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Scaling up conservation agriculture: An exploration of challenges and opportunities through a stakeholder engagement process

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Abstract

Increasing the resilience of agricultural landscapes requires fundamental changes to the dominant commodity production model, including incorporating practices such as reduced tillage, cover cropping, and extended rotations that reduce soil disturbance while increasing biological diversity. Increasing farmer adoption of these conservation systems offers the potential to transform agriculture to a more vibrant, resilient system that protects soil, air, and water quality. Adoption of these resilience practices is not without significant challenges. This paper presents findings from a participatory effort to better understand these challenges and to develop solutions to help producers overcome them. Through repeated, facilitated discussions with farmers and agricultural and conservation professionals across the U.S. state of Michigan, we confronted the policy, economic, and structural barriers that are inhibiting broader adoption of conservation systems, as well as identified policies, programs, and markets that can support their adoption. What emerged was a complex picture and dynamic set of challenges at multiple spatial scales and across multiple domains. The primary themes emerging from these discussions were barriers and opportunities, including markets, social networks, human capital, and conservation programs. Exacerbating the technical, agronomic, and economic challenges farmers face at the farm level, there are a host of community constraints, market access and availability problems, climatic and environmental changes, and policies (governmental and corporate) that cross-pressure farmers when it comes to making conservation decisions. Understanding these constraints is critical to developing programs, policies, and state and national investments that can drive adoption of conservation agriculture.

1 | INTRODUCTION

The agriculture industry in many regions, including the midwestern United States, faces a range of challenges, from increasing weather variability due to climate change, persistent water quality and soil degradation issues, a period of low commodity crop prices, tightening margins for producers, and decaying rural infrastructure (Browne, 2001). Conservation approaches to agriculture—whether focused on soil health,

Abbreviations: EQIP, Environmental Quality Incentives Program.

resilience, agroecology, regenerative agriculture, or any of the various other trends in agricultural sustainability—offer significant promise at both decreasing the exposure of Midwestern farms to these risks while also alleviating some of their underlying causes. Farm operators in this region face significant barriers to fully implementing these strategies (Prokopy et al., 2019). Helping producers overcome these challenges will involve a wide range of stakeholders, including agricultural retailers; commercial crop advisors; conservation, commodity, and farmer organizations; university researchers and extension educators; and policymakers. First, though, it is critical to understand how these challenges are experienced by producers and those who advise producers on their management.

Core Ideas

- Farmer adoption of conservation agriculture is limited by barriers at multiple scales.
- Expanding conservation agriculture will require addressing economic and social barriers.
- Engaging with stakeholders is a necessary step to developing approaches to increase resilience.
- Resilience includes social and economic aspects as well as environmental sustainability.

1.1 | Building resilience in U.S. agriculture

Resilience describes the ability of a system to absorb and adapt to disturbance while maintaining its key characteristics (Folke et al., 2010). Resilience can involve both the ability to resist these disturbances with minimal damage and the ability to adapt and transform to these shocks in ways that buffer them in the future. These capacities can be viewed in terms of bouncing back from severe events vs. bouncing forward (Lengnick, 2014). The overall adaptive capacity of a system includes the ability to respond, recover, and transform when faced with shocks. In the farm context, resilience can involve the ability of a farm to maintain key productivity elements in the face of extreme weather events, price shocks, or ownership transitions. "Response" refers to the ability of farmers to adjust their production practices to accommodate changes, especially in the short term. Farmers can adjust planting or harvest dates to accommodate variable weather patterns or build a diversified operation that spreads risks across different income sources. Equally important is the ability to bounce back, or recover, from these challenges by adapting over longer time frames. This might involve incorporating new practices to build resistance to problems in the future or building new skills to allow for greater response and adaptation capacity (Lengnick, 2014).

Resilient farms typically have high stocks of multiple types of assets: physical, financial, natural, social, and human capital. Resilience is built at the farm scale by integrating practices that increase the "wealth" of farms across these different asset classes (Lengnick, 2014). In the cropping systems that comprise much of Michigan agriculture, these often include the types of conservation practices that have been promoted widely in recent years. These include conservation or no-till, use of organic fertilizers (including compost and manure), nutrient and pesticide management, and cover crops. At their most basic level, these practices involve minimizing disruption of the soil, maintaining more cover on the soil year-round, and more efficiently managing nutrient and chemical inputs. These practices not only build the natural capital upon which cropping systems rely but also make farms less dependent on external inputs and expensive equipment (increasing financial and physical capital); build key management skills of farmers, especially adaptability (increasing human capital); and connect farmers with a broader set of institutional and consumer stakeholders (increasing social capital).

