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Harvesting Trust: Exploring Credible Information Sources about Soil Health Practices for U.S. Wheat Farmers

Morgan Orem

Holli Leggette
Texas A&M University

Jean A. Parrella
Virginia Polytechnic Institute and State University

See next page for additional authors

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Harvesting Trust: Exploring Credible Information Sources about Soil Health Practices for U.S. Wheat Farmers

Abstract

Despite farmers' knowledge and awareness of soil health practices and the growing body of evidence indicating their effective use, many farmers continue to reject such practices. To further explore the role of information source credibility in the adoption of soil health practices, we sought to measure wheat farmers' perceived source credibility of research scientists, Extension scientists, industry scientists, and general scientists and the likelihood they would adopt information about reduced and no-till practices and cover crop practices from these sources. Using an experimental survey instrument, we collected data from 127 U.S. wheat farmers. We found most wheat farmers considered themselves, Extension professionals, researchers, and other producers as scientists when seeking information about soil health practices. Participants perceived other producers, Extension professionals, and themselves as having the most trust with Extension professionals, other producers, and themselves as having the most goodwill. The means and standard deviations of perceived source credibility suggest that participants perceived each information source—general scientists, research scientists, Extension scientists, and industry scientists—as similarly credible information sources about soil health practices with a statistically significant relationship between farmers' perceived course credibility of the four scientists and likelihood of adopting information about soil health practices from them. Our results did not indicate differences between participants' perceived credibility of the four types of scientists or their likelihood to adopt information about soil health practices from the scientists. Effective communication has potential to impact wheat production positively, but achieving communication effectiveness could take years without intentionality from credible information sources.

Keywords

soil health, trust, source credibility, diffusion of innovation, experimental survey

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Authors

Morgan Orem, Holli Leggette, Jean A. Parrella, Peng Lu, Karissa Palmer, Jamie Foster, Haly Neely, and Reagan Noland

Farmers are a complex, diverse population whose work is a part of a much larger complex food system. Studies over time have lacked the ability to understand their complex characteristics and behaviors or considered the diversity of their farms and needs (Reimer et al., 2014). Complexity often does not stop, however, at personal characteristics and behaviors as a farmer's farm practices and operation structures are also complex. Complexity is often seen as differential access to resources, exposures to risk, production needs, operational goals, and types and sizes of operations as well as differences in motives, values, communication preferences, information needs, and social networks (Reimer et al., 2014).

Prior research on information needs, specifically source and credibility, has shown source type matters (Rust et al., 2022) and farmers tend to prioritize source and their relationship with the source over the content (Foster, 2019). Research has also shown that farmers trust other farmers, agricultural government agents, Extension professionals, scientists, and local experts the most (Hundemer, 2023; Moody, 2018; Phiri et al., 2019; Ranjan et al., 2019; Taku-Forchu et al., 2023). Likewise, farmer influencers, other farmers who disseminate credible information in the context of new management practices and on-farm technologies, are becoming an increasingly popular source of information for farmers (Rust et al., 2022). Phiri et al. (2019) and Ranjan et al. (2019) have noted family members, Extension agents, and personal experience are also common sources of information, indicating relationships are critical to information dissemination and adoption.

Relationships are foundational to high levels of trust, and farmers often build relationships with opinion leaders in the community (e.g., local industry experts, other farmers) to gain access to evidence-based information (Foster, 2019). Opinion leaders are early adopters of practices, innovations, and technologies (Rogers, 2003) and are often relied on to relay information within the community because of the level of respect and trust built among their peers (Foster, 2019; Rogers, 2003). A study conducted by Lawson et al. (2020) supported the use of farmers and ranchers as opinion leaders to facilitate change in agriculture and natural resources policy, indicating a need for farmers and ranchers to be trained in how to deliver credible information before communicating with government officials. To reach farmers and improve communication within and among producer groups, Extension agents often identify and develop relationships with local opinion leaders (Ranjan et al., 2019). Simply, high levels of trust allow for more effective communication (Foster, 2019; Hunt & Wald, 2020). Therefore, identifying credible information sources can assist in making knowledge and scientific information more useful for scientists and farmers and creating an effective end-to-end linkage system (Feldman & Ingram, 2009; Parrella et al., 2023).

Numerous studies exist that indicate communication and trust are important to farmers' decision to adopt a technology. In a study by Moody (2018) assessing farmers' change barriers, preferred information sources, and message receptiveness in the context of nutrient management, farmers were split. Some were willing to try new practices (42%) and others took a "wait and see" approach (58%). Moody (2018) found, as knowledge and awareness about nutrient management increased, favorability and likelihood of trying new practices in the context of nutrient management also increased. If the communication was linked to other farmers or provided specific details about on-farm decision-making, farmers had a more positive response to the information (Moody, 2018).

Additionally, in a study related to watershed management, Dewald et al. (2018, 2019) found that landowners preferred certain communication channels (i.e., websites, television, direct mailings) and ways of receiving information (i.e., industry groups, government agencies, friends, neighbors). Similarly, Licht and Martin's (2007) study about farmers' communication channel preferences found that consultants were the most preferred communication channel. Farmers preferred mass media channels (i.e., radio, magazines, internet, newspapers) for general information but preferred interpersonal communication strategies (i.e., consultations, demonstrations, meetings) for more personalized, specific on-farm information (Cooper et al., 2023; Licht & Martin, 2007). In a study on the influence of communication on farmers' adoption of agricultural technologies in the United States and Brazil, Colussi et al. (2024) found that mass media channels and interpersonal networks were both influential in innovation adoption. Although interpersonal meetings and social networks in general were important to farmers' decisions to adopt technologies in the United States, Colussi et al. (2024) found, specifically, that peer groups, retailers, and Extension agents were the most influential within the social network and YouTube, websites, and blogs were the most influential communication channels. These studies complement Norton and Alwang's (2020) work who noted that "face-to-face interactions are more amenable to delivering complex messages than the mass media that they complement" (p. 14) and that face-to-face programs have long been the bulk of the Extension budget.

Effective communication and trust also play a significant role in how farmers adapt to changing climate conditions (increased temperatures, unpredictable precipitation, and other climate-induced hazards; Karki et al., 2020; Moody, 2018; Wilson et al., 2009) and look for ways to produce more with less land and resources (Castellano & Moroney, 2018). Like other agricultural communities and farmers throughout the world, wheat farmers have felt the consequences of climate change and recognize the need to adapt and mitigate the impacts on farmland and productivity. To ensure soil health amidst intensification of farming practices (Rust et al., 2020) and climate change, farmers have implemented conservation and soil health practices (Karki et al., 2020).

