Agricultural Conservation Networks in Iowa

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Executive Summary

Iowa's farmlands, celebrated for their remarkable agricultural productivity, are facing pressing environmental challenges, including soil erosion, waterway nitrogen pollution, and vulnerability to extreme weather events. These issues imperil the state's agricultural sector's long-term sustainability and economic stability. Despite substantial investments from governmental and non-governmental entities to encourage conservation practice use, adoption rates remain persistently low. In this report, we use quantitative, qualitative, and social network analysis on a sample of 38 farmers to understand how social networks shape their adoption of conservation practices. We analyze data through a systems framework and compare counties with high- and low-adoption of conservation practices to assess influences from the individual farmer level to the broader societal context. We conclude with a discussion of strategic implications to promote conservation adoption.

Key Findings & Recommendations

1. **Farmers living in counties with high adoption rates of conservation practices have larger and more diverse social networks than farmers living in low adoption counties.** More specifically, farmers in high-adoption counties have more agricultural professionals in their network from whom they seek advice instead of exclusively friends and family. *Recommendation:* Identify and connect influential conservation-minded farmers, local agricultural leaders, Extension agents, and organizations within the community who are experimenting with innovative conservation practices.

2. **Farmers raising a diversity of crops and livestock are more likely to adopt conservation practices.** As farmers diversify their operations and overcome the challenges of multiple types of production, they may seek out new sources of information and networks of farmers experimenting with similar techniques. *Recommendation:* Create connections between farmers managing more diversified operations (often smaller farms) and large farms hoping to increase crop diversity and conservation practice use on their farms.

3. **Farmers tend to regard their network of fellow farmers, such as friends and neighbors, as knowledgeable, trustworthy, and innovative.** However, agricultural experts, extension agents, and agronomists also play a pivotal role in supporting farmers in successfully adopting conservation practices. Experts, especially those with farming experience, are trusted and thus can significantly influence the likelihood of practice adoption. *Recommendation:* Promote peer learning and community building by facilitating farmer meetups that bring together farmers at various stages of conservation practice adoption. These events can foster a sense of community, encourage shared learning, and provide a platform for farmers to interact with neighbors who have successfully adopted conservation practices in their specific region. To diversify and enhance networks, engage local agricultural experts, Extension agents, and agronomists, particularly those who already have a high degree of trust with the local community. These experts, especially those with farming experience, can offer region-specific recommendations based on an individual farmer's agronomic goals, soil types, and eligible cost-share programs.

4. **Farmers in counties with low conservation practice adoption rates expressed desire to increase conservation. Farmers in high-adoption counties were more likely to feel appreciated for their efforts and to note community-wide benefits.**
   Recommendation: Invest in learning opportunities and networking events for farmers in low-adoption counties, as farmers are eager to learn but often do not have the necessary resources to transform their agricultural practices. Connect farmers in low-adoption areas to other networks of farmers (possibly using social media as a tool) to encourage knowledge and resource sharing, including awareness of incentive programs to offset costs associated with adoption. Publicly recognize farmer conservation achievements to provide examples of successful practice adoption and highlight local role models/mentors.

5. **Counties with high adoption rates of conservation practices tend to utilize or successfully apply for government-funded conservation programs more than farmers in low-adoption counties. Many farmers successfully learned about these opportunities and how to apply for them, through individuals in their network.**
   Farmers highlighted the significance of cost-share programs at the federal and state/regional levels in supporting the successful adoption of conservation practices. When farmers engage with their peers and agricultural communities through social networks, they can become aware of new financial and technical support programs and how other farmers in their network benefit from them. Furthermore, regulations aimed at soil erosion reduction and water quality protection have motivated farmers to voluntarily adopt conservation practices, as they prefer proactive conservation efforts to avoid potential future mandates. Farmers emphasize the importance of maintaining autonomy over their operations as a key driver of early adoption.
   Recommendation: Allocate resources strategically to strengthen agricultural networks and knowledge of cost-share opportunities in low-adoption counties, perhaps by connecting farmers in low-adoption counties with those in high-adoption counties.

6. **On the societal scale, various sources of information, including agricultural organizations and media at the state, national, or international levels, play key roles in the adoption of conservation practice. However, some information sources are more important to specific demographics.** For instance, younger farmers are more inclined to use social media and podcasts, while older farmers more consistently rely on information from federal government programs. Social networks are important in spreading innovative conservation information that may not be provided in a farmer's chosen information channel.
   Recommendation: Encourage collaboration and coordination between government-funded organizations, commodity organizations, and various media outlets. Partnership can amplify and reinforce messages of how farmers are integrating conservation practices into their operations while still meeting their agronomic goals. Tailor information dissemination strategies to reach specific demographics, considering age groups, county adoption rates, and preferred information sources.

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Introduction

Iowa farmlands are renowned for their agricultural and economic productivity on an industrial scale. However, these rural lands face various environmental challenges, including soil erosion, waterway nitrogen pollution, and vulnerability to flooding and droughts that threaten their long-term sustainability and economic viability. Fortunately, many agricultural conservation practices (e.g., no-till, cover crops, wildlife habitat management) can reduce the environmental impacts of agriculture while continuing to reach yield goals. Despite considerable investments in incentive programs and technical support by the U.S. Department of Agriculture (USDA), Iowa Department of Agriculture and Land Stewardship (IDALS), and various non-governmental organizations, the overall adoption of conservation practices remains low. Research on conservation adoption has consistently focused on individual and farm-level factors to understand adoption behavior. Demographics such as farm size and land ownership have been positively associated with adoption (Zhang et al., 2018). Additionally, attitudinal factors such as risk tolerance and stewardship motivations have been associated with greater use of conservation practices (Bitterman et al., 2019; Popovici et al., 2023; Upadhaya & Arbuckle, 2021). However, meta-analyses of conservation adoption research indicate no consistent predictors of farmers' adoption behavior (Knowler & Bradshaw, 2007; Prokopy et al., 2019). For example, Prokopy et al. (2019) meta-analysis found that predictive factors, like land tenure, behave differently across studies. Overall, these meta-analyses call for a focus on structural factors that examine the socio-ecological context, including the social context in which farmers are situated.

Photo Credit: Iowa Learning Farms, University of Iowa Extension and Outreach

One method for examining the social context and the influence of social connections is called Social Network Analysis (SNA). This approach uses interviews and surveys to learn about the social connections between farmers and their friends, family, neighbors, and other professionals. It can also be used to identify sources of trusted information. SNA is useful for visualizing and exploring the impact of social connections on values, behaviors, and practices.

This study investigates the role of Iowa farmers' social networks in influencing the adoption behavior of conservation practices. We explore how farmers' social networks influence their behaviors by communicating and enforcing social norms. Networks serve as the channels through which knowledge and experiences are shared. Through surveying and interviewing Iowa farm operators, we examine how farmers' social networks influence behavior across multiple social scales. While previous studies utilizing SNA have primarily sought to identify community stakeholders, this study identifies the variety of sources farmers learn from, share information with, and view as trusted sources. We include a discussion of strategic implications to identify how the findings of this report may be translated into action to promote conservation adoption and inform future research efforts.

History of Iowa Agriculture and Conservation Efforts

The current agricultural system in Iowa emerged from the volatile economic period of the 1980s farm crisis, along with the integration of technological and mechanical innovations allowing farmers to work on larger land areas. Iowa farmers face significant economic risks and uncertainty due to surging farmland values and increasing production costs. To overcome risk and remain competitive, the average farm size in Iowa has increased over the past several decades while the overall number of farm operations has declined. The most recent 2017 Census of Agriculture shows that Iowa lost 2,533 farm operations (about 3% of all operations) between 2012 and 2017, likely due to farmland consolidation (Edwards, 2019).

Iowa is among the most agriculturally productive states in the nation, with agriculture as the economic anchor for most counties. As with all agricultural production, the natural resources that make such economic prosperity possible are also at risk of degradation due to the prioritization of yield over environmental health (Leitschuh et al., 2022). Conservation efforts in the state are vital to ensuring continued economic prosperity and ecosystem health. Additionally, conservation efforts within Iowa can have impacts that ripple beyond the state's borders, particularly at the watershed scale. Given the documented link between Midwest agricultural activities and hypoxia in the Gulf of Mexico (Burkhart & James, 1999), efforts to reduce nutrient pollution can improve water quality locally and nationally.

Iowa farmers have made significant progress incorporating conservation into agricultural production, partially thanks to financial and technical assistance programs. For instance, in 2022, the USDA's Natural Resources Conservation Service (NRCS) supplied Iowa farms with $70 million in funding for conservation and easement programming (NRCS, 2022). Additionally, efforts to increase adoption are also occurring among non-governmental organizations in Iowa. An analysis of survey data from Practical Farmers of Iowa (PFI) found that 71% of farmers adopted conservation practices thanks to their membership in the PFI (Asprooth et al., 2023). While conservation is important to Iowa farmers, there is a need to identify what factors influence practice adoption to encourage more widespread land management change.

Study Methods and Systems Framework

Sample

We surveyed 38 farmers from 10 counties in Iowa to compare the adoption of conservation practices in neighboring counties and across the state. We initially recruited farmers from neighboring Henry and Washington counties (southeast Iowa) because of documented disparities in adopting conservation practices. Despite their geographical and agronomic similarities, Washington County farmers have embraced cover crops at a rate twice that of Henry County farmers (20% vs. 10%). The adoption of cover crops was chosen as an indicator as it often reflects the broader use of conservation practices (Wallander et al., 2021). Initial recruitment was carried out in Washington and Henry counties using a list provided by the NRCS and expanded through participant referrals. Participants from additional counties (Fayette, O'Brien, Wapello, Adams, Jasper, Jefferson, Johnson, Story) were also included to increase the sample size and assess the generalizability of findings. Cover crop adoption rates in the surveyed counties ranged from 5.0% to 20.4%, averaging 12.4%, slightly higher than the statewide average of 10.1% (USDA NASS, 2017).

Data Collection

We used Network Canvas to collect data on social network characteristics and farm operations, including size, land tenure, commodities, and conservation practices. These practices were sourced from an NRCS list, with additional innovative practices added by the research team's soil scientist. The social network portion of the survey asked participants to name individuals within their social network to whom they go for conservation practice information or advice. The participants were free to identify members of their network anonymously (using initials or nicknames) if desired. We gathered information about each network member, including their relationship to the participant, what conservation practices they discuss, and their perceived level of trustworthiness, innovativeness, and expertise. Participants also selected conservation-related organizations from which they received information and answered open-ended questions about adoption influences, barriers, and environmental challenges. Likert-scale questions assessed community perceptions of conservation practice use and practice impacts.

Analysis

Data collection was completed between December 2022 and March 2023. All surveys were exported from Network Canvas, cleaned, and imported into R for analysis and visualization. The initial data analysis phase included descriptive statistics for demographic and Likert-scale variables. We then analyzed different trends by groups, such as age, county adoption rate (high vs. low), types of relationships, and crops and/or livestock produced. We used the Pearson correlation to assess the significance for correlations and determined significance based on p-values lower than 0.05.

We also included two types of social network analysis: 1) personal network analysis, in which we assess the networks of each individual farmer, and 2) two-mode network, where we connect farmers with the organizations, they reference for conservation information. Personal network analysis was carried out using the Igraph and Egor packages in R, which facilitate the assessment of the size and structure of each farmer's network and the characteristics of individuals within the network.

Open-ended responses were exported and coded thematically using NVivo, a software used for qualitative data analysis. In addition to coding open-ended responses, two research team members coded the conservation practices using a modified version of Peterson St-Laurent's (2021) "Resistance,

Resilience, and Transformation" typology of conservation practices. Practices were categorized as 1) *fundamental* practices in the current system, 2) *improved* to enhance the current system function, or 3) *transforming* how the current agricultural system functions. The research team reached a consensus for coding discrepancies by considering how each practice is applied to the landscape and referencing the team members' professional, academic, and practical experiences with the practices in question.

