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COMMENTARY FROM THE U.S. AGROECOLOGY SUMMIT 2023

Broadscale diversification of Midwestern agriculture requires an agroecological approach

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We write to highlight the potential for academic agroecology to address the crucial challenge facing agriculture in the Upper Midwest region of the U.S.: diversification. Integrative forms of agroecology—often framed as "science, practice, and movement" (Wezel et al., 2018)—can make important and unique contributions to expanding the scale at which diversified farming systems are adopted in the region. After outlining the current situation in the Upper Midwest region, we identify particular roles—currently not robustly practiced—that academic agroecologists can play to advance diversification.

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Author Disclosure

Alongside his work at the University of Minnesota, Cureton is a member in Midwest Hazelnuts, LLC, which seeks to scale the regional hybrid hazelnut industry in partnership with the University of Wisconsin, University of Minnesota, and many other entities. He is also a shareholder in Overstory Ventures, a Venture Studio focused on taking new regenerative crops to market.

The Current Status of Agriculture in the Upper Midwest, in Social-Ecological Context

The U.S. Upper Midwest region, covering the states of Illinois, Indiana, Iowa, Michigan, Minnesota, and Wisconsin, comprises one of the largest and most productive agricultural regions in the world. The region's deep, fertile soils and generally favorable precipitation patterns combine with a massive supporting infrastructure to produce vast amounts of food, feed, and bioenergy. This production is accomplished by a consolidating agricultural industry, with fewer and larger farms, in a region that is losing rural population while also becoming more culturally diverse (Iowa Small Towns Project, 2023). The loss of smaller farm operations affects rural communities by diminishing their economies and the population base supporting public infrastructure, such as schools, hospitals, and other civic institutions. New immigrants are highly important to the economic and social vitality of many rural communities, but rural immigrants also face major challenges, including low-wage employment, cultural and racial discrimination, and limited availability of health care, education, and social services (Ajilore & Willingham, 2019).

These agricultural and social trends in the Upper Midwest have been accompanied by marked degradation of the local environment (Gilliom et al., 2006; Givens et al., 2016; Heathcote et al., 2013; U.S. Environmental Protection Agency, 2023), as well as extraregionally, as exemplified by nutrient discharges that have created the hypoxic zone in the Gulf of Mexico (Alexander et al., 2008). This degradation derives, in large part, from the profound loss of biological diversity in regional landscapes and croplands (Brown & Schulte, 2011; Samson & Knopf, 1994), which has been linked to increases in greenhouse gas emissions, soil erosion, and water pollution (Lark et al., 2022). Agroecologists interested in the Upper Midwest are confronted by these agricultural, social, and ecological dynamics.

There is mounting evidence that diversification of regional agroecosystems can provide economically viable solutions to these environmental problems. For example, results of a long-term experiment conducted in Iowa (Davis et al., 2012) indicate that diverse crop rotations integrated with cattle production matched the profitability of a conventional corn-soybean system, while improving many environmental outcomes related to soil, water, biodiversity, air quality, and climate (Baldwin-Kordick et al., 2022; Hunt et al., 2017, 2019, 2020; O'Rourke et al., 2008). Diversified farming systems that incorporate practices such as cover crops, patches of perennial grasslands, and agroforestry can address challenges posed by climate change in the upper Midwest (Basche & DeLonge, 2017; Schilling et al., 2013), particularly the anticipated increases in rainfall variability (Angel et al., 2018).

Advancing Regional Diversification: Vital Roles for Integrative Agroecology

Our premise is that diversification of current agroecosystems is key to stewardship of soil, water, and biodiversity, and to the economic viability of agricultural production systems. There are many regionally relevant forms of diversified farming systems, including extended crop rotation, cover cropping, edge-of-field conservation practices, managed grazing, agroforestry, and silvopasture. However, broadscale adoption of such systems faces a wide range of barriers (Meynard et al., 2018), most of which arise from the large-scale, industrialized character of Midwest agriculture and the interlocking complex of technical, economic, political, and cultural factors that support it (Geels, 2019). The development of diversified farming systems depends on broad societal support (Bacon et al., 2012). Building and maintaining sufficiently broad support will certainly require attention to social and economic inequities and injustices in current agricultural systems. We propose that Midwest academic agroecologists can play pivotal roles in collaborative efforts to overcome these scaling barriers, including building broad societal support for diversified systems. We highlight three different roles that can be pursued; all are distinctively agroecological and not likely to be performed by other kinds of agricultural scientists.

The first role involves the civic engagement aspect of agroecology that is expressed in the "movement" element of the tripartite notion of "science, practice, and movement." We observe that this element of agroecology is recognized by regional academic agroecologists (e.g., Nicklay et al., 2023), but not widely practiced by these actors. In our view, it is crucial for academic agroecologists to intensify their participation in civil society arenas relevant to diversification. Moreover, this participation will require engagement in the politics of cross-sector collaboration (Jordan et al., 2020) and sustainability transitions. Such politics are required because broadscale diversification demands transformative change in the complex of factors that impede it. To achieve change in this complex, broad-based coalitions must be organized and sustained. In support of these coalitions, academic agroecologists can provide technical analyses relevant to contrasting scenarios of broadscale diversification, strategic insights, and assistance in building bridges between agriculturalists and stakeholders in other sectors (e.g., environmental non-governmental organizations).