Farmers do not operate in a vacuum; they exist in a complex world. Economic, social, political, and environmental conditions exert influence on farmer decisions at a variety of spatial and temporal scales. Conditions often change, both slowly and quickly. Long-term economic and policy trends have led to greater consolidation across agricultural industries (seeds, pesticides, machinery, and purchasers) and in farms themselves (Deconinck, 2019; MacDonald, 2020). Farmland has increasingly been consolidated among the largest operations, which have increased in size steadily in recent decades (MacDonald, 2020). United States farm policy has primarily been aimed at supporting a relatively small number of commodity crops, including corn (*Zea mays* L.), soybean [*Glycine max* (L.) Merr.], cotton (*Gossypium* L.), and sugarcane (*Saccharum officinarum* L.), both directly through subsidies, price supports, and risk subsidization (i.e., crop insurance subsidies) and indirectly through support for ethanol and livestock production and international trade facilitation (Angelo, 2010; Wender, 2011). These economic and policy choices have incentivized an agricultural system centered on large, consolidated farms designed to efficiently produce a narrow range of commodities for international food, fuel, and fiber markets, often at the expense of smaller, more diversified operations (Angelo, 2010).

Socially, consumer preferences have been changing, with increasing attention to health, environment, climate, and ethical considerations in the food choices people make (Schneider, 2017; Stefanovic et al., 2020). As agriculture has become more specialized and capital intensive, fewer people have direct experience or connection to the farming industry. This lack of familiarity with modern farming practices, along with

increasing public attention to the ethical and environmental impacts of agriculture, can create a sense of disconnection between farmers and the public (Schneider, 2017). These disconnections between farmers and members of the public who see the need for change in agricultural practice but have different experiences and perspectives also interacts with changing social and economic conditions within the farming sector. In particular, systemic factors (markets, policies, corporate consolidation) have put increasing economic and social strain on small- and medium-sized farming operations (Stevenson et al., 2014; Wender, 2011). These broader social and economic conditions all influence farmer perceptions of sustainable management practices and their willingness to engage in a deeper effort to build resilient food systems. There has been significant discourse focused on incorporating broad value perspectives into food production and delivery systems (Levkoe et al., 2018; Stefanovic et al., 2020), including specifically incorporating producer and consumer well-being into soil health concepts (Friedrichsen et al., 2021).

Environmental factors have also affected agricultural systems, in terms of (a) public perception and policy reaction to environmental impacts stemming from agriculture and (b) degradation of the resource and climate base upon which agriculture depends. Water quality impacts resulting from agricultural practices, especially nutrient and sediment pollution, have accrued at local, regional, and national scales (Davidson et al., 2015). In recent years, increased attention has also been given to agriculture's contributions to climate change, both from livestock sources (e.g., methane) and crop production (including directly through nitrous oxide emissions from soils and indirectly through fossil fuel–based fertilizers and pesticides) (Tellatin & Myers, 2018). These externalized environmental impacts not only increase public pressure on the industry to address them but also contribute to the long-term degradation of the resource base. Water pollution and greenhouse gas emissions to some extent represent system resource use inefficiencies that are related to long-term degradation of soil quality. For example, reductions in soil carbon stocks have contributed to greenhouse gas emissions and have negatively affected the productive capacity of these soils (Mahli et al., 2021). Reductions in soil chemical, physical, and biological properties, along with landscape-scale changes (e.g., larger farms and modified drainage patterns) have reduced the capacity of farms and farming landscapes to respond and recover to climate change-driven events (Lengnick, 2014).

There has been significant effort by researchers and practitioners to better understand and address barriers to adoption of conservation practices (Baumgart-Getz et al., 2012; Knowler & Bradshaw, 2007). Much of the research literature has focused on farm- and farmer-level challenges, especially through the use of social science methods, including surveys and interviews. This research has revealed a wide range of barriers and motivations to conservation adoption yet few universally significant variables (Reimer et al., 2014). Recent reviews of this literature have indicated that farmer decision-making is complex and context dependent, with different factors playing a role depending on the location, decision-making time frame, practice, and farmer (Prokopy et al., 2019; Ranjan et al., 2019). These reviews have also emphasized the apparent importance of social and systemic factors on farmer conservation choices, including access to key information networks, social support, and market access (Ranjan et al., 2019). In recent years, researchers and conservation practitioners have placed greater emphasis on participatory approaches that engage not only groups of producers but also the larger community of advisors, influencers, and market actors that contribute to agriculture systems (Groce et al., 2019).