Systems Framework

We analyzed our data from a systems perspective, which outlines varying levels of social influence on individual actions. In this analysis, we focused on five distinct layers, including:

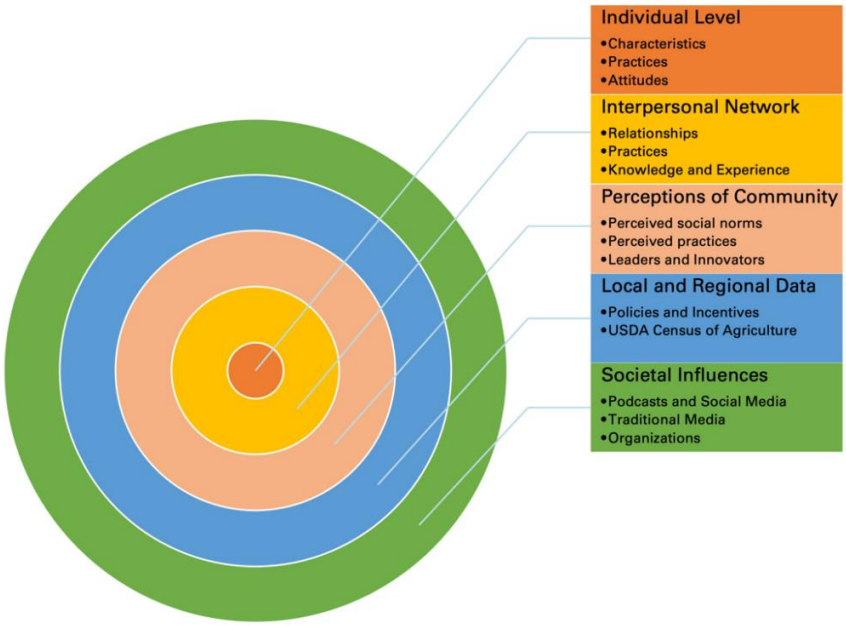
1) **Individual Level**: Individual farmers and their characteristics, practices, and attitudes around agricultural conservation.

2) **Interpersonal Network**: The people within each individual network to whom participants go for information about conservation practices, including what conservation practices they discuss, and their network connections' knowledge, leadership, and innovative experience in conservation, according to the participant.

3) **Perceptions of Community**: The perceived social norms and local community attitudes toward conservation, according to the participant.

Figure 1

Systems Framework for Analyzing Influence of Social Networks and Broader Societal Factors on Conservation Practice in Iowa



4) **Local and Regional data**: Local and regional policies, programs, and incentives and their impact on adoption rates of conservation practices.

5) **Societal Influences**: Conservation information is accessed through social media, agricultural news media, government programs, and other agricultural organizations with a broader reach than the local community.

This framework offers a nuanced perspective on the drivers and barriers shaping conservation practices by examining individual behaviors within the context of interpersonal networks, community norms, local/regional policies, and overarching societal influences. Mapping relationships and connections between individual networks can reveal patterns of influence, knowledge sharing, and innovation.

diffusion within a community. Furthermore, data analyzed within a systems framework can be better contextualized within the community's social norms and regional policies, helping to identify how these factors affect conservation practices. Understanding local, regional, and societal network influences can inform the development of more effective policies, incentives, and interventions to promote agricultural conservation.

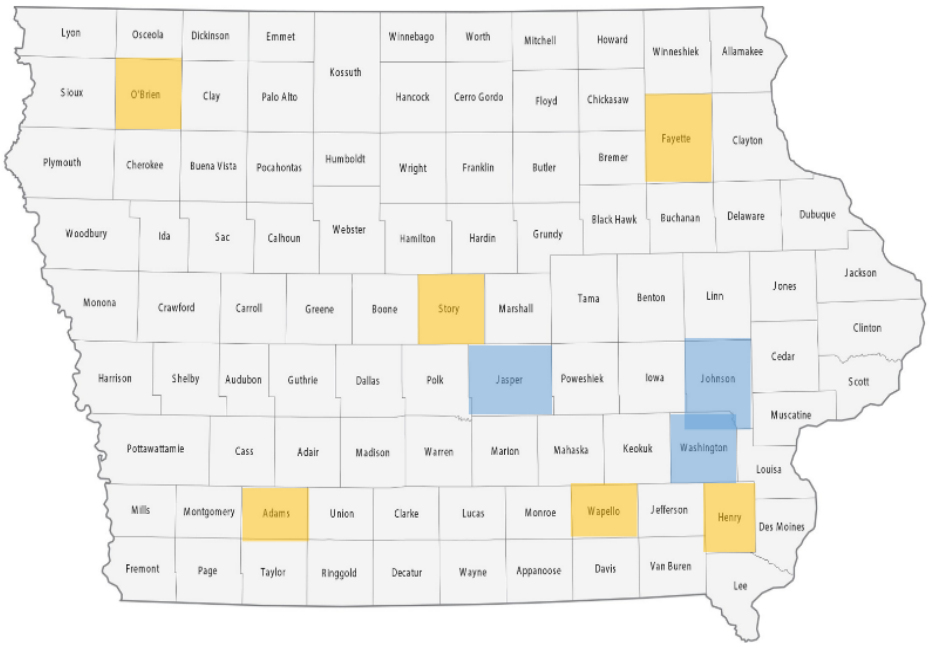
Farmer Characteristics and Conservation Practices Adopted

We surveyed 16 farmers in Washington County, 9 in Henry County, and 12 from other counties in the state. Figure 2 illustrates the location of participants and whether they are in a high-adoption or low-adoption county. High-adoption counties are those with cover crop adoption rates above the statewide average.

- 95% of participants were male, 100% were white, and ages ranged from 28 to 82, with an average age of 55.
- Farm size ranged from 40 to 5,200 acres. 58% of farmland acres are owned by the primary operator. On average, farmers age 60+ own 33% more acres than younger farmers.
- 97% of participants produced corn and soybeans. Participants also produced livestock, forage crops, small grains, and specialty crops.

Figure 2

Survey Participants Were Selected Across Iowa from Both High Adoption (Blue) and Low Adoption (Yellow) Counties



Note: Counties with cover crop use above the statewide average (10.1%) are classified as "high-adoption" (shown in blue), while counties with below-average cover crop use are classified as "low-adoption" (shown in yellow).

In the following sections, we discuss the major findings of this research. These include:

1. The most frequently applied fundamental, improved, and transformational conservation practices and adoption practices by type of farm production.
2. Farmer attitudes toward agricultural conservation practices.
3. The role of social networks and community perspectives, including how friends, neighbors, and local agricultural leaders influence conservation practice adoption.

4. The role of local incentives and government programs in encouraging farmers to adopt conservation practices.
5. The role of broader societal influences, such as media and regulations, in shaping farmer attitudes and the adoption of conservation practices.

Types of Conservation Practices and Levels of Adoption

Analyzing farmers' adoption of conservation practices and their motivations is crucial for promoting agricultural sustainability and assessing the influence of social networks in disseminating innovation. Some conservation practices are more difficult to adopt than others. Some fit easily into the existing production system (i.e., crop rotation), while others require a transformation of the current mode of production on a portion of acres (i.e., upland wildlife habitat establishment). Figure 3 illustrates several conservation practices commonly used by participants. We organize these practices into three types:

- **Fundamental**: commonly used conservation practices, often prescribed or mandated in some production systems or ecologically sensitive areas.
- **Improved**: practices that reduce the environmental impacts of existing production systems, often requiring a financial or technical investment from the producer.
- **Transformational**: practices that transition to fundamentally different ways of farming or land uses (e.g., away from annual row crops toward perennial vegetation, pasture, or restoration of native ecosystems).

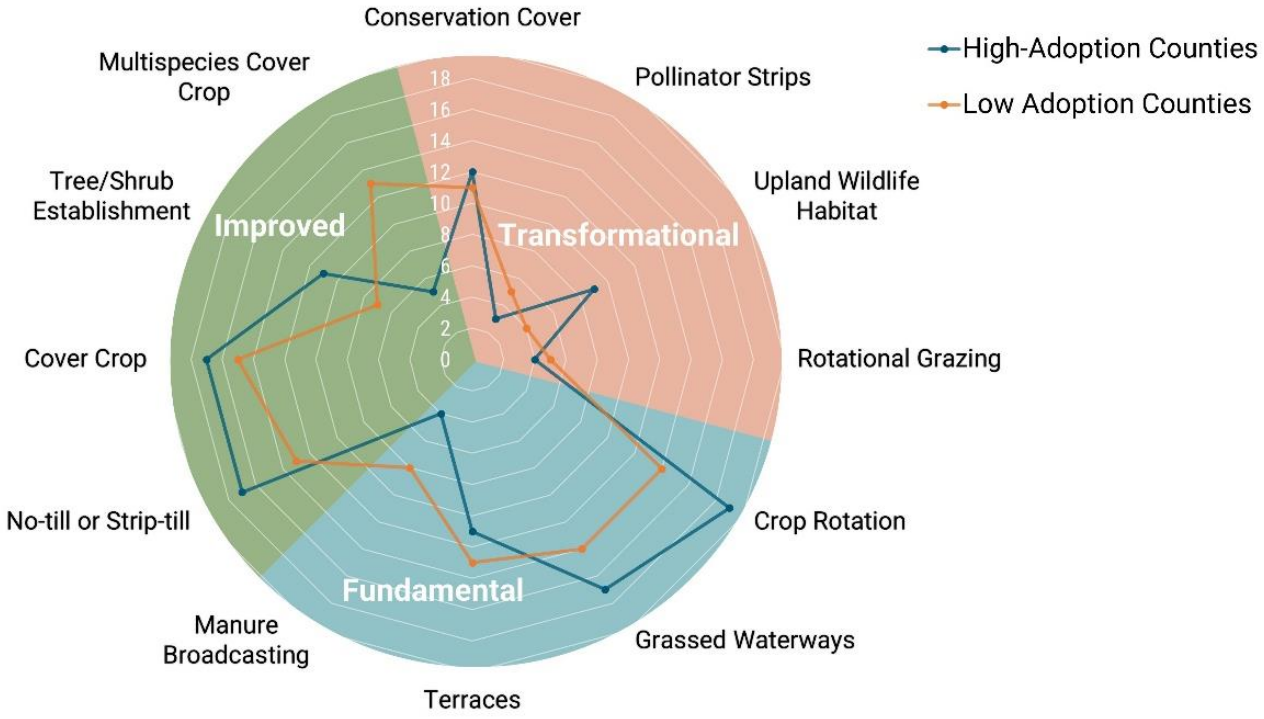
While research suggests that improved and transformational practices are superior, effective use can be a learning curve. In our sample, *fundamental practices*, particularly crop rotation and grassed waterways, are the most reported practices, especially in high conservation areas. Nearly all farmers in our sample use a variation of a corn-soybean rotation to reduce pest pressure and nutrient input requirements.

The most common *improved practices* are no-till and cover crops in high-adoption areas. Interestingly, multispecies cover crops are more commonly practiced among respondents in low-adoption areas. These farmers could be local innovators less connected to neighbors doing similar things.

Among the *transformational practices*, conservation cover, which means planting a permanent cover crop specifically to restore soil health, is used by farmers in both high- and low-adoption counties in our sample. Other transformational practices remain uncommon, even in our sample of conservation-minded farmers. However, upland wildlife habitat management, where a portion of the farm provides habitat for wildlife during their lifecycle, was more common in counties with low adoption of other conservation practices.

