-farm risks that experts associate with climate change will affect their farms are more likely to take adaptive action (Mase et al. 2017). Specific, targeted forms of knowledge can also be an important determinant of action. For example, awareness of a set

of farm-based carbon reduction measures encouraged farmers to take multiple mitigative steps such as improving their water capture and establishing perennial pastures (Mazur et al. 2012).

Other factors that tend to shape farmer decisions include household composition, psychological state, openness to adopting changes, and life stages (Lyle 2015). According to Prokopy et al. (2019) in their comprehensive review of influences on the adoption of farm conservation practices in the United States, farmer decisions also appear to be correlated with farm size, farmer education, and tendencies to seek out new information. Such statistics can be shifted through policy, as suggested by Carlisle et al. (2019). Moreover, additional farmer characteristics that are linked to adopting conservation practices such as environmental attitudes, awareness of certain practices, and even having previously adopted a conservation practice (Prokopy et al. 2019, p. 530) are all farmer characteristics that are amenable to change through education, support for farmer-led on-farm trials, and additional policy shifts.

New farmers

A largely regenerative system will require more labor and more ecological knowledge (Carlisle et al. 2019; Gosnell et al. 2019). New farmers and farmers with appropriate education and training opportunities in skills of conservation and regeneration are among the groups most likely to engage in agricultural conservation practices (Prokopy et al. 2019) such as regenerative methods. Therefore, one of the means of transforming the system includes a rapid expansion of support for new farmers. Such means are addressed extensively by Carlisle et al. (2019), and include attention to the needs of newer farmers for access to land, capital, credit, insurance, and equipment. Improvements in policy to provide better backing to newer farmers represent significant sources of traction for agricultural transformation (Gosnell et al. 2019). Those who enter farming with the high ideals gleaned from their experience in agroecology in higher education or from encounters with permacultural or regenerative farm mentors can only sustain their farms and the methods they wish to use if they have land, financial support, and access to key equipment and tools as insurance systems that ensure they can experience some poor years as they work to build their systems. In other words, high ideals for agricultural change amount to little without supports in the practical and political spheres, which allow new farmers to continue to implement new practices.

Policy supports

Accounting for human and community welfare

Farm bill policies like direct payments and insurance subsidies encourage larger farms, farm consolidation and a consequent loss of people from rural agricultural areas (O'Donoghue et al. 2005; Bruckner 2016; Azzam et al. 2021; Johnson and Lichter 2019). Addressing commodity and insurance subsidies is one element of reinvigorating rural communities, although one with steep challenges given the influence of agricultural corporations and conventional agricultural organizations (Hackett 2021). However, much of the policy that affects rural areas and farmers is outside the scope of the farm bill, including health, immigration, and rural infrastructure policy. A set of policies that focuses explicitly on the welfare of people and communities in rural areas, including farmworkers, will provide a structure of support for another important set of farm innovators: the people who do much of the daily work of agriculture. Policies that rebuild rural communities are needed to ensure an adequate source of labor and new farmers for regenerative work. Such changes require transformation in the thinking of rural people and farmers about the people that work their land. A set of policies that adequately supports the people and communities that matter for agriculture must include those that extend full legal rights to immigrants (cf. Devadoss and Luckstead 2011), that support the health and well-being of all working in agriculture by guaranteeing the right to healthcare, that allow for better communication with rural communities through policies like universal broadband access, and that effectively buoy rural schools (Kozhimanil and Henning-Smith 2021). The decline in farmers and farmworkers has coincided with a state of declining mental and physical health in rural areas (Woelf and Aron 2018; Norford 2018). Addressing this set of challenges, however, presents a particular dilemma in a rural political climate that is often dominated by a belief in “smaller” government. But ensuring more dialogue across segments of the agricultural population, a practice that an increase in polycentric governance and social learning would reinforce, may allow for community-wide conversations on the real needs of rural communities. Such conversations may help farmers acknowledge the widespread labor shortages and the lack of effective healthcare experienced in their communities. Most of all, more farmers and farm workers are needed for a regenerative transformation of agriculture, and making rural lives better is a central means of attracting more people to help with that transformation. The transformation of agriculture, then, will rely on a broader transformation in rural communities.

