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You've Got Mail: Exploring Predictors of Wheat Farmers' Behaviors Toward Soil Health Conservation Practices

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Abstract

The agricultural sector is facing significant challenges due to the projected U.S. population in 2050, indicating farmers need to adopt conservation practices to sustain the land and feed the growing population. Many farmers recognize this need and the importance of adopting sustainable practices, and they are likely already doing so. The purpose of our study, then, was to explore significant predictors of farmers' behaviors toward soil health practices. Data were collected from a sample of U.S. wheat farmers from the top wheat-producing states using a cross-sectional survey design. Guided by the theory of normative social behavior, we conducted descriptive statistics, an ANOVA, and a multiple linear regression to answer two research questions: (a) How do demographic characteristics of U.S. wheat farmers influence soil health behavior?; and (b) To what extent do descriptive norms, injunctive norms, outcome expectations, and identity predict wheat farmers' behaviors regarding soil health practices? Producers were predominantly older, white males with a college education, large farms, and conservative political views. Demographic characteristics did not significantly influence farmers' soil health behavior, and identity was the only significant predictor of their behavior toward soil health practices. Therefore, we recommend tailored educational programming related to identity and further research to explore predictors of soil health behavior.

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Introduction and Problem Statement

According to the U.S. Census Bureau, the population is expected to reach around nine billion by 2050 (n.d.). Due to this, the agricultural industry is facing intense pressure to produce safe and affordable food while also preserving the land, often by adopting conservation practices (Claassen et al., 2018). Agricultural producers often recognize the need to adopt conservation practices to address challenges posed by climate change and to maintain agricultural productivity in a changing climate (Karki et al., 2020), yet adoption is still not widespread. The Sustainable Development Goals (SDGs), established by the United Nations, provide an agenda aimed at addressing pressing issues such as decreasing poverty, protecting the planet, and ensuring all people are healthy and enjoy justice and prosperity in both developed and developing countries (United Nations, n.d.). SDG 13 focuses on climate action, which aligns with our study, because of its focus on soil health practices that support sustainability and reduce climate-related impacts (Campbell et al., 2018).

More specifically, wheat farmers have experienced the consequences of climate change, such as increased temperatures and unpredictable precipitation (Karki et al., 2020; Wilson et al., 2009), prompting the need to adopt sustainable production practices. Miner et al. (2020) documented that implementing soil health practices can reduce nutrient loss, enhance weather resistance, increase crop yields, and improve yield stability. Soil health practices may include implementing conservation tillage or using residue and cover crops (Claassen et al., 2018). Previous literature presents mixed results on crop yield and soil health benefits resulting from the implementation of no-till and cover crops (Guo et al., 2021; Pittelkow et al., 2015; Yang et al., 2020). Edwards et al. (2015) noted no-till farming can decrease field operations, fuel use, and machinery requirements, and Wallander et al. (2021) noted cover crops are increasingly being adopted due to their environmental benefits and government incentives.

Theoretical and Conceptual Framework

Our research is grounded in the theory of normative social behavior (Rimal & Real, 2003) and seeks to explore how wheat farmers engage in soil health practices (i.e., no-till and cover crops). The theory of normative social behavior includes four components: descriptive norms, injunctive norms, outcome expectations, and identity. Therefore, our study examines the influence of descriptive norms, injunctive norms, outcome expectations, and farmer identity on behaviors concerning soil health practices.