Figure 3

Number of Farmers Using Various Conservation Practices from High-Adoption Counties and Low-Adoption Counties, Grouped by Practice Clusters



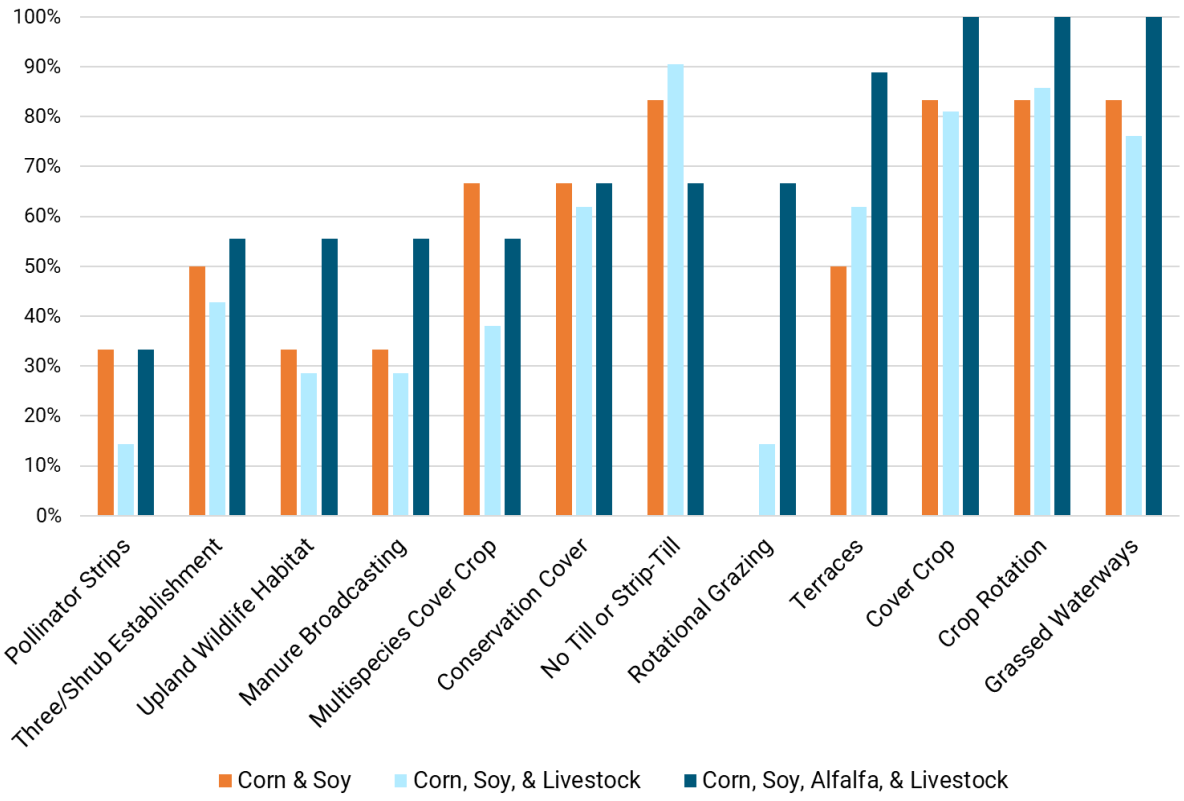
Note: The practices are organized into three categories: 1) "fundamental", basic conservation efforts; "improved", practices that require a greater financial or technical investment; and "transformational", practices that transition to fundamentally different ways of farming.

Farmers growing a greater diversity of crops are more likely to adopt transformational conservation practices.

Some conservation practices are more likely to be adopted in specific production systems. In Figure 4, we see that farmers who plant a combination of corn, soybeans, alfalfa, and livestock are more likely to adopt agricultural conservation practices. Multi-crop farmers are more likely to adopt transformational conservation practices, such as rotational grazing and upland wildlife habitat. The results suggest that farmers deviating from strict corn-soybean rotations to create a greater diversity of crops and livestock are more likely to adopt conservation practices incorporating alternative land uses.

Figure 4

Rate of Conservation Practice Uses by Types of Crops Produced



Note: Farmers who plant a combination of corn, soybeans, alfalfa, and livestock are usually most likely to adopt agricultural conservation practices and multi-crop farmers are more likely to adoption transformational conservation practices.

Attitudes, Values, and Barriers Related to the Adoption of Conservation Practices

Figure 5 illustrates farmers' attitudes toward conservation practices and how their community responds to management choices. All participants in low-adoption counties “strongly agree” that they are “looking to increase conservation on their farms.” In contrast, half of the participants in the high-adoption counties “agree.” However, farmers in high-adoption counties are more likely to agree that the “community benefits from their conservation efforts,” that “conservation changes their farm operations positively,” that they are “known for experimenting with conservation,” and that they “feel their conservation efforts are appreciated” by their community. Although the high-adoption county respondents were more likely to view agricultural conservation practices positively, the differences between the two groups are minimal.

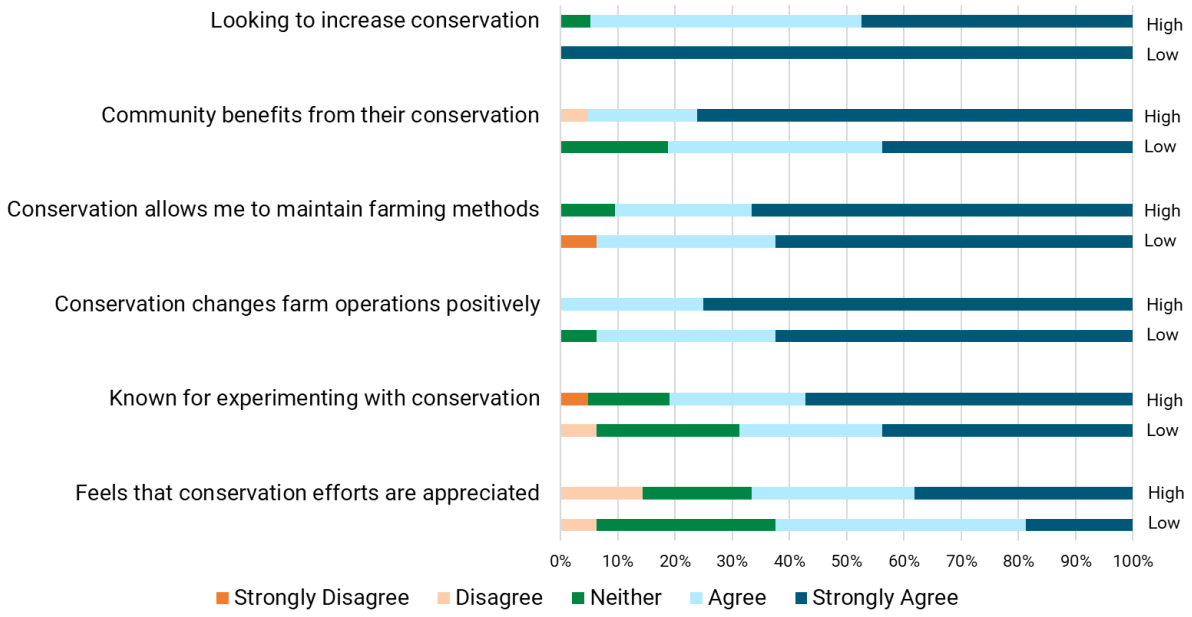
Farmers identified challenges and barriers to adopting conservation practices, including cost, the size of their operation, and their unique land and operation needs.

> *When deciding against adoption, cost is a huge factor. We are limited because of the size of our farm. Take cover crops, for example. If you have a massive operation, you can make a good return on your investment even when buying new equipment. It is more complex with smaller-scale operations.*
>
> *The second thing is the availability of labor to implement new practices because we raise hogs full-time, and there is a limit to how much we can get done. On the positive side, no-till saves us money and time and requires less equipment. When we look at something, what will it cost us? Getting that return is more difficult if it takes a long time.*

Responses to open-ended survey questions illustrate that farmers are motivated by various factors when adopting new conservation practices. These include a desire to protect the soil for future generations, to respond to land and operation needs (e.g., erosion, soil water capacity, labor, cost-sharing benefits), and to increase the resilience of their operation through expanded economic opportunities offered by conservation practice adoption.

Figure 5

Farmer Attitudes toward Agricultural Conservation Practices, Organized by High- and Low-Adoption Counties



Note: Although the high-adoption county respondents were more likely to view agricultural conservation practices positively, the differences between the two groups are marginal.

Many farmers in our sample highlighted the importance of protecting soil for future generations as a driving force for conservation practices. Many respondents had a family legacy of farming the land.

These family farms viewed maintaining or improving soil health as essential to sustain the land for future generations. One farmer stated, *"We want to hand this down to our kids and make it better for them. Why wouldn't we want to improve it for kids and the community?"*

Many participants spoke of the difficulty of restoring soil health once it has been depleted, emphasizing the need to prevent soil degradation proactively. As the cost of land increases, farmers also noted that expanding operations has become increasingly complex, thus further highlighting the need to "*protect what we have for the next generation.*"

Farmers often highlighted the practical advantages of conservation practices. Conservation practices were used to navigate land and operation needs, such as reducing labor demands through no-till or using cover crops to reduce soil erosion and nitrogen loss. Participants recognized that adopting conservation practices might require initial investment and effort, but they believed the long-term benefits were worth it. Conservation practices with observed benefits and low adoption costs were more likely to be sustained through land operation changes and spread throughout the community.

In the context of social networks, when farmers experience tangible benefits from conservation practices with relatively low adoption costs, they are more likely to continue using these practices and share their success stories with their peers. This can trigger a ripple effect within their agricultural community, as word-of-mouth and shared experiences within social networks can lead to broader adoption and sustained use of these practices. We discuss the positive impact of peer modeling in more detail in the following sections.

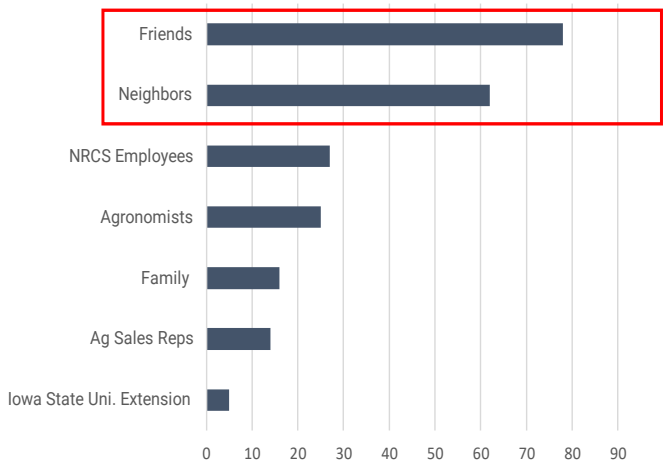
The Role of Information, Innovation, and Trust in the Adoption of Conservation Practices

Social Networks Influence Access to Conservation Information

Farmers are most likely to report discussing agricultural conservation practices with local friends, neighbors, and family. They also seek advice from USDA employees, agronomists, and Extension agents. They sought out information from of transactional relations such as seed or chemical salespersons to a much smaller extent (see figure 6).

Figure 6

Farmers Most Often Receive Conservation Information from Friends and Neighbors



Knowledge, Trust, and Innovation Impact How Network Connections Influence Conservation Adoption

Respondents were asked three Likert scale questions regarding the level of trust they have with individuals in their social network, as well as the individuals' level of knowledge and innovation around conservation practice use. For each question, we broke up responses into three groups of connections:

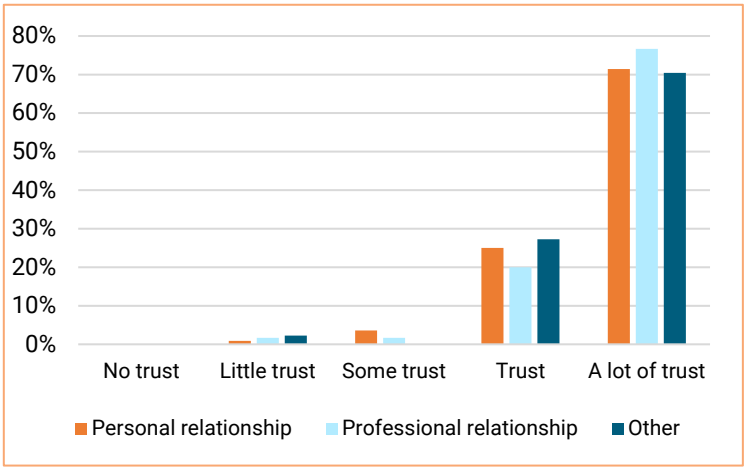
- Personal relationships (e.g., family, friends, neighbors)
- Professional relationships (e.g., USDA employee, Extension agent, landlord),
- Other (e.g., acquaintance, equipment dealer, sales representative).