Conservation practices can help preserve land and natural resources, such as water, organic matter, and soil nutrients (Claassen et al., 2018), and they can help increase yields and lower input costs (Edwards et al., 2015). Soil health conservation practices, specifically, can provide increased weather resistance, decreased nutrient loss, increased productivity of natural resources (National Resource Conservation Service National Handbook of Coservation Practices, 2014), increased crop yields, and yield stability (Miner et al., 2020). These additional benefits provide another source of stability and resilience to agricultural farmers facing uncertainty due to a changing climate. Soil conservation practices in wheat production include conservation tillage practices (no-till, strip-till, and mulch-till) and residue and cover crop practices (crop rotation, double cropping, cover cropping, and fallowing; Claassen et al., 2018). The success of such practices differs by the type of practice, crop type, duration of management, and geographic region (de Cárcer et al., 2019; Miner et al., 2020). In 2018, a report for the USDA Economic Research Service indicated that conservation tillage practices and residue and cover practices varied widely across crops and regions (Claassen et al., 2018).

Many farmers acknowledge the occurrence of climate change and support taking steps towards adaptation (Arbuckle et al., 2013) and conservation as ways to help mitigate the impact of climate change (Sargani et al., 2023). Studies have shown that farmers know about conservation practices and the need for diversified and integrated production approaches (Gardezi & Arbuckle, 2019; Moody, 2018; Wilson et al., 2009). Yet, USDA's 2022 Census of Agriculture report shows that only 4.7% (a number up by 17% from 2017 to 2022) of the nation's cropland had some type of cover crop planted on it. Thus, we can assume at least some of the intended messages produced by agricultural production-focused agencies (e.g., USDA,

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state Extension programs) are successful in reaching farmers and related audiences but can conclude many farmers are still choosing not to integrate cover crop conservation practices into their operations despite the benefits scholars have documented in the literature (Asprooth et al., 2023; Rehberger et al., 2023; Roesch-McNally et al., 2018; Wilson et al., 2009).

Many studies over time have documented why farmers decide to implement soil conservation practices with those decisions often being impacted by social-psychological and socio-economic factors (Tama et al., 2020). Tama et al. (2020) noted the more knowledge a farmer had about a practice, the more intention they had to act on that knowledge. Yet, Burnham et al. (2023) noted that long are the days where more information or more knowledge is enough. They concluded that adoption requires both knowledge and motivation, inferring that knowledge is not enough and more information does not equate more adoption and that farmers must be intrinsically motivated. Studies have also shown economics and incentives have short-term impacts on adoption (Piñeiro et al., 2020).

Rust et al. (2020) were interested in why some farmer groups choose to adopt conservation practices long-term and others do not. So, they investigated the impact of social capital on adoption and found trust, norms, connectedness, and power (components of social capital) influence farmers' decisions to change practices (Rust et al., 2020). Thus, recent studies have indicated adoption is more than monetary incentive and more than knowledge. Through a communications lens, complex decisions are often informed by a complex information system that includes content, format, "diverse organizations and individuals who are also communicating science," audiences, communication channels, and "political and societal realities within which the communication takes place," as well as other sources with "additional and perhaps conflicting or inaccurate scientific information" (NASEM, 2017, p. 84).

In 2022, Rust et al. found, when learning about soil health practices, farmers in the UK and Hungary trusted their peers more than they trusted the experts they had always trusted. Farmers did have some level of trust in agricultural levy boards and college-based agricultural scientists only if the farmers perceived they had their best interest in mind and had a long-standing relationship with the expert. Farmers in the Rust et al. (2022) study did not trust outsider scientists—a term they used to define scientists who were not part of a college or levy board—because of how information was communicated and the perspective that these scientists were more commercial focused. Rust et al. recognized their findings related to industry scientists were different in the UK than in North America, perhaps, because industry scientists in North America have long been trusted sources of information. Rust et al. (2022) noted farmers have felt a disconnect with the traditional experts and are leaning more toward farmer influencers because they are more relatable. Thus, they recommended, "instead of *talking to* the audience using experts, employing farmer influencers can open up new communication channels, creating an easily accessible information source that *communicates with* the modern farmer" (p. 38). Their work implies, then, that one way to increase adoption of modern soil health practices is to partner with farmer influencers who communicate as the change agent within a social network—a concept Rogers (2003) has long argued just not in the digital space.

Furthermore, Rust et al. (2022) found the farmers they interviewed classified farmers and agricultural levy or college advisors as different than researchers and commercial-based advisors. "Farmers contested traditional notions of scientific 'experts' versus those with 'lay' or 'local' knowledge, reframing farmers as the experts, based on experiential, situated knowledge and skills that were rooted in practical experience" (p. 40). Thus, we were interested in how United States wheat farmers perceived general scientists, research scientists, Extension scientists, and industry scientists as credible in the context of soil health practices and how perceived source credibility influenced their likelihood to adopt information from the sources.

Theoretical Framework

Hunt and Wald (2020) measured credibility based on five concepts: *understanding, integrity, concern, trust,* and *goodwill*. This measure of credibility was developed by using Gauchat et al.'s (2017) study on public perceptions of scientists in the context of climate change, Horton et al.'s (2015) multidimensional measure of credibility in the context of conservation, and McCroskey and Teven's (2009) measure of goodwill. With the lack of a framework on source credibility, we used Hunt and Wald's (2020) measure of credibility to frame our study.

Hunt and Wald (2020) described *understanding* as the level of awareness and knowledge an individual or group of individuals possesses about a topic. Previous studies have indicated the public's perceptions of scientists' contextual understanding or expertise are associated with beliefs regarding scientific credibility (Hunt & Wald, 2020) and are important to the extent that the public believes a scientist is credible (Bauer, 2009; Gauchat, 2012; Gauchat et al., 2017; Kahan, 2015). Additionally, Horton et al. (2015) found the "perception" of the understanding or competency of the scientists is not always "positive" but can be situational in nature. Horton et al. (2015) suggested that, in situations where a scientists may be acting in the role of an advisor or reporter, they should "downplay" their expertise to signal respect for the producer or local expert's experiential knowledge. In situations where the scientist is taking on a more advocacy role, they may emphasize their expertise, building on indications they are unbiased and trustworthy (Horton et al., 2015).

Integrity is defined as being influenced with the highest quality and most honest information while using that information to act in way that is best for society (Gauchat et al., 2016; Hunt & Wald, 2020). The integrity of scientists' advice is critical in establishing credibility (Gauchat et al., 2016; Noy & O'Brien, 2019). For example, in the context of climate change, the public's intention to accept scientists' advice and policy recommendations relies heavily on the perception of scientists' integrity (Gauchat et al., 2017). With agricultural and rural populations, integrity, or the perception of a scientist or institution "doing the right thing," is especially important. *Concern* refers to an individual or group of individuals working in the best interest of the public (Horton et al., 2016; Hunt & Wald, 2020). Concern plays a role in source credibility as it shows the audience that the source genuinely cares about their needs and goals (Vercic et al., 2019). For example, studies have suggested scientists' concern for human society and biodiversity has often strengthened scientific credibility (Horton et al., 2016).