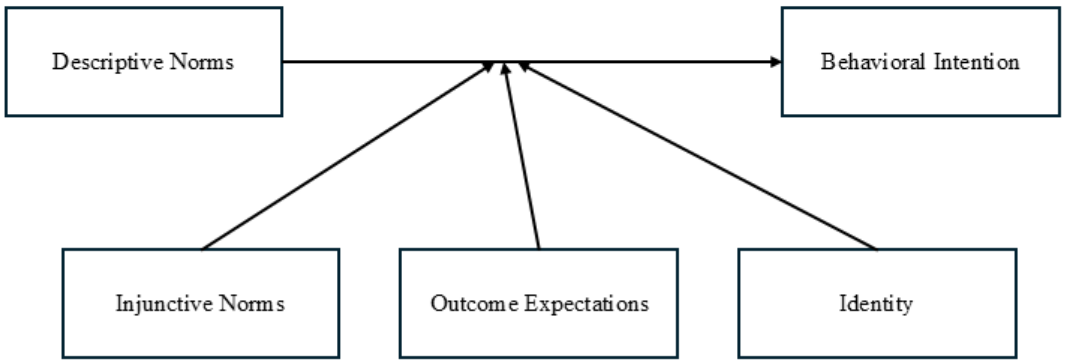
The theory of planned behavior suggests individuals act logically based on their attitudes, subjective norms, and perceived behavioral control (Ajzen, 1985), and it serves as a foundation for the development of the theory of normative social behavior (Ajzen & Fishbein, 2000). The theory of planned behavior is most effective for assessing individual factors; however, our focus was more on social or peer influence because adopting climate-smart practices is frequently connected to social norms within rural communities (Gauld & Reeves, 2023). The theory of normative social behavior served as our guiding framework because it explains how individuals'

perceptions of others' behaviors (descriptive norms) shape their own actions through three key elements: norms, expectations, and identity (Rimal & Real, 2003). Descriptive norms are beliefs about how common or socially acceptable an action (or behavior) is within their group (Rimal & Lapinski, 2015) and how it positively influences behavior directly. For example, soil health practices widely used or considered socially acceptable among wheat farmers may lead to higher adoption rates. Injunctive norms refer to social expectations and the beliefs perceived to be morally right or approved by a social group (Rimal & Lapinski, 2015). In the adoption of soil health practices, injunctive norms act as a moderating factor, such as the approval or disapproval of peers or industry experts. Outcome expectations refer to an individual's perception of the benefits or consequences that may result from behaving in a certain way, and they moderate the relationship between descriptive norms and behavior (Rimal & Real, 2003). Wheat farmers who adopt soil health practices may see long-term benefits for the environment and the consequences of not conserving the land. Last, group identity refers to the extent to which individuals see themselves as aligning with a group (Rimal & Real, 2003). For example, wheat farmers who see themselves as stewards of the land or environmentally responsible might adopt conservation practices matching the shared group identity.

Many studies have examined farmers' adoption of conservation practices and the factors influencing their decision-making. However, our study offers new insights into how the theory of normative social behavior affects behavioral intention concerning the adoption of soil health practices. Studies like the one conducted by Rezaei-Moghaddam et al. (2020) have found that social norms are crucial in farmer decision-making and that influence from other farmers has a significant impact on the adoption of environmentally friendly practices. Previous literature indicates farmers are currently implementing conservation practices and often view themselves as environmental stewards (Burke & Running, 2019). However, many of their beliefs, attitudes, and behaviors are focused on productive efficiency, which can impact relationships among farmer social groups (Burke & Running, 2019). Vaske et al. (2020) found farmers are willing to do the right things for the environment even without government compensation, possibly influenced by the opinions of those around them. Therefore, in our study, we applied the theory of normative social behavior to determine how descriptive norms, injunctive norms, outcome expectations, and identity contribute to the prediction of behavioral intention (see Figure 1).

Figure 1

Normative Social Behavior Model Adapted from Gauld and Reeves (2023)



Purpose

The purpose of our study was to identify significant psychological and demographic predictors of U.S. wheat farmers' behaviors regarding soil health practices, including no-tillage and cover cropping. By understanding what influences the adoption of soil health practices, agricultural development practitioners can better tailor educational and communication materials to reach and serve farmers effectively, ultimately supporting broader sustainability goals. Our research questions were:

1. How do demographic characteristics of U.S. wheat farmers influence soil health behavior?
2. To what extent do descriptive norms, injunctive norms, outcome expectations, and identity predict wheat farmers' behaviors regarding soil health practices?