For the first question (*How much do you trust information from this person*?), most farmers said they have "trust" or "a lot of trust." While all three relational groups are similar, more farmers had slightly higher trust in the knowledge of their professional relationships (see figure 7).

Responses to the second question (*How knowledgeable is this person regarding land stewardship needs in your area?*) were slightly more varied. Most were "moderately knowledgeable" or higher across all relationships. Farmers found most personal and professional relationships to be "very knowledgeable" or "extremely knowledgeable."

Figure 7

Farmers Expressed the Highest Trust in Information from Professional Relationships



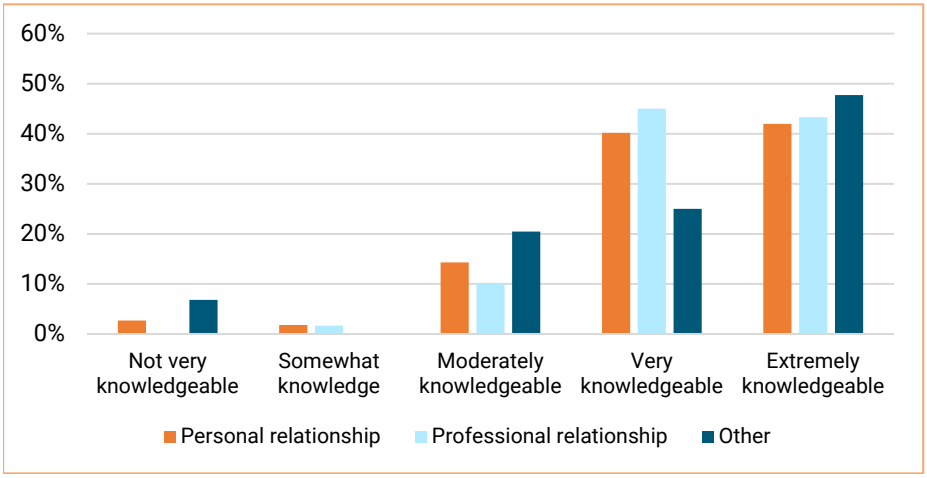
Connections in the "Other" category received the widest variation of responses, with slightly less than 10% saying these connections were "not very knowledgeable" and nearly 50% saying they were "extremely knowledgeable." This is unsurprising as the "Other" category holds a wider variety of relationships, and those individuals were frequently located outside the local community, making knowledge about local needs more variable (see figure 8).

The last question (*To what extent do you consider this person an innovator of land stewardship?*) showed the greatest response variation. Farmers found their personal relationships to be "somewhat innovative" or "very innovative," although responses were recorded across the spectrum (see figure 9)

However, 60% of those in the "Other" category were rated as "very innovative." Individuals in the "Other" category included agricultural experts, consultants, and farming and environmental conservation professionals. These individuals represent a diverse network of people with varying agricultural roles and expertise, including seed production, conservation, agronomy, and business. Additionally, this list includes mentors, colleagues, and acquaintances who provide support and guidance in farming and related endeavors while not necessarily being farmers themselves.

Figure 8

Farmers' Confidence in the Knowledge of their Social Connections

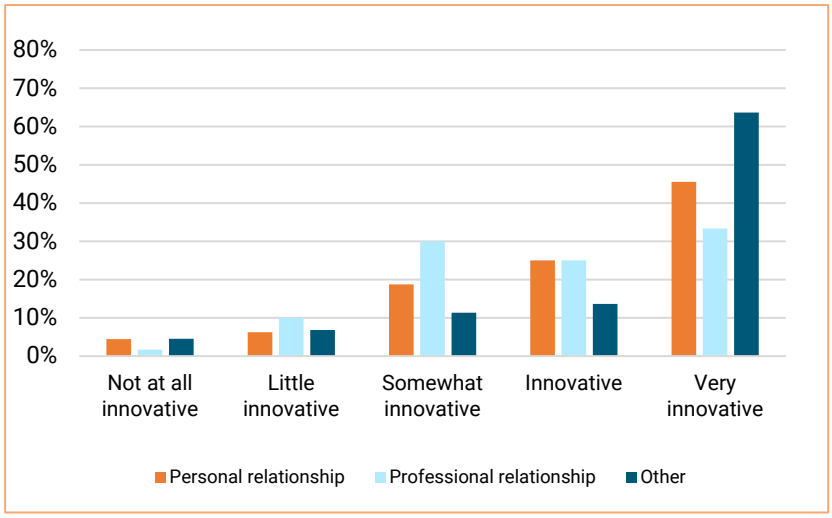


Thus, the variation in perceived innovation may result from the individual's occupation – many were not farmers and, while they were sources of knowledge, were not considered conservation innovators. Across all questions, farmers seem to have a high level of trust in members of their social networks, seeing them as being somewhat or highly knowledgeable and many as innovative.

These findings illustrate that farmers in the study demonstrated high trust in individuals within their social networks, regardless of the type of relationship. This trust is crucial for information sharing and decision-making within farming communities. Trust, knowledge exchange, and innovation diffusion within these networks are key drivers of conservation practice adoption.

Figure 9

Farmers' Perceptions of The Innovativeness of Their Social Connections



The strong trust in professional relationships, such as USDA employees and Extension agents, indicates the importance of these experts in providing valuable guidance and information related to conservation practice use. Farmers perceive individuals in their personal and professional networks as highly knowledgeable, illustrating the role of social networks in disseminating valuable knowledge and best practices among farmers. Personal relationships, like family and friends, also play a significant role in knowledge exchange. The perception of innovativeness varied widely among different relationship categories. While personal relationships were generally seen as somewhat or very innovative, the "Other" category, consisting of agricultural experts, consultants, and business partners, had a higher proportion classified as "very innovative." This suggests that individuals with diverse agricultural roles and expertise contribute significantly to innovation within the farming community. Expanding connections to diverse individuals is key to encouraging practice adoption.

Community Characteristics and Conservation Practice Adoption

The social network data revealed differences in relationships and conservation practices discussed between counties with high conservation practice adoption versus low-adoption counties. For example, improved (i.e., cover crops and no-till) and transformational practices (i.e., pollinator strips and rotational grazing) are discussed more often among individuals in high-adoption counties (Table 1). Interestingly, the types of connections varied substantially between high- and low-adoption counties. Farmers in high-adoption counties often turn to agricultural professionals for conservation practice information, while farmers in low-adoption counties are likelier to consult friends and neighbors.

Table 1

Conservation Practices Discussed with Social Connections

	High adoption	Low adoption
Conservation practices discussed with alters		
Tree/shrub establishment	5.97%	6.08%
No-till or strip-till	38.8%	48.7%
Cover crop	62.7%	55.7%
Multispecies cover crop	29.9%	14.8%
Conservation cover	8.96%	6.09%
Pollinator strips	7.46%	0%
Upland wildlife habitat	1.49%	3.48%
Rotational grazing	10.4%	7.83%
Types of relationships		
Friends	41.8%	43.5%
Neighbors	28.4%	37.4%
Family	5.97%	10.4%
Agricultural professionals	40.3%	25.2%
Relationships		
Length	23.6 years	21.21 years
Trust	4.75	4.64
Innovative	3.74	4.17
Knowledgeable	4.26	4.11
Network statistics[1]		
Average degree	3.7	3.0
Density	0.36	0.49
Average isolates	0.52	0.31

Differences in the types of relationships in high- and low-adoption counties may be explained by variability in access to agricultural professionals, local referrals to agricultural professionals by friends and neighbors, and trust in the knowledge and experience of agricultural professionals. Further, farmers in high-adoption counties tend to have slightly longer relationships, with higher levels of trust and perceived knowledgeability. However, farmers from high-adoption counties perceive their connections as less innovative on average, perhaps because the standard for innovative agriculture has been raised in those communities.

Finally, farmers in high-adoption areas have, on average, more connections (3.7) from whom they seek advice regarding conservation practices than farmers in low-adoption areas (3.0). Farmers in low-adoption counties have more densely connected networks, where about half of all individuals know each other, versus only about a third in high-adoption networks. Furthermore, high-adoption areas report more

[1] *Average degree* refers to the mean number of relationships from whom the respondent seeks advice regarding agricultural conservation practices. *Density* refers to the percentage of connected individuals among all possible connections in a network. *Average isolates* refer to the number of individuals not connected to anyone else other than the respondent in the network.

connections with individuals not connected with others in their networks (0.52 vs. 0.31 in low-adoption networks). To see a representation of all farmer networks in this study, see Figure 15 in the appendix.

The network statistics in Table One suggest that farmers in high-adoption networks, on average, tend to be connected to a more diverse range of individuals with distinct knowledge and experiences. In contrast, those in low-adoption areas are more likely to be exposed to knowledge and experiences that other members of their networks reinforce. These findings affect how information and innovation flow through farmer networks and how these connections may be strengthened to encourage conservation adoption.

For example, low-adoption counties may benefit from diversifying their connections, potentially leading to greater exposure to innovative ideas and practices. In contrast, high-adoption areas may benefit from strengthening existing connections and building new ones to encourage knowledge sharing and adopting innovative practices.

Understanding these network dynamics can inform strategies for promoting conservation practices, emphasizing the importance of leveraging diverse networks, building trust in professional expertise, and fostering connections that encourage the exchange of innovative ideas within agricultural communities.

Learning from the challenges and successes of peers is a driving force of conservation practice adoption.

Farmers often turn to those in their community who have successfully adopted conservation practices for advice, sharing of best practices, and troubleshooting. Survey responses from farmers in low- and high-adoption counties highlighted the importance of peers to motivate change in their communities and beyond. Learning from other farmers' lived experiences, challenges, and successes was critical in influencing adoption. Peers provide experiential knowledge and practical insights that address local challenges and conditions, making the adoption process less daunting.

> *Watching what other people are doing in the community and seeing what worked for them and why it did not work has been helpful for me. We had some things that did not work through the years, and I was able to network with other people and learn about their successes and challenges.*
>
> *I think what has motivated me most has been the results. They work. Some guys say if Roger can make it work, and he has not gone broke, then it works. I watched Sean some and saw the successes; I had to figure out how to implement it onto corn. I did that, and it worked.*

When farmers see their neighbors succeeding with these techniques, it shows that these practices work and can be successful in the local context. The presence of positive peer role models and the opportunity to learn from others in the community was a driving force in adoption for many farmers. In addition to sharing information, some farmers also shared equipment to reduce the cost of adoption. For farmers lacking connections to other adopters, the internet became a place of farmer-to-farmer connection and knowledge sharing.