Hunt and Wald (2020) described trust as being one factor in the discussion of credibility. *Trust* is the central component in developing both personal and professional relationships (Li et al., 2006; The Center for Food Integrity, n.d.). Without trust as foundational, it is difficult to have a relationship or effective communication between individuals (Stern, 2018). Farmers seek information and opinions from individuals they trust and with whom they have developed a long-term, mutually beneficial relationship (Foster, 2019). Depending on location, Extension professionals are highly trusted information sources for farmers and often considered important to farmers when they evaluate information sources (Licht & Martin, 2007). Yet, despite the high dependence on Extension professionals, communication among researchers, Extension professionals, and farmers seems broken in some states (Prokopy et al., 2014; Rust et al., 2022).

Because of poor communication strategies and broken linkage systems among researchers, Extension, and farmers, farmers have turned to private industry experts for

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information and management advice (Prokopy et al., 2014). Although farmers tend to seek or receive information about conservation from multiple sources (Witzling et al., 2021), farmers often see industry experts as influential leaders within their defined community of practice (Prokopy et al., 2014; Rust et al., 2022) because of the level of expertise status. In a situation where trust is lacking, community opinion leaders often serve as a middleman between the farmer and the information source (e.g., researchers, scientists, government officials, insurance agents; Foster, 2019). The result is farmers still get information but not from a primary source (e.g., researchers or scientists; Rust et al., 2022). Although farmers have shifted toward obtaining information from industry experts, those experts still rely on Extension professionals to provide credible information to farmers (Prokopy et al., 2014). Yet, the disconnect among research scientists, Extension professionals, and farmers is evident, and farmers still have unmet information needs either because of lack of trust, lack of two-way communication, a combination of the two, or other more influential factors.

The concept of *goodwill* originated with the Aristotelian concept of ethos (Hunt & Wald, 2020; McCroskey & Teven, 1999; Teven, 2008). Scholars have defined goodwill as the degree to which an individual or group of individuals is perceived as caring and likeable (Hunt & Wald, 2020; McCroskey & Teven, 1999). McCroskey (1992) noted that goodwill had three components: understanding, empathy, and responsiveness. In 2020, Hunt and Wald used scientific goodwill to measure the bias and motivation of scientists as a factor to understanding the public's beliefs about the impacts of genetically modified (GM) foods. Results indicated that individuals who believed scientists possessed goodwill were also skeptical of the risks GM foods pose to people and the environment (Hunt & Wald, 2020).

Purpose and Research Questions

The purpose of our study was to determine the information sources wheat farmers perceive as credible in the context of soil health practices and how perceived source credibility influences farmers' likelihood of adopting information from various information sources. Three research questions and two hypotheses guided the study:

1. What information sources do wheat farmers consider as scientists and credible sources of information about soil health practices?
2. What is the influence of farmers' perceived source credibility of general scientists, research scientists, Extension scientists, and industry scientists on their likelihood to adopt information from each source?
3. Does farmers' perceived credibility and likelihood to adopt differ based on the source of information (e.g., general scientists, research scientists, Extension scientists, and industry scientists) about soil health practices?
    a. H1: There are no differences in wheat farmers' perceived credibility of general scientists, research scientists, Extension scientists, and industry scientists.
    b. H2: There are no differences in wheat farmers' likelihood of adopting information about conservation practices from general scientists, research scientists, Extension scientists, and industry scientists.

Methods

Our study is part of a large, multi-phase study, so similar methods may appear elsewhere.

Study Design

Our study employed a cross-sectional experimental survey design. The survey collected data from U.S. wheat farmers about their adoption behaviors, perceived source credibility and scientific goodwill of information sources, and socio-demographic characteristics. Cross-sectional surveys are flexible in how they are administered, allowing for various delivery modes such as email/online, face-to-face, mail, or telephone (Connelley, 2016; Polit & Back, 2014). For our study, we used a randomized posttest-only control group design to assign participants randomly to one of eight groups (six treatment groups and two control groups) and provided posttest questions following exposure to the treatment. Initially, we used Qualtrics to deliver the instrument to farmers via a QR code through mail to reduce both financial and time costs (Berger, 2020). However, after minimal response, we converted the online instrument to a paper instrument and delivered it via postal mail. Because the instrument was self-administered, researcher bias was eliminated (Frankel et al., 2019). To eliminate other sources of bias, we used previously developed, valid, and reliable survey questions (Coberley et al., 2020; Hunt & Wald, 2020) and consulted a panel of experts during instrument development.

Population and Sample

To be eligible for participation, participants had to self-identify as a farmer or farm manager and had to have grown wheat in the past three years or be currently growing wheat. Most participants identified as white (f = 45; 97.83%) males (f = 43; 93.48%) who were not first-generation farmers (f = 42; 91.30%). Almost half of participants had a bachelor's degree or equivalent (f = 22, 47.83%), and three-fourths of participants were in a state beyond the five targeted states (f = 35; 76.09%; see Data Collection). Participants were relatively split in terms of if they had attended a land-grant university (f = 20; 43.48%) or not (f = 26; 56.52%), and the highest percentage of participants identified politically as somewhat (f = 19; 43.30%) or very conservative (f = 16; 43.30%). Socio-demographic characteristics are detailed in Table 1.

Table 1

Socio-Demographic Characteristics of Participants

Characteristics	***N***	***f***	**%**
Gender	172		
Male		152	88.37
Female		18	10.47
Prefer not to say		2	1.16
Age	172		
65 to 74 years		53	30.81
55 to 64 years		40	23.26
75 years or older		30	17.44
45 to 54 years		24	13.95
35 to 44 years		14	8.14
25 to 34 years		10	5.81
Under 25 years		1	0.58
Ethnicity	172		
White		159	92.44
Other		13	7.56

Highest Level of Education Completed	171		
Bachelor's or 4-year degree		64	37.43
Graduate or professional degree		28	16.37
Some college, no degree		28	16.37
Associates or 2-year degree		19	11.11
High school diploma or GED		17	9.94
Trade, technical, or vocational training		14	8.19
Some high school or less		1	0.58
Land-Grant University	169		
No		98	57.99
Yes		71	42.01
Political Ideology	167		
Very conservative		66	39.52
Somewhat conservative		58	34.73
Moderate/neither liberal nor conservative		31	18.56
Somewhat liberal		12	7.19
First-Generation Producer	171		
No		156	91.23
Yes		15	8.77
Location	172		
Montana		35	20.35
Kansas		34	19.77
Texas		24	13.95
Oklahoma		23	13.37
Oregon		20	11.63
North Dakota		19	11.05
Washington		7	4.07
Maryland		3	1.74
Nebraska		3	1.74
North Carolina		2	1.16
Ohio		1	0.58
Montana and North Dakota		1	0.58