Financial supports

Raising the level of support for new farmers, for social learning processes, and for polycentric governance requires a reorientation and an increase in the distribution of funds, including those allocated by U.S. farm bills. The role of policies in supporting agricultural transformations across the personal, political, and practical spheres is summarized in Table 2. The table highlights how each element of system change we have outlined offers traction for transformation in one or more of the three spheres. Key to building traction for transformative change, then, is a suite of alterations to U.S. farm funding. In addition to the changes in governance, social learning, and assistance to new farmers, changes to farm policy require a broader rethinking of how agricultural funds are spent. Farmers often run against federal policies that cause friction with the conservation practices they attempt to adopt (Stuart and Gillon 2013; Blesh and Wolf 2014). Moreover, little federal funding is directly dedicated to the conservation-based, agroecological, or regenerative methods that an agricultural transformation requires (DeLonge et al. 2016). Calls for a shift toward multifunctional agricultural policy in the U.S. (Boody et al. 2005) have resulted in some shifts in farm policy, but even maintaining conservation programs has proven a struggle (National Sustainable Agriculture Coalition 2019). Policies that value multifunctionality, including ecological services, social benefits, and economic resilience, are needed to increase the traction for regenerative methods. Moreover, policies that favor commodity crops and that provide little support for diversified farming systems currently create friction for farmers working to transform their systems (Bowman and Zilberman 2013). Farm subsidies tend to favor larger farms and make it difficult for smaller, diverse farms to thrive, and they discourage crop diversity by favoring the monocultural production of a limited number of commodity crops (Grover and Gruver 2017; Lin 2011). Regenerative agriculture in the U.S. will require a rewriting of the values embedded in farm bill policies. If farmers are to undertake such change, agricultural policy must clearly support multifunctionality of both farms and communities as well as the increasing diversity of fields, farms, and farmers. Accomplishing such change will require overcoming the friction of Big Agriculture's influence that maintains the current farm subsidy system (Hackett 2021). It also means that a range of programs must be rethought entirely or must be to better support a range of farming styles including perennial, mixed crops and small permaculture operations in addition to urban farms and small, organic producers.

Table 2 Providing policy traction for agricultural transformation

Sphere of transformation	Definition and parameters	Policy roles in agricultural transformation
Personal	<p>“where the transformation of individual and collective beliefs, values and worldviews occur”</p> <p>“Transformations in the personal sphere are considered to have more powerful consequences than in other spheres.”</p> <p>“goals of the system and the ‘mindset or paradigm out of which the system... arises’” (O’Brien 2018)</p>	<p>Connect farmers and policy makers to examples of regenerative agriculture, creating opportunities for new beliefs about what is possible using social learning and polycentric governance</p> <p>Co-creation of sustainability goals through social learning processes among farmers and extension personnel</p> <p>Provide farmers and farmworkers detailed understanding of how to implement regenerative methods and overcome hurdles through social learning processes to bolster their belief that such methods can succeed</p> <p>Create opportunities for discussion of values and goals of agriculture at scales from small farmer groups to a national policy level through citizens’ assemblies</p> <p>Draw perspectives from outside the conventional agricultural paradigm into networks that include those working in the conventional paradigm through the use of web platforms, social learning processes, general community events</p>
Political	<p>“the systems and structures that define the constraints and possibilities under which practical transformations take place... [i]ncludes economic, political, legal, social and cultural systems: “where politics and power influence the rules of the game”</p>	<p>Co-create sustainability goals through citizens’ assemblies, re-visioning state and federal policy, center voices of regenerative and marginalized farmers and farmworkers as expert informants</p> <p>Conduct citizens’ assemblies focused on farmer payment programs and crop insurance, to find effective means of expanding support for regenerative modes of crop production</p> <p>Conduct citizens’ assemblies on farm labor laws that include farmworkers as expert informants</p> <p>Educate policy makers and educators/extension staff about farmer innovations that are succeeding at combining food production with ecological goals; make polycentric governance a central goal so that necessary cross-linkages emerge</p> <p>Through events rooted in social learning and polycentric governance, create opportunities for marginalized farmers to educate policy makers and educators/extensionists about their needs</p>
Practical	<p>“The practical sphere represents both behaviors and technical solutions.... These include behavioral changes, social and technological innovations, and institutional and managerial reforms.” “The outcome sphere where numbers, parameters, and indicators are most often measured.”</p>	<p>Expand educational and training opportunities for agricultural community to provide more current and new farmers practice with and understanding of regenerative practices</p> <p>Increase land and equipment access through means including broad, federal support for cooperatives, land transition schemes, and expanded loan programs for new farmers</p> <p>Reform agricultural labor immigration processes to ensure adequate labor supply</p> <p>Expand healthcare funding & access in rural communities so workers and families stay well</p> <p>Expand funding & access for broadband and education in rural communities to attract more families</p>