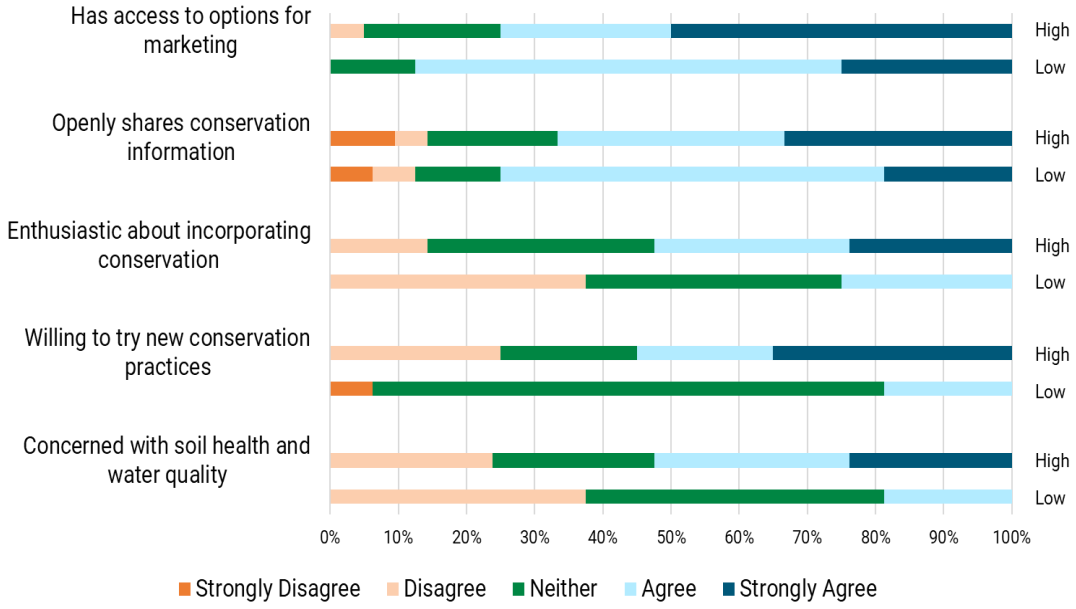
Importantly, while most farmers in our sample highlighted the positive impact of peers, peers can also have negative influences on behavior change. For example, when peers predominantly model existing or traditional practices (i.e., the status quo), it can create a sense of normalcy and inertia within the community. This normalization or "lock-in" makes it challenging for individuals to deviate from established norms and embrace new, innovative approaches. If most peers resist change, this can create a culture of resistance within the community. New ideas or alternative practices may be met with skepticism or resistance, making it difficult for innovators to gain support. To combat the negative influences of peers modeling the status quo, efforts should be made to promote a culture of innovation, knowledge sharing, and openness to change within farmer networks. Sharing success stories, educating peers about the benefits of conservation, and creating support networks beyond local community boundaries can encourage positive change.

Farmers in high-adoption counties are more likely to perceive their community as enthusiastic about conservation than farmers in low-adoption counties.

Figure 10 shows responses to Likert scale questions regarding how farmer participants perceive their community's attitudes toward conservation practices. Farmers in high-adoption counties report higher levels of agreement with all statements, including strongly agreeing that their community is: "enthusiastic

Figure 10

Differences in Community Attitudes and Perceptions Regarding Conservation Practices in High-Adoption and Low-Adoption Counties



Note: These values are based on the farmer's perspective of their community. Farmers in high-adoption counties reported higher levels of agreement across statements. Farmers in low-adoption counties indicated that their community is less concerned with soil health and water quality and less enthusiastic about conservation.

about incorporating conservation," "willing to try new conservation practices," "open to sharing conservation information," and "concerned with soil health and water quality." Further, most farmers in

high-adoption counties agree or strongly agree that they have access to various options for marketing crops and livestock. Responses from farmers in low-adoption counties indicate their community is less concerned with environmental health and less enthusiastic about adopting conservation practices.

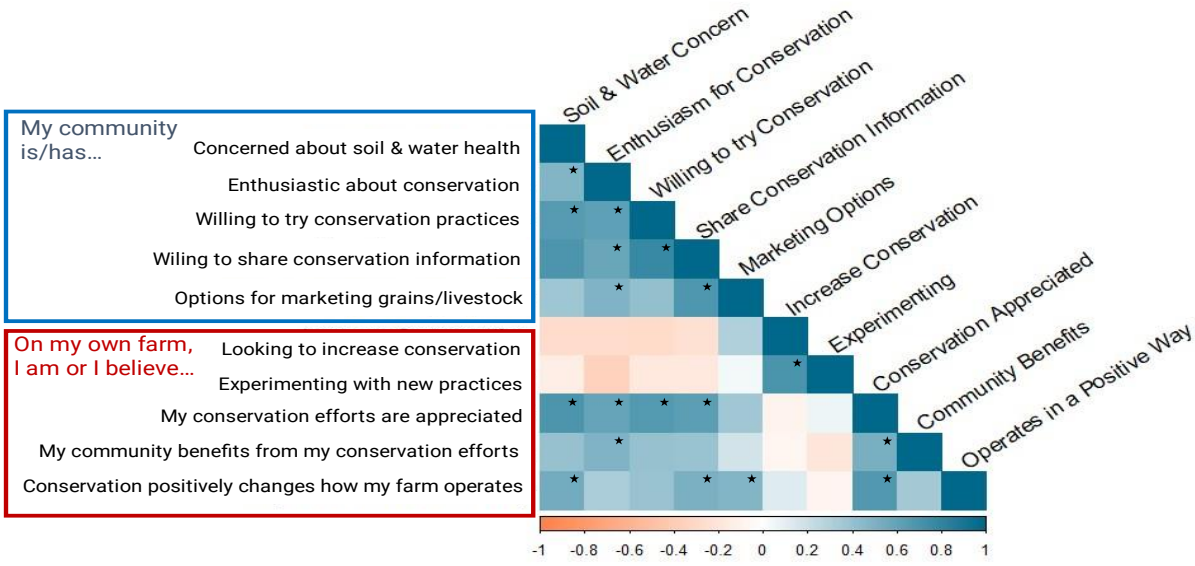
In high-adoption counties, farmers who report that their community is concerned about soil and water health also feel that their conservation efforts are appreciated.

Figure 11 shows correlations between Likert scale survey questions regarding community perceptions and individual attitudes towards conservation practices. If a farmer responds "strongly agree" to one question, they are likely to respond similarly to a question that is shown to be correlated. For example, the correlation indicates that the perceived community "concerned about soil and water health" significantly correlates to the community being "enthusiastic about conservation" and "willing to try conservation practices."

We also see that the community's "willingness to share conservation information" strongly correlates to "enthusiasm for conservation" and "willingness to try conservation." Having access to various "options for marketing grains/livestock" also correlates strongly with perceived community "enthusiasm for conservation" and willingness to "share conservation information" (Figure 11). "Looking to increase

Figure 11

Correlation of High-Adoption Farmers' Community Perspectives and Farming Operations in Their County



Note: Red indicates a negative correlation, while blue indicates a positive correlation. The color shade illustrates the strength of the correlation. A * indicates the correlation has a significance at p-value of < 0.05.

conservation" on their farm was strongly correlated with "experimenting with new practices." Further, farmers who felt their "conservation efforts are appreciated" by other farmers and their community also felt that their community "benefited from their conservation efforts," which "positively changed how their farm operates."

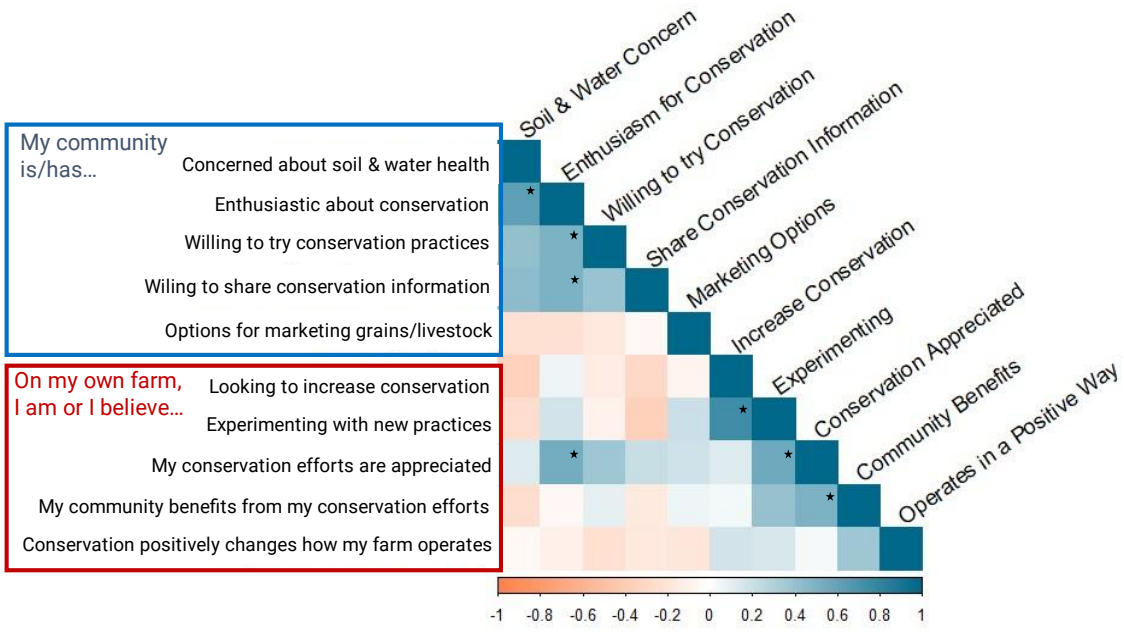
In summary, we found moderate to strong correlations between people who 1) feel the community appreciated conservation efforts, 2) that their community benefits from their conservation efforts, and 3) that the community is enthusiastic about conservation. Similarly, we also find correlations between 1) believing that the community benefits from conservation and 2) community enthusiasm for conservation with 3) community willingness to try conservation and 4) community willingness to share conservation information. These findings suggest that farmers are more likely to feel appreciated in relatively conservation-oriented communities.

In low-adoption counties, farmers who report experimenting with agricultural conservation practices also feel that their conservation efforts are appreciated.

Figure 12 shows similar correlations to those reported in the high-adoption county figure (Figure 11). However, farmers in the low-adoption subsample, in contrast to those in high-adoption counties, have a weak negative correlation between "options for marketing grains and livestock" and variables describing

Figure 12

Correlation of High-Adoption Farmers' Community Perspectives and Farming Operations in Their County



Note: Red indicates a negative correlation, while blue indicates a positive correlation. The strength of the correlation is illustrated by the color shade. A * indicates the correlation has a significance at p-value of < 0.05.

the community's interest in conservation. This suggests that a lack of options for marketing unique products derived from conservation-oriented production (i.e., cover crop seed, organic products, grass-fed livestock) might lower community interest in conservation.

Furthermore, there are considerably weaker correlations between variables concerning community appreciation for conservation, willingness to share information, and concern for soil and water health. This suggests that individual adopters of conservation practices in low-adoption counties may benefit from programming that supports adoption and informs communities of the broader impact of conservation beyond the farm level.

There are weak negative correlations regarding community benefits and conservation, where respondents believe the community benefits (see Figure 5 under Attitudes and Motivations) but rate the community low for interest in conservation. Social networks in these areas may not provide the same level of communal support and recognition for conservation efforts. Consistent with high-adoption counties, there is a strong significant correlation between wanting to increase conservation and experimenting with conservation, experimenting with conservation, believing that conservation is appreciated, and believing that conservation is appreciated and benefiting the community. Social recognition is likely an important aspect in adopting conservation practices, illustrating the influence of social networks and perceptions of community values on farmer attitudes and behaviors. Communities with higher perceived enthusiasm, information sharing, and recognition for conservation efforts are more likely to see increased adoption, while low-adoption areas may require more targeted interventions, such as expanding connections to other networks, to promote conservation.

Community perspectives of conservation may lead to differences in practice adoption.

Table 2 shows correlations between farmer perspectives and the use of twelve common conservation practices, organized into "fundamental," "improved," and "transformational practices." Manure broadcasting negatively correlates with community concern for soil and water health, meaning farmers are less likely to use this practice if concern for soil and water health is high. This is likely because manure is an excellent fertilizer that can help build soil organic matter, but it also has the potential for runoff that compromises water quality. Terrace farming, a method of cropping that can prevent erosion, is significantly correlated with community willingness to share conservation information. Maintaining grassed waterways, a practice used to improve runoff quality significantly correlates with the belief that conservation benefits the farm. There is a positive correlation between no-till/strip-till use and community appreciation for conservation practices. A positive correlation exists between establishing trees or shrubs, a practice that benefits the farm and surrounding ecosystem, and the belief that their farm operates positively.

Multispecies cover cropping negatively correlates with several variables describing community interest in conservation. Most farmers using multi-species cover crops reside in low-adoption counties with less community investment and interest in adopting conservation practices. Farmers use multi-species cover crops to grow crops organically or to raise livestock, often deviating from the status quo production systems used by their neighbors. There is also a moderately significant correlation between no-till or strip-till, a method to retain soil health, and conservation being appreciated in the community.