Participants also provided information about their agricultural production operations (see Table 2). Most participants use nutrient management (*f* = 38; 82.61%), no-till (*f* = 32; 69.57%), crop rotation (*f* = 31; 67.39%), and reduced tillage (*f* = 60, 62.57%) practices. Most participants grow either hard red winter wheat (*f* = 27, 58.70%) or soft white wheat (*f* = 25; 54.35%). The largest number of participants indicated they grow between 2,000 to 4,999 acres of wheat (*f* = 13; 28.26%) and own 1,000 to 1,999 acres (*f* = 8; 17.39%). Most participants indicated they do produce other types of crops or livestock (*f* = 37; 80.43%) with the most selected growing other field crops (*f* = 28; 60.87%) and hay and forage crops (*f* = 23; 50.00%).

Table 2
Farm Operation Characteristics of Participants

Characteristics	***N***	***f***	**%**
Current Conservation Practices Used*	172		
Crop rotation		131	76.16
Reduced tillage		104	60.47
Nutrient management		97	56.40
No-till		91	52.91
Cover crops		59	34.30
Double cropping		40	23.26
Buffer strips		24	13.95
Other		5	2.91
None		3	1.74
Total Wheat Acres Farmed	171		
500–999		34	19.88
2,000–4,999		27	15.79
1,000–1,999		26	15.20
100–139		18	10.53
260–499		16	9.36
5,000+		11	6.43
10–49		8	4.68
180–219		8	4.68
70–99		7	4.09
140–179		6	3.51
220–259		6	3.51
50–69		4	2.34
Total Wheat Acres Owned	167		
500–999		32	19.16
1,000–1,999		22	13.17
260–499		21	12.57
100–139		17	10.18
10–49		13	7.78
70–99		10	5.99
140–179		10	5.99
2,000–4,999		10	5.99
220–259		9	5.39
1–9		7	4.19
50–69		7	4.19
180–219		6	3.59
5,000+		3	1.80
	171		

Characteristics	***N***	***f***	**%**
Wheat Classes Farmed*			
Hard Red Winter		117	68.42
Hard Red Spring		56	32.75
Soft White		26	15.20
Soft Red Winter		9	5.26
Hard White Winter		7	4.09
Durum		7	4.09
Hard White Spring		1	0.58
Total Acres Farmed (including wheat acres)	171		
2,000–4,999		44	25.73
1,000–1,999		30	17.54
500–999		28	16.37
5,000+		26	15.20
260–499		15	8.77
140–179		8	4.68
100–139		7	4.09
220–259		5	2.93
10–49		3	1.75
70–99		2	1.17
180–219		2	1.17
50–69		1	0.58
Production of Other Crops/Livestock	173		
Yes		151	87.28
No		22	12.72
Other Crops/Livestock Produced*	151		
Field crops		113	74.83
Hay and forage crops		100	66.23
Cattle and calves		80	52.98
Other		14	9.27
Vegetables, potatoes, and melons		10	6.62
Poultry		7	4.64
Colonies of honeybees		6	3.97
Sheep and goats		6	3.97
Nursery, greenhouse, floriculture, sod, mushrooms, vegetable seeds, and propagative materials		4	2.65
I do not produce any other crops and/or livestock		4	2.65
Hogs and pigs		3	1.99
Fruits, nuts, and berries		3	1.99

Note. * indicates participants could select more than one response.

Survey Instrument

The researcher-developed instrument had 10 sections. All participants received sections one, two, three, four, six, seven, eight, nine, and 10. Each participant was randomly assigned to one of the eight question groups for section five. Section three data are reported elsewhere.

Section one of the instrument contained the informed consent document, and section two included three qualifying questions to determine participant eligibility (i.e., if the participant identified as an agricultural producer or farm manager, if they had grown wheat in the past three years, or if they had planted or planned to plant wheat in 2023). Section four asked participants to select who they believed to be a “scientist” when gathering information about tillage practices and cover crop practices. Participants chose from Extension professionals, researchers, other farmers, personal experience, industry professionals, local experts/opinion leaders, government agencies, and other. Personal experience indicated farmers considered themselves scientists when gathering information about conservation practices. We did not provide participants with definitions of the scientist types and acknowledge this as a potential limitation (discussed below). We chose not to provide the definitions to avoid potential influence of participants’ perceptions related to the information contained in the news stories (treatments).

Section five of the instrument used a modified version of Hunt and Wald’s (2020) scale on source credibility—source understanding, integrity, concern, and trust—and scientific goodwill. Participants in the six treatment groups received a different news article based on conservation practice (cover crops or tillage) and information source (Extension scientist, industry scientist, or research scientist), and participants in the two control groups did not receive a news article. The two control groups answered questions ‘in general’ related to scientists communicating about tillage practices or cover crop practices. Three treatment groups received a news article about tillage practices, and three treatment groups received a news article about cover crop practices. The news articles for each of the three treatment groups used a different type of scientist as the source (research scientist, Extension scientist, or industry scientist).

For the treatment groups, we wrote one-page news articles about each of the conservation practices and changed only the source communicating the information. We shortened and tightened existing National Resource Conservation Service (NRCS) articles to ensure we aligned with a national source of information on conservation practices. We then changed the information source in the article to the source of information who was part of the treatment group. Once the articles were written, two agricultural communications faculty members who specialize in messaging and two agronomy faculty members who specialize in conservation practices validated the articles for message and science. One of the agronomy faculty members has a primary Extension appointment with Texas A&M AgriLife Extension Service and the other a primary research appointment. Based on the review, we made two rounds of edits before sending the final article. The articles included information about the benefits of reduced or no-till practices or cover crop practices in wheat production. We chose soil conservation practices in wheat production as the context of our study because conservation practices have continually increased in wheat production (Claasen et al., 2019; USDA-NASS, 2019, table 47; Wallander et al., 2021) and because our study was part of a federally funded project focused on wheat production.

Section six of the instrument measured participants’ behaviors related to cover crops and reduced or no-till practices, using survey items from Coberley et al.’s (2020) instrument. Section seven of the instrument asked participants to identify the level of source credibility (i.e., understanding, integrity, concern, trust) and scientific goodwill for each information source (researchers, Extension professionals, industry professionals, government agencies, local experts/opinion leaders, other farmers, personal experience, and "I do not obtain information about this practice/not applicable"). Participants were also asked to indicate their role as primary decision-maker on the farm. If they indicated that they were not the primary decision-maker, they were asked to provide the job title of the primary decision maker.