Definitions of the three spheres from (O’Brien and Sygna 2013, pp. 4–6) unless otherwise noted

Discussion

The model of the three spheres of transformation (O'Brien and Sygna 2013) and the concepts of friction and traction (Head et al. 2013; Gosnell et al. 2019) provide a framework for exploring the literature on regenerative practices that we have outlined here. The existing friction against transformation of the U.S. agricultural system is extensive, including policies that favor monocultural agricultural production (Biermacher et al. 2006; Plourde et al. 2013; Ramey 2014), that deny rights to secure immigration status for farmworkers (Devadoss and Luckstead 2011), that take workers off-farm to better access health insurance (Ahearn et al. 2013), and that ignore farmer-to-farmer learning in favor of a top-down research-extension-farmer model (Carr and Wilkinson 2005; Lubell et al. 2014). The literature we have reviewed provides a different model. Easing the political sphere frictions outlined above would pave the way for practical and personal sphere transformations that reorient values and beliefs about the potential of regenerative agriculture among a broad swathe of participants in the system.

Such political sphere transformations will require a willingness to rethink systems such as USDA and cooperative extension so that their goals are more in line with the intended agrarian democracy of the original New Deal (Gilbert 2015). New and reoriented programs could provide virtual and in-person fora that highlight the perspectives of shadow networks (Table 1, Pelling et al. 2008). Such programs could increase the cross-linkages between conventional and regenerative farmers, offering new contacts who could both inspire conventional farmers with stories of regenerative success, and also walk fellow farmers through the details of how to make regenerative systems prosper (Kroma 2006; McKenzie 2013). Similar programs could build on new networks and create citizens assemblies, selecting participants by lottery from among a range of farm and farmer types (e.g., farmers represented by organizations in Table 1) to offer intensive feedback on needed revisions to federal policy. Selection by lottery is important to reducing perceptions of bias, thus lending legitimacy to the work of the assembly (Devaney et al. 2020). Such citizens assemblies have successfully reshaped policy on climate change and abortion in Ireland (Devaney et al. 2020) and encourages citizens involved in assemblies to advance their thinking and better acknowledge other perspectives (Suiter et al. 2016). So, citizens assemblies may be an important means to create new agricultural policies that are more inclusive and regenerative while simultaneously generating personal sphere transformations among participants. To ensure that assembly recommendations become part of policy, the government must create provisions for their use, as with the Irish climate change assembly in which a dedicated parliamentary

committee was created for considering and forwarding the work of the citizens' assembly (Devaney et al. 2020). Building the groundwork for citizens' assemblies in advance would require the recruitment of champions in Congress and among farmers and policy advocates to ensure that participant selection, legitimacy of the new deliberative body, and methods of uptake of its policy recommendations were carefully planned in advance. Networking for change could also take place in social learning contexts, with farmers leading on-farm or virtual learning opportunities facilitated by cross-cutting organizations (e.g., those in Table 1) so as to highlight a diverse range of farmer innovators. Since social learning often incorporates participants from multiple governance levels, it can also represent a locus for both personal and political sphere change for farmers, extension educators, and even policymakers (Phuong et al. 2017). Traction for change can also come from shifts in formal education that educate farmers and future farmers to "shape and create change" (O'Brien et al. 2013, p. 50).