Methods

Our study is part of a larger project; therefore, similar methods may appear elsewhere. The study employed a cross-sectional survey design, which Fraenkel et al. (2019) described as a survey that collects data at a single point in time from a predetermined population. In our study, this population was U.S. wheat farmers. Cross-sectional surveys are adaptable and can facilitate the collection of larger volumes of data from a broad population (Levin, 2006). The survey sought to collect data from U.S. wheat farmers about their adoption behaviors, perceived source credibility, scientific goodwill, and socio-demographic factors (Orem et al., 2024). The sample was U.S. wheat farmers from the top five wheat-producing states at the time of the study (i.e., Kansas, North Dakota, Montana, Texas, and Oklahoma; Agricultural Marketing Resource Center, 2022).

The socio-demographic characteristics of the sample are detailed in Table 1. The majority of participants identified as white (*f* = 104; 88.89%) males (*f* = 102; 87.18%) who were not first-generation farmers (*f* = 106; 90.60%). The majority of participants were between 55 and 74

years old (*f* = 74; 63.25%). Slightly less than half of the participants had a bachelor's degree or equivalent (*f* = 41, 35.04%), followed by farmers who had some college or no degree (*f* = 21, 17.95%). More than half of participants did not attend a land-grant university (*f* = 65; 57.02%). Additionally, the largest proportion of participants identified their political views as somewhat or very conservative (*f* = 81; 71.05%).

Table 1

Socio-Demographic Characteristics of the Farmers who Participated in the Study (N = 119)

Characteristic	*n*	*f*	%
Gender	117		
Male		102	87.18
Female		15	12.82
Age	117		
65 to 74 years		43	36.75
55 to 64 years		31	26.50
75 years or older		23	19.66
35 to 44 years		7	5.98
45 to 54 years		7	5.98
25 to 34 years		6	5.13
Ethnicity	117		
White		104	88.89
Other		13	11.11
Education	117		
Bachelor's or 4-year degree		41	35.04
Some college, no degree		21	17.95
Graduate or professional degree		19	16.24
Trade, technical, or vocational training		13	11.11
Associates or 2-year degree		11	9.40
High school diploma or GED		11	9.40
Some high school or less		1	0.85
Attend Land Grant	114		
No		65	57.02
Yes		49	42.98
Political Ideology	114		
Conservative		81	71.05
Moderate/neither liberal or conservative		23	20.18
Liberal		10	8.77
First-Generation Producer	117		
No		106	90.60
Yes		11	9.40

Participants in our study also shared details about their agricultural production operations (see Table 2). Most participants grew hard red winter wheat (*f* = 64, 55.17%) followed by hard red spring wheat (*f* = 23; 19.83%). The largest number of participants indicated they farmed 2,000 to 4,999 acres of wheat (*f* = 27; 22.88%), 1,000 to 1,999 acres (*f* = 26; 22.03%), or 500 to 999 acres (*f* = 21; 17.80%). Participants were evenly dispersed among five states: Montana (*f* = 32; 27.35%), Kansas (*f* = 29; 24.79%), Oklahoma (*f* = 20; 17.09%), Texas (*f* = 19; 16.24%), and North Dakota (*f* = 17; 14.53%).

Table 2

Characteristics of Participants' Farms (N = 119)

Characteristic	*n*	*f*	%
Wheat Class	116		
Hard red winter		64	55.17
Hard red spring		23	19.83
Hard winter and spring		13	11.21
Hard red winter, hard red spring, and Durum		4	3.45
Hard red spring and Durum		3	2.59
Hard red winter and soft red winter		2	1.72
Soft red winter		2	1.72
Durum		2	1.72
Hard red winter and hard white winter		1	0.86
Hard white winter		1	0.86
Hard white spring		1	0.86
Acres Farmed	118		
2,000 – 4,999 acres		27	22.88
1,000 – 1,999 acres		26	22.03
500 – 999 acres		21	17.80
260 – 499 acres		11	9.32
5,000 acres or more		9	7.63
140 – 179 acres		7	5.83
100 – 139 acres		6	5.08
220 – 259 acres		3	2.54
10 – 49 acres		3	2.54
180 – 219 acres		2	1.69
70 – 99 acres		2	1.69
50 – 69 acres		1	0.85
Location	117		
Montana		32	27.35
Kansas		29	24.79
Oklahoma		20	17.09
Texas		19	16.24
North Dakota		17	14.53