Section eight of the instrument asked participants to describe their operations—number of wheat acres farmed, number of wheat acres owned, wheat classes produced, production of other crops/livestock besides wheat, total acres farmed (including wheat), and status as a first-generation farmer. Section nine of the instrument asked participants to describe themselves, including gender, age, ethnicity, location of farm by state, level of education, attendance at a land-grant university, and political ideology. Section 10 asked participants to include their name and email address if they chose to receive the $10.00 Tango gift card incentive for completing the survey. In addition to the 10 sections, we used a quality check question following section five to determine if participants were paying attention during the survey.

Validity and Reliability

First, we used a panel of experts to establish the face and content validity of the survey instrument and interventions. Second, we conducted a pilot study to assess the reliability of the scales we included. To collect pilot data, we obtained a list of individuals who had received Agriculture Risk Coverage and Price Loss Coverage wheat payments in 2019, 2020, and 2021 from Kansas, North Dakota, Montana, Oklahoma, and Texas, which were the top producing wheat states during that time frame. The list came from the United States Department of Agriculture Farm Production and Conservation Business Center, under the Freedom Information Act and included the associated state Farm Service Agency name, formatted payee name, address information line, delivery address line, city name, state abbreviation, zip code, payment date, and accounting program description. To prepare for data collection, we removed duplicates of formatted payee name, any payments sent outside the target states (i.e., Kansas, North Dakota, Montana, Oklahoma, Texas), and payees who did not meet the population requirements. We used the final list to draw the pilot study sample.

The pilot study followed Dillman et al.'s (2014) recommendations for recruiting participants into an online survey. We sent three recruitment postcards to 600 individuals. The postcards included a prenotice postcard notifying participants they would soon receive an invitation to participate in the study, an initial survey postcard with a QR code and link to the online Qualtrics survey, and a reminder postcard with a QR code and link to the online Qualtrics survey. Due to low response, we were unable to obtain the number of responses needed to assess the reliability of the survey instrument using the mailed postcard.

Therefore, we used a modified Dillman et al.'s (2014) method to distribute emails to a wheat farmer email list through an Extension agent in Morrow County, Oregon. We collected a total of 34 usable responses through the Morrow County Extension Office. Next, we contacted 27 state wheat and grain associations, and 10 of the associations agreed to distribute the survey to their members via an email list or newsletter. We collected a total of 83 responses. However, we ended up with 46 usable responses including the 34 usable responses collected as part of the Qualtrics study. Of the 83 responses, 32 were missing at least one data value or did not qualify for the study. The last five responses were removed due to participants incorrectly answering the quality check question, resulting in 46 usable responses. With only 46 usable responses, we chose to distribute mail surveys for final data collection to obtain more responses.

Using pilot data, we assessed the reliability of Hunt and Wald's (2020) credibility and goodwill Likert-type scales using Cronbach's alpha ($\alpha \geq .70$). Credibility was measured using four items, one for understanding, integrity, concern, and trust (n = 32, α = .82) and scientific goodwill was measured using two items (n = 33, α = .78). Each scale was four points.

Final Data Collection

After the pilot study was unsuccessful in achieving a satisfactory response rate, we switched the study to mail survey study and followed a modified version of Dillman et al.'s (2014) methods for collecting survey responses via the United States Postal Service (see Table 3). We used four points of contact: 1) initial postcard informing participants of the study; 2) survey packet; 3) reminder postcard; and 4) survey packet. As we received returned surveys, we marked individuals as complete/incomplete, and they did not receive subsequent communication. We sent 3,000 invitations to participate in the study with the hopes of achieving a 10 to 15% response rate, which was typical for populations similar to ours prior to the COVID-19 pandemic (Alvåsen et al., 2014; Angell et al., 2014). Initially, we had 140 responses including incomplete surveys that were sent back. Because of the low response rate on the final data collection, we chose to check for significant differences between the pilot study data and the final data in hopes that we could use the data from both collections. There were no significant differences, so we collapsed the data into one dataset and reported the data as one. Thus, we combined the 46 usable responses with the 127 usable responses for a total of 173 usable responses. We cannot calculate a final response rate with the pilot study data included because we are not sure how many people received the pilot study Qualtrics link as part of the associations' email blast. Data for the project were collected between January 2023 and April 2023 with 15 days between the end of the pilot study and the beginning of the final data collection.

Table 3
Data Collection Phases

Phase	Description	Sample Size
Study Design	Cross-sectional experimental survey design with a randomized posttest-only control group.	
Pilot Study/ Initial Data Collection	Online (Qualtrics) *Method*: QR code and email invitations to reduce financial and time costs *Reason*: Minimal response to the online survey	Sent 600 postcards, received 0 usable responses. Sent Qualtrics link to farmers connected to an Oregon-based Extension office, received 34 usable responses. Sent Qualtrics link to farmers through 10 association email listservs, received 12 usable responses.
Transition Phase	Converted the online instrument to a paper instrument *Method*: Delivered via postal mail *Reason*: Improve response rates and data collection consistency	

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Phase	Description	Sample Size
Final Data Collection	Mail survey *Method*: Followed Dillman et al.'s method with four points of contact (initial postcard, survey packet, reminder postcard, and survey packet)	Sent 3,000 mail surveys with an expected response rate of 10-15%, received 127 usable responses (4.23% response rate)
Final with Combined Datasets	Combined pilot study data (46 usable responses) with final data (127 usable responses)	Reported the data from 173 usable responses.

Data Analysis

We handled missing data by deleting 11 responses that were missing each data value for either the independent and/or the dependent variable. We used the mean imputation technique to replace missing data values in the remaining responses. Only eight responses had missing data values with seven having one missing data value and the eighth response having two missing data values. Therefore, we imputed only nine missing data values in the entire dataset.

We answered the first research question using frequencies and percentages to determine the information sources wheat farmers considered as scientists and perceived as credible. We answered the second research question by conducting four simple linear regression analyses, using ordinary least squares as the method of estimation, to determine the influence of farmers' perceived source credibility of general scientists, research scientists, Extension scientists, and industry scientists on their likelihood to adopt information about conservation practices from each source. Because we had four different outcome variables—likelihood to adopt information from general scientists (1), research scientists (2), Extension scientists (3), and industry scientists (4)—we ran four separate simple regressions. Though not necessary, we chose to also conduct Pearson product-moment correlations between each independent and dependent variable to gain a comprehensive understanding of the strength and direction of relationships. For the 4-point response scales, we used the following cutoff values to interpret the means of perceived source credibility and likelihood to adopt information: means below 1.50 indicated low levels; means from 1.50 to 2.49 indicated somewhat low levels; means from 2.50 to 3.49 indicated moderate levels; and means above 3.50 indicated high levels. We answered the third research question by conducting two one-way ANOVAs to determine if wheat farmers' perceived credibility and likelihood to adopt information means differed across information sources.