An example of a relevant political arena is the current project to develop a "hub" for regional scaling of sustainable aviation fuel (SAF; Greater MSP Partnership, n.d.). Scaling SAF could drive extensive diversification in the region if novel oilseed crops that would provide much-needed winter ground cover (e.g., pennycress, camelina) were included and supported by necessary policies, breeding efforts, technical infrastructure, and other innovations and scaling factors. More broadly, development of a SAF industry in the Upper Midwest could drive equitable progress, providing positive social, economic, and environmental outcomes for both rural and urban communities. Conversely, SAF scaling might be undertaken without diversification of current agriculture and in a way that does not address—and may worsen—environmental and social challenges facing these communities. Therefore, responsible innovation and scaling around SAF development requires an inclusive and reflexive process (Stilgoe et al., 2017) attentive to the nature and outcomes of SAF development and the distribution of its costs and benefits. In particular, the environmental performance of cropping systems producing SAF feedstocks will be a key consideration in responsible development of SAF. The Forever Green Partnership, hosted by the University of Minnesota, provides a platform for such engagement by academic agroecologists in regional SAF scaling, in collaboration with other parties, such as environmental non-governmental organizations. Through alliance with these organizations, academic agroecologists have been able to gain influence in the development of the regional "hub" for SAF scaling.

A second role involves the support of place-based diversification projects. Such projects strive to devise locally adapted and economically viable diversified farming systems, tailored to the bio-physical and socio-cultural circumstances of particular places. Implicit in these efforts is the premise that increasing the adoption of diversified farming systems at a regional scale requires weaving together a multiplicity of different place-based projects. Doing so is likely to require organizing farmer networks and cross-sector community support (Asprooth et al., 2023).

Such a place-based project is underway in the Cloverbelt region of central Wisconsin, which has experienced major agriculture-related declines in water quality during recent decades. A robust coalition of agricultural and environmental interests has formed the Eau Pleine Partnership for Integrated Conservation (EPPIC) to address these water problems, and agroecologists participating in the Grassland 2.0 project have collaborated with that organization. Collaborative roles for agroecologists have included dialogues with EPPIC members and professionals to identify opportunities for expanding grassland agriculture in the Cloverbelt region, as a means of addressing shared community goals for the future. These deliberative efforts have identified a particular diversified farming system—custom dairy heifer grazing—as a promising option for increasing grassland agriculture in the region. Currently, EPPIC and Grassland 2.0 are organizing a collaborative network to pilot heifer grazing systems and link this network to market channels for the milk produced. Agroecologists have helped coordinate multiple organizations and individuals involved in the project, have linked farmers and other members of the agricultural and conservation communities to supportive resources at landgrant universities and interested markets, and have provided informational and analytic support (e.g., model-based assessments of adoption of diversified systems at scale in the region).

Finally, agroecologists can play crucial roles in addressing the supply chain and value chain challenges that emerge from place-based pilot projects. To expand the scale at which novel diversified farming systems are adopted, supply chains must be built for the products they generate, and supportive ancillary policies, finance, and collaborative networks must be developed and cross-linked (Herrero et al., 2020). The resultant "support systems" built from these elements are crucial to the economic viability of novel diversified systems, which in turn is crucial to broadscale adoption. Much collaborative co-innovation will be required, spanning all links in supply chains, especially for producing, processing, and marketing novel crops (Meynard et al., 2017). Again, this co-innovation and scaling must be undertaken with attention to both the social and ecological outcomes of these developments (Wigboldus et al., 2020).

Scaling production and market distribution of hybrid hazelnut, a novel tree crop, provides a current example of such collaborative co-innovation. This work is being carried out by hazelnut growers, investors, entrepreneurs, and University of Minnesota and University of Wisconsin scientists and extension workers, along with a network of nongovernmental organizations. including the Savanna Institute. It spans innovation in crop propagation, harvesting equipment, post-harvest processing, land access, finance for hazelnut growers, and the development of multiple new commercial ventures. It also involves "steward ownership" of hazelnut germplasm and associated enterprises, as a means to ensure that these are used to achieve stated sustainability goals while commercial activities develop. Applied to agriculture, steward ownership is an innovative business structure which guarantees that profits will be reinvested to address some social-ecological goal (Sanders, 2023). Steward ownership of novel crop germplasm and associated enterprises is a notable example of responsible innovation. Academic agroecology can play a key collaborative role in organizing co-innovation and developing methods for responsible innovation and scaling.

Conclusion

Agricultural diversification in the Upper Midwest U.S. is a complex problem in urgent need of solution. Implementing diversified farming systems in the region requires concerted and persistent collaboration among multiple societal sectors across multiple scales (Geels, 2019). By practicing integrative agroecology—that is, supporting integration among science, practice, and civic engagement activities—academic agroecologists can help organize and sustain the cross-sector and cross-scale collaborations necessary for responsible innovation. They can also support viable farming systems that provide positive social, economic, and environmental outcomes for both rural and urban communities. These efforts may involve collaboration with currently dominant agricultural firms, institutions, and organizations. If conducted with attention to reducing social and economic inequities and inequalities and to the limits of compromise, we believe such collaborations can be useful.

Many agricultural science disciplines carry out research on diversification, but most have a narrow focus and fail to address the integrative and collaborative challenges crucial to responsible scaling of diversified farming systems. Agroecology has philosophical and intellectual roots in classical ecology, which studies transformative changes and heterogeneity at multiple scales, from genotypes to populations, communities, and ecosystems. Within academic institutions, academic agroecologists bring a unique perspective on multi-faceted impediments and socio-ecological strategies that can be employed to diversify Midwestern agriculture. If Midwestern academic institutions are going to effectively contribute to the development and widescale regional adoption of diversified systems that benefit the regional environment and both rural and urban communities, agroecologists within those institutions must step forward into practical and leadership roles.

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