Taken together, the complex conditions contributing to farmer choices and the state of knowledge of these conditions emphasize the need for greater engagement by a wide variety of stakeholders to increase farm resiliency. This paper seeks to contribute to the existing literature and practice of conservation agriculture by exploring these challenges and developing a shared understanding of potential solutions and efforts to overcome them. We present a set of themes that reflect the domains in which these challenges and solutions exist while connecting them with each other. This is in line with recent calls to look at conservation decision-making in a specific context (in this case, a single U.S. state) and across multiple spatial (local, regional, state-wide) and conceptual scales (government policies, markets, social networks) (Reimer et al., 2014). By focusing on these interconnections and the ways in which these interacting systems either inhibit or support conservation agriculture, this paper reveals insights into the lived experiences of farmers and agricultural advisors. Although many of the individual barriers have been previously identified (and many have been the focus of policies and promotion efforts), we believe the iterative and participatory approach used in this study adds context and nuance to the ways they interact.

2 | MATERIALS AND METHODS

An in-depth, participatory case study approach (Bergold & Thomas, 2012) was used to explore the perceptions of agricultural professionals and their experiences with conservation agriculture in the U.S. state of Michigan. This process involved a series of participatory meetings between December 2017 and April 2021 with groups of key stakeholders across the state. Participants were row-crop farmers (primarily growing corn and soybeans, though many also grew wheat [*Triticum aestivum* L.], small grains, sugar beets [*Beta vulgaris* L.], and forage crops), farm advisors and retailers, government agriculture and resource agency staff, researchers, and food system specialists. We tapped into our existing

connections with farmers and agricultural professionals to identify farmers, agricultural and conservation professionals, and researchers to invite to roundtable discussions and virtual sessions. We incorporated a snowballing technique (Corbin & Strauss, 2008) in which we asked participants for recommendations about additional individuals or organizations to include in future meetings. We did not intend for meeting participants to be broadly representative of each profession across the state. Rather, we sought participants who were already engaged in conservation agriculture or agricultural resilience and were willing to make thoughtful contributions to discussions of the challenges and opportunities faced by farmers across the state. Our aim with these meetings was to have a diversity of perspectives of those with experience and insight into conservation agriculture. Most farmer participants in our meetings had been using conservation practices (especially no-till and cover crops) for multiple years and could be characterized as innovators or early adopters in Rogers' (2003) Diffusion of Innovations curve. There were several farmers who were very interested in conservation agriculture systems but had limited experience with them, allowing us to hear non-innovator perspectives.

Meetings were typically conducted with between 2 and 30 participants, primarily in-person prior to March 2020 and virtually after that (due to COVID-19 health and safety restrictions). These meetings, facilitated by the authors, focused on developing a shared understanding of the broader context around Michigan agriculture and how the individual participants and institutions might help promote conservation agriculture. We used a semi-structured facilitation guide composed of open-ended questions and proposed ground rules for the conversation. We actively listened to understand by taking notes, asking clarifying questions and encouraging participation from all. These meetings were structured and facilitated around a set of key questions generated based on our project team's background and previous experiences with farmer engagement activities (Doll et al., 2018, 2020; Reimer et al., 2017). These questions were (a) In 20 yr, what would a vibrant, more resilient agriculture look like in Michigan? (b) What does society need to do to help your farm/your industry get there? (c) What are the key leverage points that can be shifted to expand and enhance markets/policies? On farm adoption of resilient systems? and (d)What mechanisms would facilitate more collaboration and networking?

We used two main approaches to reach participants: (a) interviews with key individuals or small groups of stakeholders, typically —two to five people, on a focused topic such as climate change or the retail industry, and (b) roundtable discussions among multiple participants. We facilitated these discussions to develop a shared understanding of the challenges faced at the field, farm, and state scales to implement and maintain conservation agriculture practices and to document possible opportunities to support and assist farmers in moving toward sustainable practices. During the course of this project, we held eight in-person roundtables and three virtual roundtables; the roundtables included 4–30 participants. Where possible, these engagement approaches were conducted with similar audiences over time to allow for relationship building among participants and between facilitators and participants. In addition, this repeated engagement allowed us to share what we had heard in previous meetings and gather additional feedback around findings and recommendations.