Finally, in transformational practices, establishment of upland wildlife habitat correlates with increased conservation and experimentation. This suggests that farmers who utilize upland wildlife habitats actively seek ways to increase conservation on their farms and are known for experimenting with new practices. Rotational grazing is negatively correlated with community appreciation of one's conservation practices and broader community and farm benefits of conservation practices. Farmers who use rotational grazing also feel their conservation efforts do not benefit or are not appreciated by their community. We suspect this is the case because raising cattle on pasture is no longer a predominate practice in Iowa, where most acres are dominated by row crop production. Some participants who utilized rotational grazing were reincorporating livestock into their operations to diversify production, which can improve overall farm resiliency. Community members may not fully comprehend the ecological and economic benefits of these resource management practices. They may associate them with more traditional continuous grazing practices, leading to soil degradation. Additionally, the benefits of rotational grazing, such as improved climate resilience, soil health, and forage quality, may take time to manifest fully, leading some farmers to feel that the broader community and their farm do not have immediate advantages. Finally, there is a negative correlation between pollinator strips, enthusiasm for conservation practices, and willingness to share conservation information in the community, perhaps due to respondents' beliefs that they are more committed to conservation than others.

Table 2

Correlations Between Conservation Practices, Community Perspectives and Individual Farmers' Attitudes Toward Conservation

	Community Perspective					Farm Operations				
	Soil & Water Concern	Enthusiasm for Conservation Practices	Willing to try Conservation Practices	Share Conservation Information	Marketing Options	Increase Conservation	Experimenting	Conservation Appreciated	Community Benefits	Operates in a Positive Way
Transformational practices										
Conservation Cover	-0.05	0.01	-0.23	-0.31	-0.01	0.21	0.20	0.04	-0.24	0.16
Pollinator Strips	-0.11	-0.29	-0.08	-0.40	-0.15	0.13	0.10	-0.18	-0.08	0.05
Upland Wildlife Habitat	0.07	0.12	-0.09	-0.04	0.18	0.33	0.42	0.24	-0.10	-0.06
Rotational Grazing	-0.18	-0.24	-0.20	-0.15	-0.03	0.05	0.02	-0.49	-0.61	-0.13
Improved practices										
Crop Rotation	0.25	0.11	0.09	-0.07	-0.07	-0.01	-0.11	0.21	-0.12	0.02
Grassed Waterway	0.17	-0.10	-0.14	-0.22	-0.19	-0.08	-0.21	0.00	-0.20	0.34
Terraces	0.05	0.17	-0.06	0.28	0.15	-0.24	-0.14	0.17	-0.05	-0.18
Manure Broadcasting	-0.43	-0.21	-0.18	-0.21	-0.04	0.12	0.21	-0.12	-0.06	-0.03
Fundamental practices										
Cover Crop	-0.15	-0.20	-0.10	-0.15	-0.21	-0.18	0.07	0.10	-0.27	-0.11
No-till or Strip-till	0.24	0.22	0.24	0.08	0.16	0.01	0.09	0.49	0.13	-0.09
Multi-species Cover Crop	-0.47	-0.52	-0.30	-0.31	-0.31	0.08	0.19	-0.06	0.02	0.02
Tree Shrub	0.17	0.04	-0.11	0.02	0.00	0.08	-0.08	0.11	0.16	0.37

Significance	0.1	0.05	0.01

Community values and norms influence conservation practice adoption.

As illustrated in the figures above, self-reported perceptions of community norms influence how farmers approach agricultural conservation practices. Open-ended survey data provided more information on the

role of perceived community values and norms as a motivation for farmers to adopt practices prioritizing environmental stewardship and sustainable land management.

> *What most influenced me to adopt these practices was trying to leave the farm in better shape than when I started. Part of it was to show the neighbors that I was using these practices. I was trying to keep up with what other neighbors were doing and be a positive influence.*

Learning from neighbors, participating in local agricultural networks, and attending community events exposes farmers to successful examples and encourages the exchange of knowledge about conservation practice adoption. Additionally, the desire to maintain a positive reputation within the community and leave a legacy for future generations often drives farmers to embrace practices that enhance soil health, reduce erosion, and protect natural resources.

However, negative pressures, such as the fear of failure and community attitudes not supporting conservation practices, can pose significant challenges for farmers considering adoption. The concern of failing while attempting new methods can be daunting, especially in communities where success is closely observed. The fear of being perceived as unsuccessful due to not conforming to conventional practices can discourage farmers from taking risks with innovative conservation practices. Additionally, being part of a community that is not pro-conservation can create a sense of isolation, making it difficult for farmers to find local support, resources, or role models for guidance.

The Role of Federal, State, and Regional Programs

Participants spoke of the importance of federal, state, and regional conservation programs that provide cost-share opportunities and technical assistance for adopting conservation practices. At the federal level, USDA NRCS programs such as the Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program, and the Agricultural Conservation Easement Program provide financial and technical assistance for practices such as cover cropping, no-till, and conservation cover. State and regional programs administered by local soil and water conservation districts, watershed groups, and nonprofit organizations such as Practical Farmers of Iowa also administer conservation support programs. The goals of these programs vary based on local resources and environmental concerns. Additionally, farmers may receive federal crop insurance discounts through the USDA's Risk Management Agency.

Research indicates the use of cover crops significantly reduces crop insurance claims in the face of extreme weather events, suggesting cover crops are a beneficial practice for farm-level resilience and reducing the cost of federal crop insurance administered through the Farm Bill. Although research suggests larger farmers are more likely to adopt conservation practices, comparing the eight counties in Iowa in this sample, we found no differences in farm operation characteristics, (i.e., operation size, number of larg 3). e operations, or average land asset value) between high- and low-adoption counties in our sample (Table 3).

Table 3

Average Farm Characteristics for High- and Low-Adoption Counties

	median	mean	Max	min	SD
Total number of farm operations					
high adoption	1058	1002	1257	636	268
low adoption	892	871	1265	509	253
Average operation size, in acres					
high adoption	300	306	384	242	61.8
low adoption	311	331	439	279	59.8
Number of operations larger than 1000 acres					
high adoption	58	64	99	40	26
low adoption	59	68	103	49	22
Average land asset value, in dollars per acre					
high adoption	6700	6744	8037	5538	1033
low adoption	6722	7083	9727	4876	2127
Average annual crop sales per acre					
high adoption	457	429	473	330	67.6
low adoption	423	421	566	285	121

Note: This sample showed no differences in farm operation characteristics between high- and low-adoption counties.

While county-level data on the use of assistance structures is not widely available, we evaluated several variables that may indicate general participation in financial and technical assistance programs (Table 4). On average, in high-adoption counties, more acres are enrolled in conservation easement programs where farmland is permanently or temporarily set aside. This may reflect awareness of opportunities to receive payments or the amount of marginal farmland in the county. Further, funding received for federal government programs and state revolving funds was more significant in the high-adoption counties. The number of certified crop advisors and educational field days offered was somewhat similar in the high- and low-adoption counties, suggesting these variables may not be strong determinants of adoption differences within the sample.

Table 4

2017 County-Level Participation in Conservation Programs and Access to Conservation Advising/Education

	median	mean	max	min	SD
Percent of county acres enrolled in conservation easement programs					
high adoption	0.7	0.9	1.79	0.37	0.64
low adoption	0.4	0.4	0.52	0.31	0.08
Government program support received per acre, in dollars *(where receipts are available)*					
high adoption	29.8	36.2	36.1	9.41	11.8
low adoption	23.7	24.8	37.9	16.2	7.66
State Revolving Fund program support received per acre, in dollars.					
high adoption	2.19	30.9	11.8	0.73	58.4
low adoption	1.92	3.68	13.9	0.46	5.12
Number of certified crop advisors in the county					
high adoption	14.5	13.5	24	1	9.47
low adoption	11.5	14.5	37	2	13.6
Number of field days offered within a 25-mile radius					
high adoption	7	15.8	45	4	19.6
low adoption	5	12.8	48	2	17.6

Note: Farmers in high-adoption counties receive more funding from federal governmental programs and state revolving funds and have more acres enrolled in easement programs. [2]

Governmental policies, regulations, and available financial support influence practice adoption.

Farmers in our sample indicated that government initiatives, such as incentive programs and subsidies for sustainable practices, have provided key financial support and resources to implement conservation methods. Cost-effectiveness and potential profitability were crucial factors to farmers when adopting conservation practices. Farmers identified how conservation practices increased the resilience of their operations by providing economic benefits and new opportunities. This was often related to cost-sharing incentives but also linked to expanded market opportunities. Farmers were also more frequently adopting practices with cost-share benefits, such as cover crops. Many farmers spoke about government incentive programs as influential in adopting conservation practices.

[2] Statistics in tables 3 and 4 are from USDA 2017 Census of Agriculture.

> *The cost-share to start motivated me to adopt cover crops, and then I saw the benefits. Specifically, grazing cattle on them is where I see the most benefit. It saves on extra feed.*

These programs have helped alleviate the initial costs associated with transitioning to more environmentally friendly approaches, making it more feasible for farmers to adopt practices like cover cropping, reduced tillage, and nutrient management. Notably, farmers must be aware of incentive programs to utilize them. Farmers frequently learned about these programs through conversations with others in the area, as well as through their local NRCS agents. NRCS agents who were aware of new incentive programs and communicated them to farmers were crucial for encouraging adoption and subsequent sharing of enrollment information amongst farmer networks.

Moreover, regulations aimed at reducing soil erosion, protecting water quality, and promoting sustainable land use have prompted farmers to adopt practices that align with these goals. In some cases, farmers expressed wanting to opt into conservation versus being mandated through regulations.

> *If we want to keep farming like we do, we will have to implement these things [conservation practices]. I feel like, at some point, we might be forced to do it. I do not want to be told to do things, so I would rather be innovative.*

Maintaining autonomy over their operation was a driving force for farmers to adopt conservation practices to stay ahead of potential regulatory mandates.

Regarding network implications, these findings highlight the importance of effective communication and knowledge-sharing mechanisms within farming communities. Peer-to-peer discussions and discussions with NRCS representatives are instrumental in spreading awareness about government programs and encouraging adoption. Additionally, the network effect of shared experiences and the benefits of conservation practices can motivate more farmers to participate in these initiatives. Overall, policies and regulations, when combined with effective information dissemination within farming networks, can accelerate the adoption of conservation practices, promote sustainability, and enhance the resilience of farming communities.

Access to Information Related to Conservation Practices

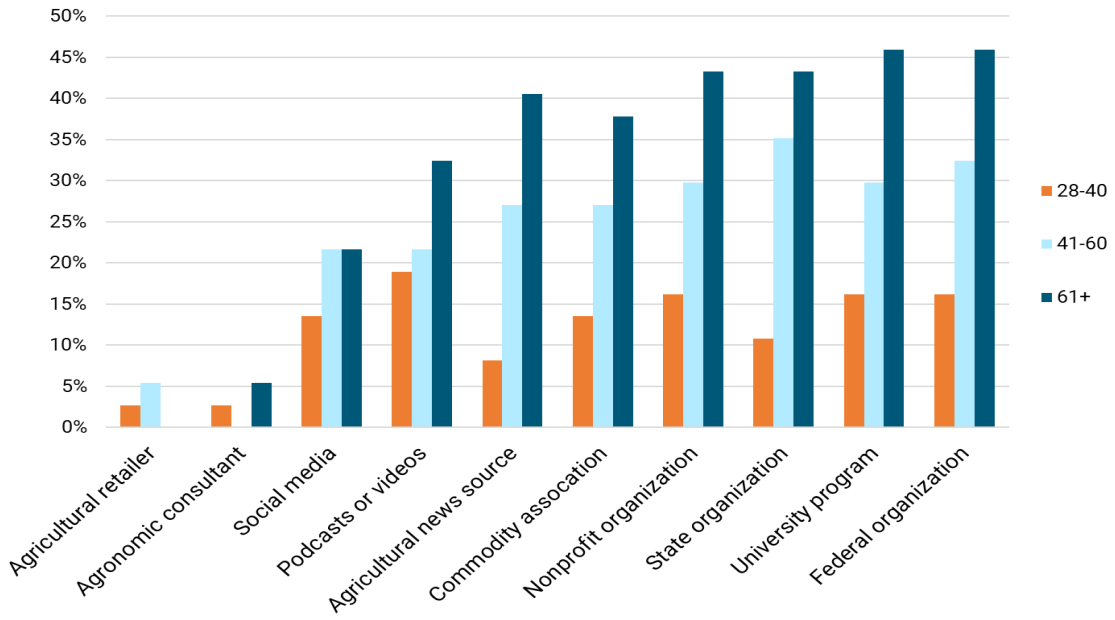
When asked about what kinds of organizations, media, or social media the farmers in our sample consult to learn about agricultural conservation practices, federal government organizations, including the Farm Service Agency and the NRCS, were the most consulted resources. Iowa State University mainly offers university Extension services in this region. Some individuals specifically mentioned the Leopold Center for Sustainable Agriculture. State government organizations such as the Iowa Department of Agriculture and Land Stewardship, the Iowa Department of Natural Resources, and the Soil and Water Conservation District were frequently mentioned. Unlike other states, Iowa farmers, including those in our sample, maintain close contact with local nonprofit farming-related organizations such as Practical Farmers of

Iowa, Iowa Farm Bureau, Iowa Farmers Union, and commodity-specific organizations, including the Iowa Corn Growing Association and Iowa Soybean Association.