We checked if the assumptions of regression analyses (i.e., linearity, normality, homoscedasticity) were violated by the data for each of the four simple linear regression analyses. To assess linearity, we used Residual versus Predictor Plots. The Lowess lines in these plots were aligned with the linear reference lines for most of the distribution, indicating a linear relationship existed between the predictors and outcomes. To assess normality, we used Density Plots and QQ Plots. For each analysis, both plots revealed a semi-normal distribution with the skewness close to 0 and the kurtosis close to 3 (general scientist: skewness = -1.24; kurtosis = 4.75; research scientist: skewness = -0.72; kurtosis = 4.85; Extension scientist: skewness = 0.02; kurtosis = 2.39; industry scientist: skewness = -0.58; kurtosis = 2.01). Because the skewness and kurtosis values for the general scientist and research scientist groups indicated slight deviations from normality, we used Huber-White sandwich estimators to adjust for potential minor issues related to non-normality. To assess homoscedasticity, we used Residual versus Fitted Plots and Breusch-Pagan tests. The plots revealed constant dispersion of residuals across fitted values, supporting the assumption of homoscedasticity. Breusch-Pagan test results were also non-significant (general scientist: ($X^2(1) = .63$, $p = .428$); research scientist: ($X^2(1) = .65$, $p = .421$); Extension scientist: ($X^2(1) = .02$, $p = .885$); industry scientist: ($X^2(1) = .00$, $p = .957$)), providing further support for the assumption.

Due to the small number of participants assigned to each of the original eight groups, we combined the two sets of practices (reduced/no-till and cover crops) into a single category focusing on soil health practices. By combining the two sets of practices, we created four distinct groups delivering information about soil health practices (i.e., general scientists [$n = 47$], research scientists [$n = 39$], Extension scientists [$n = 49$], industry scientists [$n = 37$]) to answer the second and third research questions. As a result, we increased the sample size per group and improved the robustness of our analysis.

Limitations

The current study has six key limitations related to methodology. First, the data collected were self-reported and may not reflect participants' actual behaviors. Second, hypothetical bias may play a role in farmers' willingness to adopt because the situation posed is hypothetical. Third, the study only assessed source credibility and scientific goodwill of general, research, Extension, and industry scientists. Fourth, the different topics presented to participants may have influenced perceptions of each type of scientist, potentially introducing variability in responses as an uncontrolled variable. Fifth, we combined the pilot study data with the final study data to increase response rate. Although we checked the data themselves for differences and found none, the quantitative checks did not allow for differences in seasons, history, or other events impact results. Last, we did not provide definitions for the different types of scientists. We recognize this limits our results, but we did not want to influence perceptions by providing a definition.

Results

RQ1: What Information Sources do Wheat Farmers Consider as Scientists and Credible Sources of Information about Soil Health Practices?

More than half of the participants (~57%) considered Extension professionals, researchers, and other farmers as *scientists* when receiving information about soil health practices (i.e., reduced till, no-till, and cover crop practices; see Table 4). A smaller proportion of (<19%) considered local experts/opinion leaders or government agencies as *scientists*.

Table 4
Information Sources Wheat Farmers Consider as "Scientists" When Seeking Information about Reduced/No-Till and Cover Crop Practices

Information Sources	Reduced/No-Till Practices ($N = 182$)		Cover Crop Practices ($N = 181$)	
	f	%	f	%
Extension professionals	122	67.03	116	64.09
Researchers	112	61.54	106	58.56
Other farmers	105	57.69	115	63.64
Personal experience	102	56.04	83	45.86
Industry professionals	90	49.45	74	40.88
Local experts/opinion leaders	76	41.76	83	45.86

Information Sources	Reduced/No-Till Practices (*N* = 182)		Cover Crop Practices (*N* = 181)	
Government agencies	31	17.03	33	18.23
Other	8	4.40	8	4.42

Note. Participants selected all information sources they considered "scientists." Personal experience meant that farmers could consider themselves to be scientists.

The largest percentages of participants perceived other farmers (37.87%), Extension professionals (36.69%), themselves (36.09%), and researchers (35.50%) as having the greatest *understanding* of conservation practices. They perceived Extension professionals as having the greatest *integrity* (40.83%), followed by other farmers (39.64%) and themselves (34.91%). Regarding concern about soil health practices, participants perceived themselves as having the greatest *concern* (40.24%), followed by Extension professionals (34.91%) and other farmers (31.36%). In addition, participants perceived other farmers (41.42%), Extension professionals (40.24%), and themselves (37.28%) as being the most *trust*worthy. They also perceived Extension professionals (44.38%), other farmers (41.42%), and themselves (37.28%) as having the most *goodwill* in the context of soil health practices (see Table 5).

Table 5

Information Sources Participants Considered Credible When Seeking Information about Conservation Practices (N = 169)

Source	Understanding		Integrity		Concern		Trust		Goodwill	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Researchers	60	35.50	50	29.59	41	24.26	44	26.04	28	16.57
Extension Professional	62	36.69	69	40.83	59	34.91	68	40.24	75	44.38
Industry Professional	29	17.16	22	13.02	24	14.20	24	14.20	23	13.61
Government Agency	11	6.51	12	7.10	25	14.79	8	4.73	15	8.88
Local Expert /Opinion Leader	44	26.04	45	26.63	41	24.26	39	23.08	43	25.44
Other Farmers	64	37.87	67	39.64	53	31.36	70	41.42	73	43.20
Personal Experience	61	36.09	59	34.91	68	40.24	63	37.28	56	33.14
Not Applicable	7	4.14	8	4.73	11	6.51	7	4.14	9	5.33

Note: column groups are under the spanning heading "Credibility Attribute".

RQ2: What is the Influence of Farmers' Perceived Source Credibility of General, Research, Extension, and Industry Scientists on Likelihood to Adopt Information?