Finally, policymakers engaged in systems of social learning and deliberative democracy like citizens assemblies will undergo transformation themselves. In becoming more aware of the realities of farmers on the ground through polycentric governance opportunities or social learning events, policymakers will better account for farmer decision-making (Koopmans et al. 2018). Such increased awareness can help shape policies that make more space for new farmers and better remunerated farmworkers (Carlisle et al. 2019). By creating financial supports for policies that offer traction across the three spheres of transformation (summary in Table 2), policymakers will have made the transformation to regenerative agriculture a far more viable goal.

Conclusions

U.S. agriculture is dominated by industrial methods that cause greenhouse gas emissions (Smith et al. 2014), pollute waterways (Christianson et al. 2018), degrade soil, and whose emphasis on a limited set of commodity products limits agrobiological diversity and consequent system resilience (Lin 2011). As we have argued, the system is difficult to change because of a lack of sufficient traction for agricultural transformation. However, making sense of the personal sphere factors that shape the agricultural system, of the beliefs about the feasibility of regenerative methods and of the methods through which farmers change what they value in their operations, provides opportunities to identify activities that engender change. Attention to the beliefs, values, worldviews and paradigms of farmers, educators, and policymakers, and how they create traction with regenerative methods is the aim of transformation. As we have reviewed, such shifts require a careful reconsideration of

the orientation of policy. Policies that support transformation should allow for the voices of regenerative and socially marginalized farmers to be heard in new fora that offer guidance on regulations and forms of financial support for farming. Citizens' assemblies offer potential for democratic leadership by farmers in new law-making (Hayward 2014). Expert voices at such fora must include the farmers long denied effective support by USDA, and farmers who are implementing regenerative methods and finding ways to reinvigorate their rural communities. However, hearing from those voices in legislative gatherings is not sufficient to spur broader agricultural change by itself. The cross-fertilization of ideas must also be supported by social learning processes financed by governments and the coordination of existing and new elements of cooperative extension and agricultural education. With a goal of changing beliefs about the possible, processes must allow farmers spaces to discuss, ask hard questions, and experiment both virtually and on their farms. All such changes will be facilitated if agricultural funding mechanisms that currently support commodity crop production are heavily reoriented toward multifunctional goals. In other words, to support the personal sphere transformation of farmers and policy makers, political processes, funding instruments, and practical information geared toward regeneration must all be brought to bear at once, in a vast rethinking of agriculture akin to that of the "intended" agricultural New Deal that was an element of President Roosevelt's response to the challenges of the Great Depression (Gilbert 2015).

Gilbert (2015) asserts that the bold vision of deep agrarian democracy that was the most important and yet overlooked aspect of the New Deal's farm policies was quashed before it ever fully emerged. Such a re-visioning of agriculture requires an integrative approach that recognizes the relationships between changes in the personal sphere, changes in policy, and changes in practice. With the challenges that confront the United States from climate change, perhaps it is time to return to and build on the vision of the agrarian intellectuals of the New Deal via additions to the proposed Green New Deal (Carlisle et al. 2019). The Green New Deal aims to address poverty and inequality even as it addresses environmental goals, and it gestures at the need for more democratic governance, including this passage, "ensuring the use of democratic and participatory processes that are inclusive of and led by frontline and vulnerable communities and workers to plan, implement, and administer the Green New Deal mobilization at the local level" (Congressional Research Service 2019, p. 12). However, in its broad gestures approach, it is difficult to read how exactly its text leads us to the deep democracy advocated by the agrarian intellectuals of the original New Deal. The processes we have outlined in this article, including new policy fora like citizens' assemblies, revisioning the use of USDA's Climate

Hubs, and reshaping agricultural learning are intended to provide starting points toward the deeper agrarian democracy that was on the table for the agricultural visionaries of the New Deal.

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