To ensure open, honest discussion of these topics, we did not record these conversations and did not record verbatim quotes from any participants. We collected data using flip charts to capture information as it was discussed by participants during meetings as well as notes recorded by the project team. These data were analyzed by the project team following each meeting using a thematic analysis approach (Braun & Clarke, 2006). Because there were no verbatim data collected, we did not use a textual coding process; rather, we used a thematic coding approach wherein each project team member identified major emergent themes within each guiding discussion question. These themes were then compared and refined into emergent, cross-cutting themes. This paper presents the major themes we heard during these discussions, summarizing what we heard and the shared understanding of challenges and opportunities developed with these groups over the course of the project. The iterative approach taken in this study, wherein we met multiple times with each group, allowed us to gather ongoing feedback from participants. To ensure reliability and trustworthiness in our findings (as in Whittemore et al., 2001), we presented draft themes in subsequent meetings, garnering valuable feedback about the accuracy and relevance of our themes, as well as serving as a mechanism for advancing the discussions through barriers to potential solutions and opportunities to achieve conservation outcomes in Michigan.

By facilitating discussions that directly confront the challenges to sustainability and resilience faced by Michigan farmers, we have been able to identify key solutions that can be implemented at the local and state level. These solutions will help support farmers in their efforts to innovate and build resilience to a wide range of existing and growing challenges.

3 | RESULTS AND DISCUSSION

3.1 | Challenges to conservation agriculture adoption

The adoption of resilience practices is not without significant challenges. In our discussions with farmers and farm advisors across Michigan, we confronted these adoption barriers head-on. What emerged was a picture of a complex and dynamic

set of challenges at multiple spatial and conceptual scales and across domains. Farmers face a range of barriers at the farm scale, including the technical, agronomic, and economic challenges that previous research into conservation decision-making have traditionally focused on. Exacerbating these very real challenges are a host of community constraints, market access and availability problems, climate change–induced weather variability, and policies (governmental and corporate) that cross pressure farmers when it comes to making conservation decisions.

We break these challenges into four broad themes based on what we heard in our discussions: markets, social networks, human capital, and conservation programs. However, it is important to note that these themes are all interconnected and difficult to disentangle. The thematic presentation here is an attempt to lend structure and understanding of how these connect to each other and to frame the vision of potential solutions that emerged from 18 mo of discussion across Michigan.

3.2 | Markets

Farm operations are at their basic level a business firm operating in complex regional, national, and international markets outside of their control. This is especially true in field crop agriculture where, increasingly, Michigan farmers rely on just a few international commodity markets, especially corn, soybeans, and wheat. Farmers in our discussions indicated that they have limited options for marketing outlets for their crops. Farmers often have only a few choices about where and from whom to buy inputs, such as seeds, fertilizers, herbicides, and pesticides. These products are produced by highly integrated international corporations, and although many farmers noted that they rely on the products these companies provide, the lack of choice and competition in these markets is seen as a challenge. Moreover, reliance on external inputs to drive production increases farm operating costs and encourages farmers to specialize in corn–soy (and sometimes wheat) rotations. These narrow commodity markets decrease the financial incentives to diversify cropping systems. Consolidation in key input and commodity markets narrow farmer choices in crops, livestock varieties, and management systems; lock producers into constrained markets; and reduce returns to good management.

As we heard from more innovative farmers, although management can affect the productivity of farms, at the end of the season "bad" managers and "good" managers get the same price per bushel of crops produced, even if the quality of grain is higher from the good manager. A heavy focus on commodity crop production therefore locks farmers into a short-term, yield-focused mindset rather than a broader profitability and long-term viability mindset. National policies can also constrain farmer decisions through commodity supports, crop insurance rules, conservation programs, and market regulations. Private sector stakeholders play a role too: innovative farmers and advisors we spoke with indicated that farm organizations could play a critical role in promoting innovation but currently are focused on protecting the status quo.

Current market structures do not provide incentives for conservation practices. The USDA Certified Organic program provides a regulatory and licensing framework for crops and animal products produced without the use of most synthetic chemical inputs and allows products made from these crops to be labeled and advertise their certification, which segments them in the market from products made with the use of synthetic chemicals. Although this program does segment the market for commodity crops, there is no similar structure to provide market distinctions or price premiums for the use of sustainable practices, such as management aimed at soil health. Commodity crops are treated the same in these markets, incentivizing producers to focus on optimizing yield at the lowest production cost, often over short (annual) time frames. Although the innovative producers we spoke with recognize the benefits of conservation for their production systems, they also largely acknowledge the upfront costs with implementing new practices and time lags before the payoff is clear. Commodity markets also largely ignore product qualities associated with other socially positive attributes, such as nutrient density, focusing instead on qualities associated with the needs of the food processing industry.