Regarding media, several farmers in our sample report read Farm Progress/Wallaces Farmer and Acres. Furthermore, many consult social media sources such as Facebook and TikTok, podcasts, and YouTube videos. Finally, a small group of farmers consult agronomic consulting companies and agricultural retailers.

Figure 13

Top Societal Influences by Age Group



Note: The youngest subset of farmers uses modern information sources like social media and podcasts at rates that are similar to or greater than traditional information sources such as the state and federal organizations.

When comparing societal resources consulted by age group, older farmers tend to rely slightly more on traditional sources such as federal and state government organizations and university extension services. Older generation farmers disproportionately consult print, such as agricultural magazines. In contrast, the younger generation likes to use online sources such as podcasts, YouTube videos, and social media. While this is a more common source among younger farmers, the older generation of farmers over 60 are also relatively active in following online media related to agricultural conservation practices (Figure 13).

When comparing societal influences, farmers in high-adoption countries are more likely to report taking advantage of any information source except agricultural retailers. This suggests that the diversity of information and exposure to different perspectives within their social networks may contribute to the

greater adoption of conservation practices. Access and community recommendations for specific sources of land stewardship information may also drive this discrepancy between sources.

In summary, social networks play a significant role in how farmers access information about agricultural conservation practices. Different generations within the farming community may have varying preferences for information sources, but the influence of peer recommendations and community connections remains strong. The use of newer online and social media sources among younger farmers reflects the evolving landscape of information sharing within agricultural networks. These insights underscore the importance of considering generational differences and social networks when designing strategies for disseminating knowledge and encouraging the adoption of conservation practices.

Similar to social networks, farmers consult networks of print and digital information sources aligned with their agricultural interests and goals.

To learn what sources of information farmers consult regarding agricultural conservation practices, respondents were asked to select their preferred sources from a predetermined list of information sources. Farmers could also add information sources that were not provided on the list. Figure 14 represents the network of sources most frequently mentioned together.

Sources in the center of the network tend to be consulted most often by most farmers in our sample, while a smaller number of farmers consulted sources on the periphery. The colors represent an algorithm of sources that tend to cluster, meaning that multiple farmers in our sample tend to mention a similar combination of sources. Federal and state government organizations and university Extension services are in the center. This illustrates that most farmers in the sample frequently consulted these sources and that these organizations can amplify each other's messages. Online sources outside the local community, such as YouTube, podcasts, and social media, are often mentioned together.

In **green**, we see the mainstream farming organizations that may include some conservation organizations. In **peach**, we see organizations that tend to be the most innovative and have a mission to advance sustainable agriculture. Finally, in **blue**, we see conservation-minded organizations, sometimes incorporating agriculture in their agenda, and other times, agricultural organizations strongly emphasizing conservation. This means that while some mainstream and centrally positioned sources such as YouTube, podcasts, and social media may be consulted by a substantial proportion of the farmer population, there is a tendency to frequently consult a combination of like-minded organizations regarding agricultural conservation practices. This implies they are drawn to sources that align with their interests and goals.

While farmers tend to consult like-minded organizations, there is also the potential for bridging and cross-pollinating ideas and practices across information sources. For instance, the overlap between mainstream farming organizations and conservation-oriented organizations suggests an opportunity for knowledge exchange and the adoption of sustainable practices within more conventional farming communities. Organizations are numbered in Figure 14; see Appendix – B for a legend.

Farmers use social media to learn from the challenges and successes of other conservation-minded farmers.

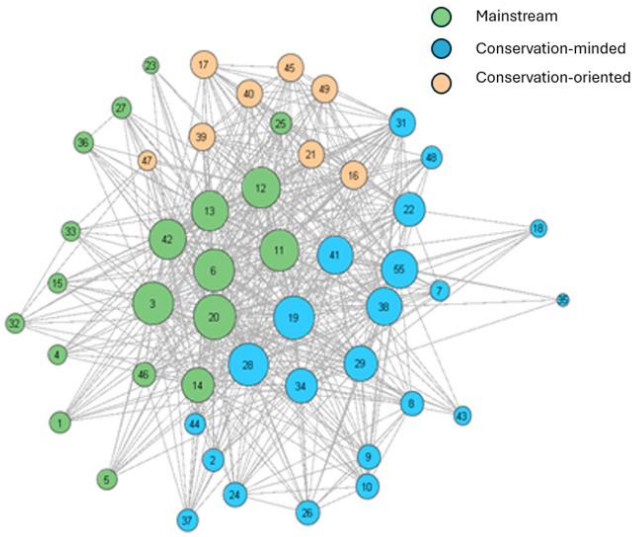
Social media platforms like X (formerly Twitter), Instagram, Facebook, and podcasts play a crucial role in shaping the adoption of agricultural conservation practices. Social media enables farmers to share their experiences, learn from each other's successes and challenges, and access insights outside of their community. Participants identified social media as a critical source of information, particularly when learning about the successes and challenges of farmers who had adopted a practice of interest. [3]

> *"In 1994, I stumbled upon online forums, so I no longer relied on what local people focused on... The more I shared, the more other people shared. And then, we got invited to speak to places, tell our story, and learn more from others. I put much research into what we do before we take the first step. I learn from other people's mistakes, which helps me be more successful. We have had failures, but we turn those into learning and success moves forward."*

One participant in our sample had their own YouTube series where they shared more about their farm operation and conservation-related information with other farmers. Another participant hosts a podcast inviting farmers to share the successes and challenges they experience as they adopt new practices. Social media and podcasts contribute to breaking down geographic and informational barriers, creating a community where farmers can share information across contexts and more localized networks.

Figure 14

Farmers Seek Advice from a Variety of Mainstream, Conservation-Minded, and Conservation-Oriented Sources



Note: Organizations that are closer to the center of the network indicate the most used sources and less commonly used sources are positioned toward the edge. The colors indicate which organizations were most often used together and reveal underlying patterns. The **green** group is characterized by traditional agricultural information sources. The **blue** group represents conservation focused information sources. The **peach** group represents local and grassroots conservation organizations.

For farmers using social media to share about practice adoption, organizations can play a key role in further amplifying their message and expanding their reach. Supporting farmers who create online content through funding and resources can amplify their reach and impact. Financial support can

[3] Figure 14 represents the sources for agricultural conservation information. Sources are represented as circles (for the legend, see Appendix B). Larger central circles are sources most frequently consulted together by respondents. A modularity algorithm detects three sources commonly consulted by the same individuals: mainstream in green, conservation-minded in blue, and conservation-oriented in peach.

help cover the costs of creating and sharing informative content, such as videos, podcasts, or blog posts. Organizations interested in promoting conservation practices can consider offering grants specifically to facilitate content creation related to agricultural conservation. This financial support not only aids individual farmers but also contributes to the broader dissemination of valuable knowledge. Organizations can consider creating online knowledge exchange platforms to facilitate further knowledge sharing among farmers. These platforms can cultivate a network where farmers can share insights, ask questions, and learn from each other's experiences. Allocating funding for developing and maintaining such platforms can foster community, expand farmers' networks across geographic boundaries, and provide a centralized hub for farmers interested in conservation practices to connect and collaborate.

Lessons Learned and Implications

This report shows the importance of collecting data about multiple levels of social scale and social networks to examine the variety of societal influences on farmers' adoption of agricultural conservation practices in Iowa. Understanding how these levels interact is essential for promoting the adoption of agricultural practices that support sustainability in farming, benefit soil health, wildlife, pollution, climate mitigation, and improve both the quality and quantity of production yields.

Individual Level

At the individual level, farmers are likely to use fundamental practices such as crop rotation and grassed waterways, which are considered mainstream agricultural practices. Improved practices that enhance sustainability and yield or quality, such as cover crops and no-till, are standard in our sample. A smaller proportion of farmers in our sample use transformational practices designed to improve soil, water, and the environment, often forgoing agricultural yields. Most agrarian conservation practices are more common in areas with high adoption rates.

In addition, farmers who produce multiple crops are more likely to adopt conservation practices. This is likely due to broader networks increasing the likelihood of discussing conservation practices, farm size, and opportunities to incorporate, for example, livestock in their corn, soy, and alfalfa growing practices. Farmers in low-adoption areas are more likely to report wanting to increase conservation, suggesting a possible insufficiency in opportunities, incentives, and access to networks with expertise in agricultural conservation practices. Farmers in high-adoption areas more often report experimenting with conservation practices, benefiting from conservation practices, and being appreciated by their community for their use of conservation practices. In qualitative findings, we learned that the main barriers to the adoption of new conservation practices are cost and time investment.

Interpersonal Level

At the interpersonal level, our network analysis shows that farmers most frequently report discussing agricultural practices with friends and neighbors. Respondents see their farmer-peers and local professionals, such as friends and neighbors, as knowledgeable, trustworthy, and innovative network members. Comparing the low- and high-adoption counties, the embeddedness of local agricultural experts, Extension agents, or agronomists in guiding farmers through the process of adopting agricultural conservation practices aligns with substantially higher adoption rates for most practices. Furthermore, on average, connections in high-adoption counties receive slightly more trust, are considered slightly more knowledgeable, and are rated less innovative. Regarding network structure, we

found high-adoption farmers have a more extensive network of individuals from whom they seek advice regarding agricultural conservation practices. These networks are also more diverse, with fewer relationships between the reported individuals than low-adoption counties.

Qualitative findings indicated that learning groups and peer models have been an encouraging factor in trying out new evidence-based practices because farmers could observe what worked for friends and neighbors who practice agriculture on similar soils and climatic conditions. Participants emphasized their reliance on fellow farmers' knowledge, recognizing the importance of lived experiences when venturing into new agricultural practices. They view peer models as trustworthy information sources to mitigate experimentation risks. Finally, having peers nearby to share equipment is an effective cost-management strategy. To encourage practice adoption, peer-to-peer learning networks and community engagement initiatives, including organizing community meetings, workshops, events, and field days where farmers can share their conservation efforts and success stories and provide hands-on demonstrations, are important interpersonal strategies to leverage.

Community Level

At the community level, social network dynamics are pivotal in understanding the differences between low-adoption and high-adoption counties. Farmers in low-adoption counties perceive lower community support and environmental sustainability concerns. When examining individual farmers' conservation efforts within their community context, respondents expressed a greater personal interest in advancing conservation and a willingness to experiment compared to their perspective of their broader community. We found substantial differences in marketing options and perceived community support and interest in conservation, with strong positive correlations in high-adoption counties and weak negative correlations in low-adoption counties. In high-adoption countries, there were strong correlations between perceived community interest in conservation and feeling appreciated. In contrast, in low-adoption countries, there were significant correlations between willingness to experiment with conservation and conservation being appreciated.