Participants completed a mail survey aimed at exploring soil health practices. We selected a mail survey because Coon et al. (2019) and Quinn (2010) suggested that, when targeting rural and agricultural audiences, mail surveys yield a higher response rates when compared to online surveys. We identified participants using the USDA Farm Service Agency payment list of wheat farmers and collected data using a modified version of Dillman et al.'s (2014) method. Data were collected in the summer of 2023, and the survey data were manually entered into Qualtrics. We received a total of 124 mail responses and, ultimately, obtained 119 usable responses after accounting for missing data.

Coberley's (2020) survey items were used to measure farmers' soil health practice behaviors, specifically cover cropping and no-till practices. Twelve items were assessed on a five-point Likert scale (i.e., 1 = *strongly disagree*; 2 = *disagree*; 3 = *neither agree nor disagree*; 4 = *agree*; 5 = *strongly agree*). The 12 items allowed us to measure soil health practice behavior (2 items); descriptive norms (2 items); injunctive norms (2 items); outcome expectations (3 items); and identity (3 items). See Table 3 for a summary of the items used to measure soil health practice behavior. We assessed instrument content validity through a panel of experts and scale reliability using Cronbach's alpha.

Table 3

Summary of Items to Measure Soil Health Practice Behavior Adapted from Coberley (2020)

Variable	Item
Soil Health Behavior (Dependent Variable)	1. The use of soil health practices on my farm is important to me. 2. I have increased the use of soil health practices on my farm over the past five years.
Descriptive Norms	3. Most farmers use soil health practices on their farm. 4. Most farmers have increased their use of soil health practices over the past few years.
Injunctive Norms	5. Most farmers would encourage me to adopt or increase my level of soil health practices on my farm. 6. Most farmers would encourage other farmers to adopt or increase their level of soil health practices on their farms.
Outcome Expectations	7. The benefits of using soil health practices on my farm outweigh the costs such as time or financial burdens. 8. Most farmers agree the benefits of using soil health practices on their farm outweighs the costs such as time or financial burdens. 9. The use of soil health practices increases productivity and income on my farm.
Identity	10. The need to protect and improve the soil on my farm has a strong influence on my decision to use soil health practices. 11. The need to protect my source of income and improve my financial situation has a strong influence on my decision to use soil health practices. 12. The need to produce higher yields and improve productivity of my farm has a strong influence on my decision to use soil health practices.

We used Stata and SPSS to conduct the statistical analysis. To answer research question one, we conducted a univariate analysis of variance (ANOVA) to examine the effects between the dependent variable (soil health behavior) and the independent variables (i.e., gender, age, ethnicity, and education). To address research question two, we conducted a correlation analysis followed by a simultaneous multiple linear regression, using soil health practice behavior as the outcome variable and descriptive norms, injunctive norms, outcome expectation, and identity as predictor variables. We conducted an assumption check to determine normality of residuals, homoscedasticity (constant variance of residuals), multicollinearity, and independence of observations. Our study is not without limitations, including a small sample size and a geographic bias toward five states, which limits its generalizability to those who completed the survey and those who are representative of the top five wheat-producing states. Therefore, our data are not representative of U.S. wheat farmers but are representative of only the sample of 119 farmers whom we surveyed. Another limitation of conducting a cross-sectional survey is self-reported data, which may not reflect participants' actual behaviors.

Findings

Research Question 1: How do Demographic Characteristics of U.S. Wheat Farmers Influence Soil Health Behavior?