3.3 | Social networks

Farmers are also operating in a local social and economic context. There are a wide range of advisors from whom farmers can seek information, including local retailers and crop consultants, university extension, conservation districts, the USDA-NRCS, and other farmers. We heard from many that farmers are often reluctant to share information with neighboring farmers out of a sense of competition for prime rental ground and a fear of social stigma associated with more innovative practices. Farmers also indicated that they often felt that some key advisors, including extension and conservation agencies, do not have enough staffing or agricultural expertise to provide timely advice to farmers. On the other hand, private-sector crop advisors and retailers are often too unfamiliar with key conservation practices to be able to provide recommendations or technical support.

Although research on farmer decision-making and social networks emphasizes the importance of peer-to-peer connections in promoting and supporting conservation practices (Ranjan et al., 2019), our discussions revealed some significant gaps in these networks. In our participants' experiences, farmers often do not talk to each other locally, espe-

cially about innovative practices, inhibiting the development of social norms around innovation/adaptation and slowing information transfer. Tensions associated with land rental and perceived competition for this rental ground serve as significant inhibitors among local farmers. Where discussions do exist, they often reflect local social dynamics and are based in the efforts of particular individuals in facilitating discussions.

Connections with public institutions (USDA-NRCS, conservation districts, extension) are often degraded due to the lack of agency capacity, mismatched perspectives, and perceived lack of innovation by agencies. Although many farmers increasingly rely on retailers and retail agronomists for advice and management support (Stuart et al. 2018), private industry often lacks technical expertise in more innovative agronomic or conservation practices. This lack of experience with management-intensive conservation practices (e.g., cover crops) leads to a lack of confidence among these private-sector advisors to promote innovative practices and cropping systems. In addition, advising carries significant risk; advisors in our discussions emphasized the importance of developing long-term relationships with customers based on trust. Advising the use of practices that may create management challenges or fail to result in observable impacts on short time scales (i.e., a single growing season) risks damaging long-term relationships. Retail advisors also see themselves as primarily responding to customer demand, so without significant interest from growers, retailers are often reluctant to promote new practices. Although these are significant challenges for advisors, some of our participants indicated the importance of advisors promoting practices and approaches that are likely to increase the long-term success and resilience of their customers. For more progressive advisors, this includes conservation practices (e.g., cover crops and reduced tillage) as well as precision agricultural approaches.

Advisors indicated they would benefit from more applied research generated by public institutions (e.g., government agencies and universities) that provides more direct guidance on how customers can benefit from adopting conservation systems, especially soil health practices that generate benefits over multi-year time frames.

3.4 | Human capital

On the farm, crop producers operate in a complex relationship with nature, responding to a broad range of soil types, variable and uncertain weather conditions, and increasingly erratic precipitation patterns. These conditions vary widely from farm to farm and from region to region. In addition, farmers have different operational considerations, including the types of crops and livestock produced, different farm sizes and financial capacities, and off-farm employment. Farmers are also individuals like everyone else and have different values, attitudes, and goals that influence their decisions. These mindset differences emerged as a key determinant of whether a farmer is willing to adopt key conservation practices. Although implementing cover crops or conservation tillage can be challenging in certain climate or soil conditions, farmers with a willing mindset can find ways to overcome these barriers through experimentation and innovation.

Study participants reflected a perspective that current policies and markets tend to be "one size fits all" and treat farmers as a monolith. There was a desire expressed by many for a diversified agriculture that reflects the diversity of farmer mindsets, skills, and values. This would include diversified production systems, but participants acknowledged that not all farmers want to engage in these systems. Conservation or agro-ecological production systems can require more farmer adaptability and a different form of management than commodity-oriented production systems. Neither of these systems (or the variety of other types of systems that could be supported in a more diversified industry) is inherently "harder" or "easier" than another, but they do require different sets of knowledge and management skills. Participants reflected that the agriculture industry in Michigan is largely oriented toward building skills for commodity-oriented systems, leaving many farmers (especially new and beginning farmers) without the training or skills needed to successfully implement conservation systems. Although some of this support can and should come through social networks, participants also saw a need for greater training and skill-building for dynamic and resilient production methods.