These findings suggest that social recognition is associated with a willingness to adopt agricultural conservation practices. However, there were primarily negative associations when comparing the adoption of practices with perceived community attitudes. This suggests that farmers invested in conservation may feel their community is not as supportive and concerned as they would like. Therefore, many farmers in this sample may be ahead of their community and influence others as much as their community affects them. These findings demonstrate the critical influence of social networks and community perspectives on farmers' conservation behaviors. They also highlight the need to harness these dynamics to bridge the gap between individual commitment and community-level support for agricultural conservation practices.

Local-Regional Level

At the local-regional level, high-adoption counties have, on average, more acres enrolled in conservation easements, receive more dollars in government and State Revolving Fund support per acre, and have more certified advisors and crop field days. In high-adoption areas, there is a higher concentration of farms. However, the number of large farms, the average size of farms, and land asset value tend to be similar. These findings suggest that adopting conservation practices highly depends on available resources, such as agricultural professionals, learning events, and financial support. Investment in

resources to increase adoption of conservation practices makes sense not only from a sustainability perspective but also from an economic perspective, as high-adoption counties receive substantially more in crop sales per acre.

Societal Level

At the societal level, some sources of information, such as agricultural organizations and various forms of media, operate on a larger scale, such as the state, national, or international level. Government-funded organizations are frequently consulted by farmers of all ages and low- and high-adoption counties. Most farmers consult multiple sources of information regarding agricultural conservation practices. Analysis by age group, low- and high-adoption counties, and social network analysis revealed that certain types of information are more likely to reach specific demographics. For example, younger farmers are more likely to use social media, while older farmers are more likely to consult magazines. Notably, farmers in high-adoption counties consume more types of information overall. Finally, farmers will likely obtain information from sources with similar objectives and messages. For example, farmers who primarily seek out mainstream agricultural resources are likely to report seeking information from multiple similar-minded organizations. At the same time, those who are explicitly conservation-minded tend to follow organizations with deep roots in land stewardship and conservation. Therefore, an effective network of collaboration between organizations would amplify and reinforce the message about more sustainable and higher yield practices.

Implications

1. **System-Based Data Collection**: System-based data is essential to better understand how different layers of society influence the adoption of agricultural conservation practices. By understanding how information flows and decisions are made within social networks, interventions can be designed to align with existing communication channels and community dynamics. Farmers seek advice, guidance, and information from their social networks. Recognizing the impact of peer influence and community norms within these networks can inform strategies to promote conservation practices. For example, leveraging influential individuals within social networks can help disseminate knowledge and encourage adoption at a grassroots level.

2. **Individual-Level Implications**: At the individual level, the findings emphasize the importance of farmer-peers, friends, and neighbors as influential sources of information. Farmer attitudes toward conservation practices are not only shaped by personal beliefs but also influenced by social networks. Farmers in a close-knit community where conservation practices are widely embraced may have more positive attitudes toward adoption. Friends, neighbors, and local agricultural leaders can play a pivotal role in shaping these attitudes through peer modeling, shared values, and community norms. In this context, social networks act as conduits for transmitting attitudes and beliefs related to conservation practices. Promoting networking events and farmer meetups can facilitate peer interactions for sharing experiences and advice on agricultural conservation practices.

3. **Interpersonal-Level Implications**: It is essential to identify influential farmers, local agricultural leaders, Extension agents, and organizations within the community who are willing to experiment with conservation practices and can then serve as champions for those practices. Ideal candidates are local farmers who have already adopted these practices because personal experiences are more convincing than scientifically found benefits in building awareness and encouraging others to adopt practices.

These influential conservation-minded members of the local agricultural community should be encouraged to share their experiences at public events such as workshops, field days, webinars, and seminars to educate other farmers about the benefits of conservation practices, such as improved soil health, reduced erosion, and increased yield potential. Agricultural experts, Extension agents, and agronomists should be trained to reinforce the examples of innovative farmers. These professionals can offer personalized and transparent recommendations based on specific farm conditions, soil types, and cropping systems to increase the chances of successfully adopting conservation practices and provide information related to cost, time investment, and impacts on yield.

4. **Community-Level Implications**: Farmers care about meeting social norms and being valued by their local community. Given these findings, increasing awareness of agricultural conservation practices within the local community can be facilitated through networking events, social gatherings, or farmer meetups that both acknowledge the efforts of farmers who have successfully incorporated innovative practices and encourage others to follow their lead and spread use of the practice until it becomes a community norm. Community-level interventions leveraging social networks and community norms can be powerful drivers of change in agricultural conservation practices. By creating an environment where innovation is celebrated, knowledge is freely shared, and positive peer influence is harnessed, the adoption of conservation practices can become a community norm.

5. **Local-Regional Implications**: High-adoption areas benefit from more resources such as conservation easements, government funding, certified advisors, and educational events. The availability of these resources strongly correlates with adoption rates, highlighting the importance of resource accessibility. Local incentives and government programs, often disseminated through local agricultural organizations and government agencies, can be key to encouraging farmers to adopt conservation practices. These programs provide financial and technical support, making it more financially feasible for farmers to implement these practices. Farmers share information about these incentives and programs within social networks, influencing others to participate. Peers who have benefited from such programs may act as advocates and encourage their network connections to enroll.

6. **Societal-Level Implications**: Collaboration between government-funded organizations, agricultural groups, and media outlets is critical to amplifying and reinforcing messages about conservation practices. Tailoring information dissemination to reach specific demographics, such as younger farmers through social media and older farmers through magazines, is essential for effective outreach. Collaboration among these entities can also facilitate peer-to-peer influence within social networks. When farmers receive information from trusted sources like government organizations, agricultural groups, or respected media outlets, they are more likely to share it within their social networks. This peer-to-peer dissemination can lead to discussions, knowledge exchange, and norm-setting within the farming community, ultimately driving adoption. In this way, messages from trusted sources contribute to the establishment of community norms and trust within networks. When conservation practices are consistently promoted and supported by trusted sources at the societal level, they are more likely to become part of the accepted wisdom within farming communities. This, in turn, influences community values, attitudes, and the adoption of conservation practices. Financial support to start, maintain, and promote trusted sources and create opportunities for collaborative efforts can be an effective strategy to encourage the adoption of conservation practices.

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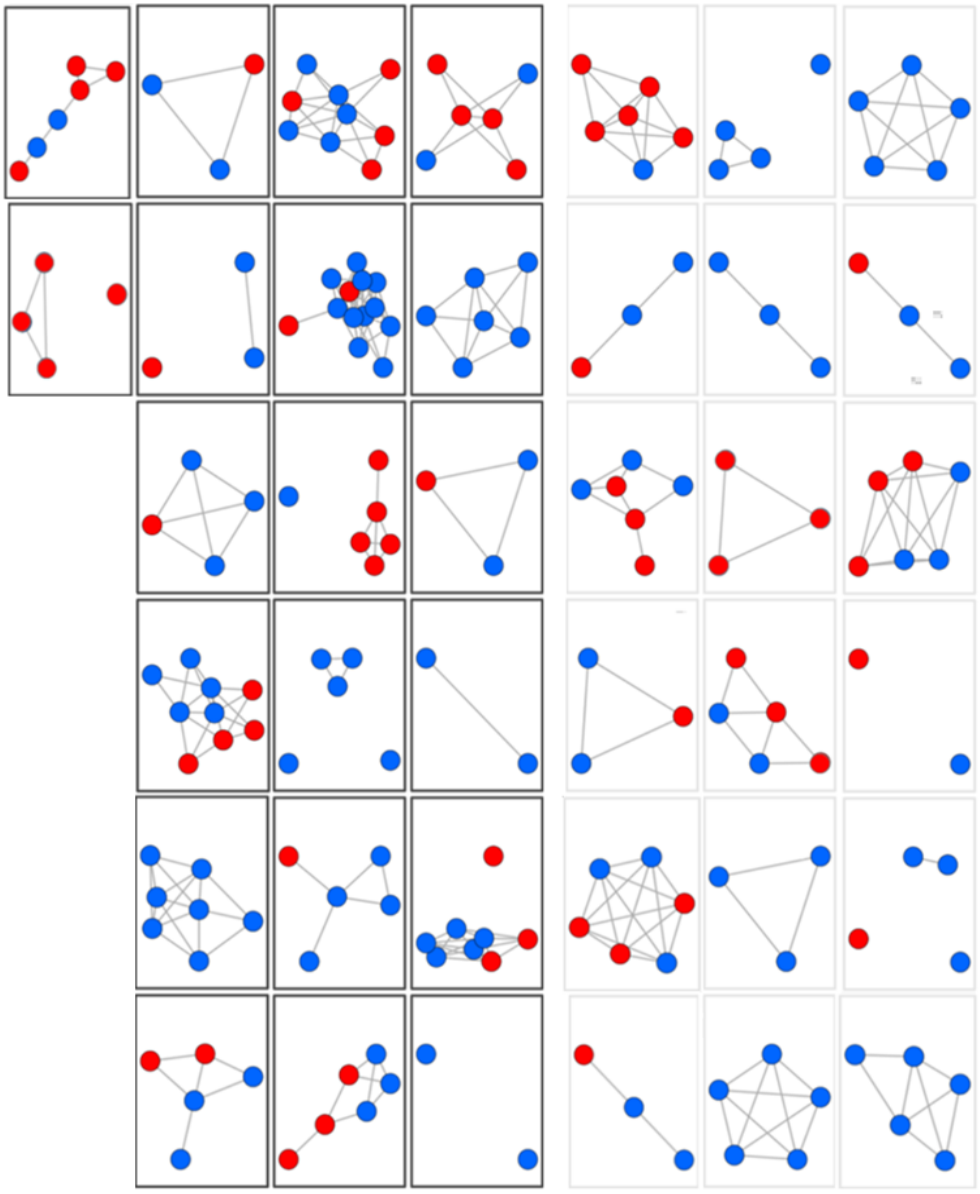
Appendix A- Social Networks of All Farmers

Figure 15

Farmers in High-Adoption Areas Have Larger Networks and More Diverse Connections than Farmers in Low-Adoption Counties



Note: Each box represents an Iowa farmer in the study. The red dots represent connections of the farmers that did not adopt cover crops, while the blue ones did adopt cover crops. A line between the dots means the connections know each other according to the interviewed farmer.

Appendix B - Information Resources Legend

Table 5

List of Agricultural Conservation Information Sources Consulted by Farmers

N	Organization	N	Organization
1	Continuum Ag	26	National No Till
2	Facebook	27	National pork board
3	AgriGrowth	28	Natural Resource Conservation Service
4	Farm Progress / Wallaces Farmer	29	No-Till on the Plains
5	Cattleman's Association	30	No-Till Farmer
6	Farm Service Agency	31	Peasant Quail Turkey Federation
7	BECKs	32	Peasants Forever
8	Farmer Managers	33	Podcast
9	Iowa Ag Water Alliance	34	No Till on the Plains
10	Iowa Association of Farm Managers	35	Pork check-off
11	Iowa Corn Growers Association	36	Pork Producers Association
12	IA Department of Agriculture and Land Stewardship	37	Practical Farmers of Iowa
13	Iowa Department of Natural Resources	38	Racoon River Watershed Association
14	Iowa Farm Bureau	39	RCND
15	Iowa Farmer Today	40	Social media
16	Iowa Farmers Union	41	Soil and Water Conservation District
17	Iowa Learning Farms	42	Strip-Till Farmer Magazine
18	Acres USA	43	Tall Grass Prairie Grazing Conference
19	Iowa Soybean Association	44	The Sparks
20	Iowa State University Extension	45	TikTok
21	Isaac Walton League	46	Trees Forever
22	Leopold Center for Sustainable Agriculture	47	US Grains Council - international
23	MOSA	48	Women in Food and Ag Network
24	National Association of Conservation Districts	49	YouTube
25	National Corn Growers		