To examine research question one, we conducted a univariate ANOVA to determine the effects of gender, age, ethnicity, and education on soil health behavior. The overall model was not significant $F(13,103) = 0.83$, $p = 0.63$, $R^2 = 0.95$. The results revealed that none of the individual factors were significant influencers on soil health behavior, indicating that soil health behavior did not significantly differ across *gender* $F(1,103) = 0.84$, $p = .36$; *age* $F(5,103) = 1.12$, $p = .36$; *ethnicity* $F(1,103) = 1.01$, $p = .32$; or *education* $F(6,103) = 0.23$, $p = .97$.

Table 4

Univariate ANOVA for Soil Health Behavior of U.S. Wheat Producers

Source	Type III SOS	*df*	Mean Square	F	*p*
Intercept	1177.92	1	1177.82	649.05	<0.01
Gender	1.52	1	1.52	0.84	0.36
Age	10.12	5	2.02	1.12	0.36
Ethnicity	1.83	1	1.83	1.01	0.32
Education	2.48	6	0.41	0.23	0.97
Error	186.93	103	1.82		
Total	8265.00	117			
Corrected Total	206.53	116			

Note. $F(13,103) = 0.83$, $p = 0.63$, $R^2 = 0.95$

Research Question 2: How do Descriptive Norms, Injunctive Norms, Outcome Expectations, and Identity Predict Farmers' Soil Health Practice Behaviors?

The dependent variable *soil health behavior* was positively and moderately associated with the predictor *descriptive norms* ($r = 0.24$, $p < 0.01$) and *outcome expectations* ($r = 0.26$, $p < 0.01$), indicating *soil health behavior* increases as *descriptive norms and outcome expectations* increase. There was also a strong positive association between *soil health behavior* and *identity* ($r = 0.56$, $p < 0.001$) (see Table 5). All predictors were moderately to strongly positively correlated, suggesting an increase in one was associated with an increase in the other.

Table 5

Descriptive Data and Interrelationships Among Variables (N = 119)

	M	*SD*	1	2	3	4	5
Behavior (1)	4.15	0.66	1.00				
Descriptive norms (2)	3.45	0.82	0.24**	1.00			
Injunctive norms (3)	3.25	0.72	0.16	0.60***	1.00		
Outcome expectations (4)	3.35	0.64	0.26**	0.25**	0.28**	1.00	
Identity (5)	4.03	0.58	0.56***	0.28**	0.27**	0.56***	1.00

Note. *** indicates $p < .001$; ** indicates $p < .01$; * indicates $p < .05$.

The model including *descriptive norms, injunctive norms, outcome expectations,* and *identity* explained 33.26% of the variance in *soil health behavior*. Accounting for the number of predictors, the adjusted percentage of variance explained is 30.92%. The F-test shows the model explained a statistically significant amount of variation in the outcome, $F(4, 114) = 14.20$, $p < 0.001$. The predicted *soil health behavior* is 1.53 when *descriptive norms, injunctive norms, outcome expectations,* and *identity* are all zero, which is statistically significantly different from zero ($t(119) = 3.94$, $p < 0.001$). Holding *descriptive norms*, *injunctive norms,* and *outcome expectation* constant, each additional unit increase in *identity* is associated with an increase of .67 in *soil health behavior*, which is statistically significantly different from zero ($t(119) = 6.28$, $p < 0.001$). One standard deviation increase in *identity* is associated with 0.59 standard deviation increase in *soil health behavior* on average, indicating a strong positive effect (see Table 6).