The means and standard deviations of perceived source credibility suggest that participants perceived each information source—general scientists, research scientists, Extension scientists, and industry scientists—as similarly credible in providing information about soil health practices (see Table 6). All means surpassed the scale midpoint, ranging from 2.61 to 2.87, indicating farmers generally viewed each source as moderately credible. Among the sources, Extension scientists were perceived as the most credible (*M* = 2.87, *SD* = 0.58), followed by research (*M* = 2.73, SD = 0.49), general (*M* = 2.69, *SD* = 0.40), and industry (*M* = 2.61, *SD* = 0.51). The means and standard deviations of likelihood to adopt information from general, research, Extension, and industry suggest participants were similarly inclined to adopt information about soil health practices from each source. All means surpassed the scale midpoint, ranging from 2.63 to 2.84, indicating participants were moderately likely to adopt information from any of the four types of scientists. Among the sources, participants were most likely to adopt information from research scientists (*M* = 2.84, *SD* = 0.60), followed closely by Extension (*M* = 2.81, *SD* = 0.61) and general (*M* = 2.81, *SD* = 0.49). They were least likely to adopt information from industry scientists (*M* = 2.63, *SD* = 0.53).

Table 6

Means, Standard Deviations, and Reliability Coefficients of Independent, Dependent Variables

Variable	*M*	*SD*	α
Perceived source credibility of general scientists (*n* = 47)	2.69	0.40	.67
Likelihood to adopt information from general scientists (*n* = 47)	2.81	0.49	.84
Perceived source credibility of research scientists (*n* = 39)	2.73	0.49	.77
Likelihood to adopt information from research scientists (*n* = 39)	2.84	0.60	.89
Perceived source credibility of Extension scientists (*n* = 49)	2.87	0.58	.82
Likelihood to adopt information from Extension scientists (*n* = 49)	2.81	0.61	.93
Perceived source credibility of industry scientists (*n* = 37)	2.61	0.51	.82
Likelihood to adopt information from industry scientists (*n* = 37)	2.63	0.53	.96

Note. α = Cronbach alpha coefficient. Cut point values provided in the Data Analysis section.

Pearson product-moment correlations revealed a statistically significant relationship, substantial in strength, existed between participants' perceived source credibility of general scientists and their likelihood to adopt information about soil health practices from them (*n* = 47, *r* = .56, *p* < .001). The regression model including perceived source credibility of general scientists as a predictor accounted for 31.16% of the variance in farmers' likelihood of adopting information about soil health practices. Accounting for the number of predictors, the adjusted variance explained is 29.63%. The F-test shows the model explained a statistically significant amount of variation in the dependent variable (*F*(1,45) = 21.48, *p* < .001; see Table 7). Each additional point in perceived source credibility is associated with a statistically significant average increase in likelihood to adopt information of .682 (*t*(45) = 4.63, *p* < .001).

Table 7

Results from the Regression Model with Likelihood of Adopting Information from General Scientists as the Dependent Variable

Predictor	Likelihood of Adopting Information from General Scientists			
	B (S.E.)	*t*	*p*	*β*
Intercept	0.977 (0.390)	2.50	.016	--
Perceived Source Credibility	0.682 (0.147)	4.63	< .001	0.558

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A statistically significant, substantial relationship existed between participants' perceived source credibility of research scientists and likelihood to adopt information about soil health practices from them ($n = 39$, $r = .61$, $p < .001$). The regression model including perceived source credibility as a predictor accounted for 36.91% of the variance in farmers' likelihood of adopting information about soil health practices. Accounting for the number of predictors, the adjusted variance explained is 35.20%. The F-test shows the model explained a statistically significant amount of variation in the dependent variable ($F(1,37) = 16.18$, $p < .001$; see Table 8). Each additional point in perceived source credibility is associated with a statistically significant average increase in likelihood to adopt information of .741 ($t(37) = 4.02$, $p < .001$).

Table 8

Results from the Regression Model with Likelihood of Adopting Information from Research Scientists as the Dependent Variable

Predictor	**Likelihood of Adopting Information from Research Scientists**			
	B (S.E.)	*t*	*p*	*β*
Intercept	0.813 (0.497)	1.64	.110	--
Perceived Source Credibility	0.741 (0.184)	4.02	< .001	0.608

A statistically significant, substantial relationship existed between participants' perceived source credibility of Extension scientists and their likelihood to adopt information about soil health practices from them ($n = 49$, $r = .66$, $p < .001$). The regression model including perceived source credibility of Extension scientists as a predictor accounted for 43.25% of the variance in farmers' likelihood to adopt information about soil health practices. Accounting for the number of predictors, the adjusted variance explained is 42.04%. The F-test shows the model explained a statistically significant amount of variation in the dependent variable ($F(1,47) = 35.81$, $p < .001$; see Table 9). Each additional point in perceived source credibility of Extension scientists is associated with a statistically significant average increase in likelihood to adopt information of .689 ($t(47) = 5.98$, $p < .001$).

Table 9

Results from the Regression Model with Likelihood of Adopting Information from Extension Scientists as the Dependent Variable

Predictor	**Likelihood of Adopting Information from Extension Scientists**			
	B (S.E.)	*t*	*p*	*β*
Intercept	0.829 (0.337)	2.46	.018	--
Perceived Source Credibility	0.689 (0.115)	5.98	< .001	0.658

A statistically significant, substantial relationship existed between participants' perceived source credibility of industry scientists and their likelihood to adopt information about soil health practices from them ($n = 37$, $r = .59$, $p < .001$). The regression model including perceived source credibility of industry scientists as a predictor accounted for 35.27% of the variance in likelihood to adopt information. Accounting for the number of predictors, the adjusted variance explained is 33.42%. The F-test shows the model explained a statistically significant amount of variation in the dependent variable ($F(1,35) = 19.07$, $p < .001$; see Table 10). Each additional point in perceived source credibility of industry scientists is associated with a statistically significant average increase in likelihood to adopt information of .624 ($t(35) = 4.37$, $p < .001$).

Table 10
Results from the Regression Model with Likelihood of Adopting Information from Industry Scientists as the Dependent Variable

Predictor	**Likelihood of Adopting Information from Industry Scientists**			
	B (S.E.)	*t*	*p*	*β*
Intercept	1.000 (0.380)	2.63	.012	--
Perceived Source Credibility	0.624 (0.143)	4.37	< .001	0.594

RQ3: Does Farmers' Perceived Credibility and Likelihood to Adopt Differ Based on the Source of Information about Soil Health Practices?

Results from a one-way ANOVA revealed no statistically significant differences between participants' perceived credibility of general scientists, research scientists, Extension scientists, and industry scientists ($F(3, 168) = 2.174$, $p = .093$, $\eta^2 = .037$). Results from a second one-way ANOVA revealed no statistically significant differences between participants' likelihood to adopt information about soil health practices from general scientists, research scientists, Extension scientists, and industry scientists ($F(3, 168) = 1.115$, $p = .345$, $\eta^2 = .020$).