3.5 | Conservation programs

Although not all participants had direct experience with conservation programs, nearly all were familiar with them, including federal programs such as the Conservation Reserve Program and the Environmental Quality Incentives Program (EQIP), as well as state programs, especially the Michigan Agricultural Environmental Assurance Program. Our discussions of these programs often highlighted their limitations, and although it was recognized that there is benefit in having programs to support adoption of conservation practices, the current structure and implementation of these programs is insufficient to expand conservation significantly.

Interestingly, many (though not all) of the conservation-oriented farmers felt these programs were not particularly helpful for them. Programs were often characterized as inflexible and bureaucratic, which both increased the barrier to entry for farmers seeking support and limited their usefulness for innovation. Among the more innovative farmers we spoke with, this limitation was significant. Cost-share payments offered through programs such as EQIP incentivize fast adoption of complex practices for small time windows, which

does not allow for adequate learning and leads to bad experiences. The innovative farmers in our discussions emphasized the role of learning and experimentation, processes that often extend beyond the 2-to-3-yr contract time frames offered through existing programs. Moreover, EQIP contracts are often granted to construction of physical infrastructure, especially for livestock operations (e.g., manure storage structures), leaving less funding available for more innovative practices.

Along with our discussions of the human capital and social barriers to adoption of conservation practices, current programs do little to address the underlying barriers related to mindset and market incentives. Programs largely focus on field-scale practices through technical and financial assistance, and although these field-scale challenges can be important barriers, alleviating these alone is insufficient. For some in our discussions, current incentive-based programs lead to "renting conservation," cultivating a dependency mindset where farmers will not adopt conservation practices without cost-share. In addition, programs that only support adoption of new practices also reduce incentives to participate for more progressive, conservation-oriented farmers. This lack of acknowledgement of past innovation not only serves as a direct barrier to participation but also may alienate the most progressive farmers from programs and the agencies that operate them.

3.6 | The path forward

The challenges to expanding conservation in Michigan agriculture are significant. Perhaps most difficult is the way these barriers span multiple conceptual domains and spatial scales and interconnect in significant ways. Although the participants in our discussions were aware of the difficulties of moving to a different system (i.e., one that promotes and supports conservation action), they also generated important insights into potential solutions. Some of these have been documented in previous efforts, such as the need for larger and more stable funding for conservation practices, markets for a more diverse set of crops, more effective programs that are easier for farmers to access (Reimer, 2015), and better information with which to make decisions (Stuart et al., 2018). The discussions held through this effort also revealed the importance of action in areas that have not previously been emphasized, particularly focused on empowering individual farmers, farm advisors in both the public and private sector, and more social support at the community level to drive lasting change.

Any significant shift in such a complex system will require a wide set of solutions supported by an array of stakeholders. Below we present a broad overview of the economic, policy, and social changes that could support more conservation in Michigan agriculture. These solutions include specific recommendations (Zimnicki et al., 2021) and describe broader approaches that deserve deeper attention and further development. It is important to note that these solutions reflect a set of discussions with a particular set of stakeholders over 2 yr as well as our own understanding of agricultural conservation policy and decision-making. Although the views of these stakeholders are critical to identifying sustainable solutions, they are not the only voices needed in these discussions. We hope that by reflecting the views of these critical stakeholders in what is needed to support Michigan farmers in undertaking conservation, we spur more conversation and more innovative thought about and action on future policies and programs.

3.7 | Diversified and robust markets

Among the most significant challenges to effective conservation reflected by participants was the lack of diversity in Michigan agricultural landscapes. Although Michigan has a more diversified agricultural sector than many Midwestern states (Michigan Ag Council, 2021), large portions of the southern tier of the state are dominated by narrow corn–soybean (and sometimes wheat) crop rotations. These monocrop-based systems are largely the result of highly specialized international commodity markets that incentivize high-yield, high-input production. Having markets for additional crops, including small grains, perennials, and other field crops, would allow producers more flexibility in their cropping decisions. In addition, more diverse markets may also support greater use of winter cover crops and innovative production systems, including integrated crop–livestock systems.