Table 6

Regression Model Results with Behavior as the Dependent Variable (N = 119)

Predictors	Soil Health Practice Behavior (α = .76)			
	B (S.E.)	*t*	*p*	*β*
Intercept	1.53(0.39)	3.94	<0.001	
Descriptive norms (α = .83)	0.11(0.08)	1.41	0.16	0.14
Injunctive norms (α = .80)	-0.05(0.09)	-0.57	0.57	-0.06
Outcome expectations (α = .64)	-0.09(0.10)	-0.91	0.36	-0.09
Identity (α = .67)	0.67(0.11)	6.28	<0.001	0.59

Conclusions, Discussion, and Recommendations

For research question one, we sought to describe the personal characteristics that influence wheat farmers' soil health behavior. Our results indicated no demographic differences in education, age, ethnicity, and gender in soil health behavior. According to our demographic analysis, farmers who participated in this study were predominantly older, white males with college educations who owned large farms and held conservative political views. Our descriptive analysis indicates trends associated with generational farming, land-grant influence, crop specialization, and age distribution. These factors may subsequently affect the norms,

expectations, and identities of farmers as discussed by Rimal and Real (2003). The overwhelming majority of participants were not first-generation farmers, indicating a tradition of multi-generational farming and a legacy of livelihood. Some participants may have an advantage due to their knowledge from land-grant universities, which provide exposure to research and extension programs, possibly influencing their attitudes toward soil health practices. Hard red winter wheat was the primary crop of farmers from Montana, Kansas, North Dakota, Oklahoma, and Texas who participated in this study, which could further shape farmers' soil health practices due to the specific planting and soil management needs.

Among wheat farmers in our sample, demographic characteristics, including gender, age, ethnicity, and education, were not significantly associated with soil health behavior. However, previous studies have investigated demographic factors associated with the adoption of conservation practices and found that education, household size, income, age, gender, and experience have varying impacts on farmers' behavior (Burton, 2014; Cheruiyot, 2020). Farmers who are younger and/or female as well as farmers who have more experience and knowledge about conservation practices are more likely to adopt conservation practices than their counterparts (Burton, 2014). Therefore, tailored outreach along with more community-based activities where resistant farmers can gain experience and learn about successful conservation practices, like no-till and cover crops, are essential in reaching targeted populations.

In response to research question two, we aimed to investigate how descriptive norms, outcome expectations, injunctive norms, and identity impact behavior toward soil health practices. We discovered identity is the sole significant predictor of soil health practice behavior, which is consistent with previous literature (Chekima et al., 2016; Comito et al., 2013; Floress et al., 2017). Oyserman et al. (2012) discussed that, when a choice becomes connected to a person's identity, it becomes natural or automatic. For example, individuals who identify as a soil health-conscious wheat farmer will make decisions to maintain the soil, and it will not be a difficult decision because they believe in conservation efforts. Typically, farmers have a primary identity focused on productivity, like maximizing yields and profitability (Coberley, 2020). As the need for more conservation efforts increases, farmers' identities need to shift from productivity to conservation-focused.

Although the correlation table shows norms and expectations are correlated with behavior, identity is crucial in motivating wheat farmers to adopt soil health practices. As a result, farmers' intentions to adopt these practices are strongly influenced by their self-identification as soil health practitioners, which is consistent with Rimal and Real's theory of normative social behavior (2003). Given identity emerged as the sole significant predictor, initiatives aimed at promoting soil health practices should incorporate elements of personal and community identity to enhance adoption, as Carlisle (2016) recommended. Additionally, as Rezaei-Moghaddam et al. (2020) noted, social norms play a vital role in promoting the adoption of environmentally friendly practices. Thus, outreach initiatives should go beyond individual messaging to foster a sense of collective identity among farmers and should be rooted in shared values centered around environmental stewardship, by encouraging community engagement and relationship-building (Burke & Running, 2019). Furthermore, although farmers

are adopting soil health practices (Burke & Running, 2019), they face social pressures regarding implementation. This signifies the need for developing educational resources and programs to alleviate pressures and improve farmers' awareness of the benefits associated with implementing soil health practices. Practitioners should use farmers to disseminate information about soil health practices, given peer influence and impact (Rezaei-Moghaddam et al., 2020).

We encourage professionals in agricultural leadership, education, and communications to investigate how norms, outcome expectations, and identity influence different groups of farmers and ranchers, such as those cultivating cotton, raising cattle, or producing corn, to identify any distinctions. Additionally, future research should examine the potential of removing identity as a predictor and evaluating the variance explained by norms and expectations.

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