Conclusions

Using a cross-sectional experimental survey design, we determined the information sources U.S. wheat farmers perceive as credible in the context of soil health practices and the influence of perceived source credibility on farmers' likelihood to adopt information from those sources. First, participants considered Extension professionals, researchers, and other farmers as scientists when seeking information about soil health practices. They perceived other farmers, Extension professionals, themselves, and researchers as having the most *understanding* about soil health; Extension professionals and other farmers as having the most *integrity* in terms of information quality and using the information for the good of wheat farmers as a whole; themselves, Extension, and other farmers as having the most *concern* for wheat farmers and caring about the needs and goals of U.S. wheat farmers; other farmers, Extension professionals, and themselves as being the most *trusted* individuals in the wheat farming community; and Extension professionals, other farmers, and themselves as having the most *goodwill* and being the most caring and likeable. Second, perceived credibility of the information source influenced participants' likelihood to adopt soil health information from that source. Third, our results confirm H1 and H2, indicating no differences in perceived credibility and likelihood to adopt information among the four types of scientists: general, research, Extension, and industry.

Discussion and Recommendations

Drawing on the conclusions of Rust et al. in 2022, we chose to further investigate the differences in scientist type as their qualitative results show there could be differences in type of scientist delivering the information. Although our participants perceived researchers to have understanding, they did not perceive researchers to have as much integrity, trust, concern, or goodwill as other professionals. Our findings are similar to Rust et al. (2022) because farmers in their study separated experts by perceived lack of empathy. Our results show farmers perceive researchers know the science but perhaps lack concern and care for the farmer, which Horton et al. (2016), Hunt and Wald (2020), and Vercic et al. (2019) described as important to source credibility. In contrast, participants perceived Extension professionals, others, and themselves as having understanding, integrity, trust, concern, and goodwill, aligning with Rust et al. (2022) in that farmers are expert information sources based on knowledge, skills, and practical experience.

Although our study did not support the research regarding farmers' trust in agricultural government agents and local experts (Moody, 2018; Phiri et al., 2019; Ranjan et al., 2019), it did confirm participants place significant trust in Extension professionals and other farmers (Foster, 2019; Rust et al., 2022). Our results, consistent with other studies, suggest Extension professionals are highly trusted and credible sources of information (Licht & Martin, 2007; Rust et al., 2022, Taku-Forchu et al., 2023) who play a pivotal role in influencing farmers' decisions regarding conservation practices. Other farmers were perceived as significantly credible, indicating peer influence is a critical factor in farmers' choice to adopt a technology. The perceived credibility of other farmers underscores the importance of peer influence, suggesting potential for farmer-led initiatives as discussed by Rust et al. (2022).

Initiatives to build social capital (trust, norms, connectedness and power) are crucial for enhancing the adoption of conservation practices among farmers (Feldman & Ingram, 2009, Rust et al., 2020, Rust et al., 2022) as only one concept of Hunt and Wald's (2020) credibility measurement is related to knowledge (understanding). Our findings suggest Extension scientists are perceived as more credible than the other sources (Fortner et al., 2022), potentially due to their direct involvement with practical and research-based farming solutions. However, as Prokopy et al. (2014) and Rust et al. (2022) described, communication among the scientist groups is perhaps lacking, causing farmers to receive secondary and not primary information.

Based on our study, credibility in the context of wheat production and soil health might be less about the information source and more about other important factors, including content; publication outlet (NASEM, 2017); specific farm practices; farmers' goals, motivations (Burnham et al., 2023), intentions (Tama et al., 2020); and on-farm characteristics. Studies (e.g., Moody, 2018; Roesch-McNally et al., 2018; Wilson et al., 2009) have shown farmers are knowledgeable about soil health and conservation practices, yet they are hesitant to implement such practices, perhaps because of perceived lack of social capital (Rust et al., 2023) or lack of motivation (Burnham et al., 2023). Thus, information sources may not matter in the context of soil health and wheat production because farmers may make decisions to adopt or reject a practice separate from receiving information about a practice. Therefore, there is a need to further explore specific concerns and perceived risks that farmers associate with the practices.

Continued research is necessary to better understand the root of farmers' trust—whether it is through direct interactions, shared experiences, or the practical relevance of the information provided by these sources. Rust et al.'s (2023, 2022) findings indicate social capital, interaction, experience, and relevance are important in the decision to adopt something, which could be captured in the Hunt and Wald (2020) measurement of credibility concepts. Agricultural Extension services and research institutions should continue to build their credibility with farmers and communicate evidence-based messages that incorporate understanding, integrity, trust, concern, and goodwill (Hunt & Wald, 2020). We did not investigate trust between source groups, but we recommend this to be explored more. Perhaps, lack of communication between scientist groups is causing a breakdown in communication between scientists and farmers, which is contributing to low adoption of soil health practices. Furthermore, our results identify a need to enhance the credibility of less trusted sources, like industry professionals and government agencies. We recommend specific efforts to improve credibility that focus on building relationships, improving communication, and demonstrating concern for farmers' needs (Prokopy et al., 2014; Rust et al., 2020, 2022).

Most participants in our study (more than 95%) have adopted at least one conservation practice, which is not representative of the U.S. farming population according to the 2022 USDA Agriculture Census. Therefore, we recognize this could impact our results, specifically in how farmers perceive source credibility and who they perceive as credible. There are reasons those who have not adopted cover crops did not reply to our survey, but we do not know why unless we ask. So, we must find ways to access the non-adopting population to better understand patterns of adoption. Extension professionals should continue to provide consistent support and high-quality information to wheat farmers. Farmers can facilitate change in agriculture and natural resource policy (Lawson et al., 2020), but this requires a supportive relationship with Extension professionals (Ranjan et al., 2019) who prepare farmers and ranchers for disseminating credible information at a legislative or community-based level.

We would be remiss to not acknowledge our low response rate as an ongoing problem in survey research with producer audience groups. Many studies have documented low response rates in the last few years, and it has become more and more challenging to engage in survey research with farmers (Avemegah et al., 2020). Thus, we believe there is a need to investigate response rates further and explore other ways to collect rigorous data that does not require investing large amounts of money with little to no return on data.

Our study suggests trust and source credibility, peer influence, and effective communication strategies are critical in communicating about soil health practices among wheat farmers. The role of Extension and research scientists in disseminating information is evolving; therefore, we recommend further research to investigate the complexities of the communication technologies and systems these scientists use to disseminate information about soil health and the role scientists play in the science communication process. Furthermore, farmers are increasingly becoming a hard-to-reach audience group in terms of scientific research using a variety of research methods. Yet, now is the time to include these seemingly hard-to-reach audience groups in conversations about how to conduct effective social science research within their communities while maintaining trust and upholding scientific research standards. Effective communication grounded in trust and leveraged through social capital across stakeholders involved in soil health has the potential to impact the agricultural production system for many years (Rust et al., 2020, 2022), but achieving effective communication could take years without intentionality.

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