More diverse marketing outlets could build incentives for innovative management and diversified production systems and potentially link soil health to product value. Diverse markets might take two forms: (a) markets for additional crops, including small grains, forages, biomass, ecosystem services, and (b) market differentiation based on product qualities (e.g., nutrient density) or production practices (e.g., sustainability metrics), which could also be linked with changing consumer preferences. Currently, although the public at large and consumers specifically may value the climate and resilience benefits of farmers' utilization of soil health practices, our participants were not aware of any specific labeling or certification programs that can distinguish between products produced using these methods (Friedrichsen et al., 2021). There was significant interest among participants in creating some sort of market mechanism through which consumers (and other value chain actors) can make purchasing decisions based on these values, creating a market premium for crops produced using soil health practices. Although this market differentiation is conceptually appealing to many of our participants, it faces some significant challenges. Developing these

markets requires significant coordination because multiple links are necessary for new supply chains to emerge. For example, although there may be consumer demand for products, such as baked goods using small grains grown with sustainable practices or place-identified (Michigan or regionally identified), meeting this demand requires developing storage and handling, aggregation, distribution and transportation, and processing capacity that largely does not currently exist in the state. Although project participants in the retail and process industries indicated that such demand does exist, the absence of robust supply chains for noncommodity products inhibits both product development and farmer production of alternative crops.

3.8 | Strengthened social networks

Policies and programs to promote conservation practices typically focus on the individual farmer as the primary decision-maker and policy target. Although our participants emphasized the need for individual empowerment, they also indicated the need for a greater focus on community-scale factors that influence conservation decisions. A lack of social support or even discussion about conservation practices among farmers was often noted as a significant barrier. Several regionally specific farmer networks exist across Michigan; however, most lack defined outcomes and objectives, which appears to inhibit progress toward quantifiable environmental outcomes. Additionally, these groups often do not have consistent leadership to effectively build and sustain farmer-centered networks, which requires skills in facilitating social processes and the resources to encourage participation (Groce et al., 2019).

Farmers need more support, both to encourage conservation activities and support individual empowerment. This support needs to come from other farmers, from greater connection to public and private institutions, and from broader connections to their local communities and consumers. Local networks were seen as critical, both in the form of peer-to-peer farmer networks and with the broader set of advisors supporting on-farm decision-making. These advisors also reflected the need for more active collaboration, especially between traditional public-sector institutions (extension, university researchers, state and local conservation agencies) and private-sector advisors (crop advisors, retailers, and farmer organizations). This desire for greater social connection to support adoption of conservation systems aligns with other work that has revealed both the formal (information and resource sharing) as well as the informal ("moral support") role that networks play. Use of conservation practices can both reflect as well as reinforce values and ethical frames for individual farmers and networks of farmers (Roesch-McNally et al., 2018).

Participants also identified a need for more involvement from non-operating landowners, lenders, market outlets, and other stakeholders across Michigan food systems and supply chains. Intriguingly, even though most of the participants produced commodity crops, many expressed an interest in connecting more with consumers of their products. Although farmer–consumer connections have often been discussed in specialty markets (i.e., fruits, vegetables, and meat in direct-to-consumer markets), the desire for this in row-crop production systems has often been overlooked, though attention has increased in recent years through work on food hubs and other forms of values-based food system models (Berti & Mulligan, 2016; Levkoe et al., 2018).

Many of the farmers we interacted with expressed a disconnect between farmers and researchers and conservation practitioners, noting that academia's reductionist approach to research is often not reflective of the dynamic nature of on-farm conservation. Participants suggested more locally relevant, stakeholder-driven research investigating on-farm conservation systems and integrated food systems–food supply chain research.

Multiple networks spanning different spatial scales may be necessary to overcome challenges associated with practice adoption density (i.e., lack of local examples). In addition, it is also important to recognize complex social dynamics, especially around farmer competition for rental ground, competition for customers between different advisors, and differing goals and incentives between various stakeholders. This recognition is important and must be reflected in how networks are constructed, facilitated, and supported. Networks alone are not a "silver bullet" to ensure conservation adoption, but they are necessary to develop community norms that support conservation practices and the resilience of the farm sector in both environmental and social dimensions.

3.9 | Investments in human capital

As a concept, human capital has often been rooted in an economic or organizational value model (Barro, 2001; Lengnick-Hall et al., 2011), encompassing the need for specific skills and education to increase the economic value of the individual. Although our discussion participants indicated the need for more skills training and education, they also reflected a broader set of goals based around empowerment of individual farmers. This broader focus on individual empowerment was based in the need for more market power as well as systems that encourage innovation and experimentation.

Farmer participants frequently referenced the need for systems that reward effective farmer management, with conservation practices a key strategy in this. Conservation-minded farmers and advisors recognize the importance of protecting and enhancing the productive capacities of their farm,

especially through development of soil health to support resilient cropping systems. This theme was strongly connected to the market challenges and opportunities, particularly in the need for commodity markets to allow farmers to capture the economic benefits of engaging in conservation. These systems would also allow for greater returns to effective management and support innovation.

New technologies have the potential to more closely link environmental/conservation benefits with production benefits and to reward innovation and management skills. To access and incorporate these new technologies, participants indicated the need for more farmer education and skills development, greater access to reliable and trusted information, and more control of farm data. Training and education programs are not only limited to farm managers; participants indicated a lack of available skilled labor, indicating that access to training for young farmers and farm laborers is a potential roadblock to further adoption of new technologies. In addition, some farm advisors indicated their need for more training and education, specifically regarding soil health and conservation practices. Programs and support are needed for skill development, focused on specific on-farm technical skills (especially for farm labor) and management skills for farmers, including data management, marketing and financial management, adaptive management approaches, and resilience-based management.

3.10 | Reformed conservation programs

Although existing conservation programs at the state and federal level offer important support and incentives, participants identified barriers and shortcomings that limit their effectiveness. They expressed that programmatic funding could be more effective if it supported farmers over long time frames—especially in the adoption of conservation systems—rather than focusing on single practices. In addition to providing financial assistance for practice adoption, programs could be more skill and mindset focused to promote lasting change in farming systems. From an administrative perspective, they stated that programs need to be more flexible and adaptable to farm and local scales. Along with the concept of human capital, farmers would be well served if programs supported and empowered individual farmers and on-farm innovation.

In addition to noting the need for longer-term programs, several farmers commented on the need for programs to develop better outcome-based tracking methods, targeted investments, and expanded technical capacity regarding the conservation practices within the program. Participants expressed a desire for conservation programs to prioritize outcomes rather than only incentivizing practices. They also noted that program efforts need to be targeted, focusing on regions, watersheds, and even specific fields to address nutrient losses. To support this outcome-focused approach, edge-of-field and in-stream monitoring capacity could be expanded to better ascertain the source of nutrient losses. To expand the scope of monitoring and allow for participatory program approaches that incorporate farmer stakeholders, the cost and complexity of monitoring efforts would need to be reduced (Taylor & Eberhard, 2020).

3.11 | Building a resilient agriculture

There is tremendous opportunity to rethink and restructure conservation practice promotion efforts that promote environmental sustainability and resilience in the food system. Paramount to this vision is engagement with farmers and farmer influencers across geographies and over long time horizons. This engagement is critical to developing programs, policies, and state and national investments that drive adoption. This work must be approached with a sense of humility and desire to truly hear and understand the perspectives of farmers, agricultural service providers, conservation professionals, researchers, and consumers. Building a shared understanding of the broader conditions is a necessary step to deriving the solutions that can build resilience across multiple dimensions. Although resilience has technical considerations that are important to understand, building resilience in Midwestern agriculture is fundamentally a social process. Co-creating a resilient agriculture sector starts with building relationships to address the challenges facing the broader food system in a given region and agricultural community.

In this article, we have described a process that we hope is only the beginning of a long-term, fruitful, and respectful dialogue between stakeholders to move conservation forward in Michigan. Although others have documented similar barriers and opportunities, policymakers and state agencies continue to struggle to achieve effective farmer engagement in conservation. This suggests a disconnect between existing research and the application of results. Part of this may be attributed to the fact that most of the recent comparable research in this field is not specific to Michigan. Although the conclusions and recommendations in this paper may be similar to neighboring states, policymakers are often more convinced by reports that specifically speak to farmers and food system issues within their state and localities, which makes this research particularly valuable. We encourage others to undertake similar engagement approaches to generate consensus and develop new concepts for building resilience. These efforts are needed across multiple spatial scales, including local efforts (e.g., county- or community-scale efforts) focused on relationship building, state-level efforts focused on cross-sector engagement, and regional approaches that bridge across states to develop new markets and policies that support local efforts to increase resilience. Innovative policies and

programs are needed to facilitate these engagement efforts, including providing resources for organizations and training for leadership. Building a food system that is more resilient to global changes requires more than farm-level adoption of sustainable agricultural practices; efforts need to acknowledge the systemic social, policy, and market conditions needed to support the people seeking to implement change. Engaging and connecting stakeholders is a key step in the process of building this resilience and more projects are needed to develop insights and strategies to facilitate this change.

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AUTHOR CONTRIBUTIONS

A. Reimer: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Supervision, Writing–original draft, Writing – review & editing. J. E. Doll: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing–original draft, Writing – review & editing. T. J. Boring: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Validation, Writing–original draft, Writing–review & editing. T. Zimnicki: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing–original draft, Writing–review & editing.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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