Rethinking the Significance of Scientific Information: A Field Experiment with Agricultural Producers

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Abstract

To study how farmers respond to scientific information and marketing appeal about beneficial management practices (BMPs), we run an experimental auction at the 2023 Canada's Outdoor Farm Show. We measure farmers' preferences for the examined BMPs using a modified Becker-DeGroot-Marschak (BDM) mechanism. In this way, we ensure incentive compatibility while eliminating competition among participants in a field experiment. Two types of messages were randomly assigned to subjects via a between-subjects design to examine how the type of information impacts farmers' bids. We find there is no significant treatment effect of either of the information.

Keywords: experimental auctions; beneficial management practices; pre-registered field experiments, scientific information; and marketing appeal

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1. Introduction

Public distrust of scientific information permeates every sector of society, impacting government policy effectiveness and hindering the dissemination of innovative technologies (Iyengar and Massey 2019). Within agricultural production, there exists a notable reluctance to adopt production technologies that have ample economic and environmental benefits. Our study employs individual-level experimental auction data to investigate the hypothesis that producers exhibit higher willingness to pay for fertilizer management practices when they are presented with scientific information. Understanding producers' response to information formats and sources is crucial in identifying channels for promoting a variety of beneficial management practices (BMPs).

This paper investigates the influence of information on technology adoption, particularly comparing how farmers respond to scientific information and marketing appeal related to the adoption of beneficial management practices. With a pre-registered field experiment, we engage agricultural producers who are actual stakeholders in the agri-food industry and expand upon current literature suggesting that scientists as messengers negatively impact willingness to pay for new BMPs (Pourtaherian and Li, 2023). This paper particularly focuses on the format of information nudges and its influence on farmers' bids in experimental auctions.

Using a between-subjects design, we randomized participants into two groups where the members of each group receive pro-environmental information nudges with similar content but in different formats. In the *marketing appeal* treatment, participants were exposed to a straightforward and engaging marketing message before they placed their bids, while participants in the *scientific information* treatment group received scientific information that cites papers by Qiao et al. (2022) and De Laporte et al. (2021). Each of the treatments had over 400 respondents.

A key contribution of this study is its examination of the hypothesis whether the type of messages, rather than messengers themselves, plays a pivotal role in influencing farmer's decisions.

In the context of enhancing fertilizer management practices to reduce emissions and promote soil health, this study focuses on farmers' preferences for the examined best management practices, specifically nitrogen stabilizers and fertilizer metering systems. Across a span of three days, approximately 800 farmers submitted their cost-share bids on a scale ranging from 0% to 100% indicating their willingness to pay to adopt beneficial management practices for fertilizers. The practices encompass various types of fertilizer meting systems and nitrogen stabilizers, with two products presented in randomized order. Following bid submissions, farmers completed a post-experiment questionnaire, covering standard demographic and farm-specific questions. Each farmer received $20 CAD for participation upon the completion of the survey. One in every hundred farmers had a bid randomly selected for evaluation. We ensure incentive compatibility and eliminate competition among our participants in our modified Becker-DeGroot-Marschak (BDM) mechanism design (Becker, DeGroot, and Marschak 1964). If a farmer's bid exceeds "experimental cost-share payment rate" determined by a computer, they could purchase the product at the discounted price, equivalent to the "experimental cost-share payment rate" and the remaining cost are subsidized.

We test two hypotheses that (1) the information treatments (i.e., scientific information versus market appeals) significantly impact farmers' cost-share bids for fertilizer BMP products and that (2) Farmers' individual characteristics influence their cost-share bids for fertilizer beneficial management practice products as well as their responses to different information. Then, we estimate the impact of the scientific information and marketing appeal on farmers' bids for the

tested products. This randomized field experiment was pre-registered with a pre-analysis plan on the Open Science Framework (OSF).

Preliminary results from our incentivized experiment with two between-sample treatments reveal limited evidence that scientific information plays a bigger role in influencing producers' bids for new technologies, when compared to the impact of marketing messages. That is, none of treatments statistically significantly impacts bids. Illustratively, bids in both information treatments exhibit a comparable level, averaging 32% (37%) with the standard deviation of 26% (32%) for the first product (the second product). Regression results show that, on average, older farmers submit lower bids than young individuals, while male farmers tend to exhibit higher bids than others. There is no discernable impact of farming experiences on bidding behavior.

Our analysis provides evidence on the impact of two types of messages suggesting that exposure to scientific information does not inherently diminish or enhance individuals' preferences for new technology. This finding highlights a possible limitation in the influence of messages on technology adoption. Our research contributes to existing studies on the role of information and messengers, emphasizing that the messengers' identity holds greater importance than the framing of the messages themselves. This experimental investigation adds valuable insights to the development of reliable outreach strategies in the realm of sustainable agriculture, fertilizer use, and emission reduction within the agricultural sector.

The remainder of this paper follows this structure: Section 2 reviews extensive literature on information nudges and beneficial management and conservation practices. Section 3 describes the experimental setup. Section 4 describes the treatment design and hypotheses. Section 5 presents descriptive statistics, as well as our empirical results. Section 6 concludes.

2. Literature Review

Thaler and Sunstein (2008)'s seminal work has sparked a rapidly expanding and diversifying body of literature on information framing, garnering scholarly attention across various policy areas, including in the fields of agricultural conservation practices and technology adoption (Byerly et al. 2021; Downs 2014; Fischer et al. 2020; Wallander et al. 2023). Despite the concept of information nudges interpreted differently across contexts (Clark, Maki, and Morrill 2014; Mariotti et al. 2023; Ouvrard and Stenger 2019; Page et al. 2022), these strategies are widely implemented across various research domains, including retirement savings (Blaufus and Milde 2021), conservation program enrollment (Davidson and Goodrich 2021), water runoff management (Li et al. 2021), and dietary choices (Morren et al. 2021). While some define information nudges as default choices, others consider timely information updates as information nudges.

The efficacy of information framing, however, appears to be format-dependent. For instance, Yang and Hobbs (2020) examine the impact of information framing on the effectiveness of science communication and they find that narratives about biotechnology diminish negative perceptions and enhance public acceptance of new technology. Similarly, Byerly et al. (2021) argue that stories are more effective than scientific information, concluding that "scientific evidence fails to motivate people to act". Wallander et al. (2023) observe improvements in conservation practice quality following the implementation of real-time information updates during conservation auctions with U.S. farmers. It remains an unresolved issue which type of behavioral nudges are most effective at promoting pro-environmental behaviors across various contexts and countries (Palm-Forster et al. 2019; Grilli and Curtis 2021). Our study centers on

information nudges delivered in diverse formats. These approaches, whether employing scientific terminology or marketing appeals, have been relatively underexplored.

Norm-based messages, often integrating injunctive and descriptive normative messages, have been major strands of recent literature, aiming to induce behavioral changes (Hrozencik et al. 2023; Earnhart and Ferraro 2020). Notable works by Wallander, Ferraro, and Higgins (2017) suggest that information nudges are a cost-effective means to reduce conservation program costs and mitigate pollution via peer comparisons. Further, studies by Hrozencik et al. (2023) and Bernedo, Ferraro, and Price (2014) emphasize the long-term persistence and spillover effects of social comparison treatments. Bicchieri and Dimant (2019) discuss the potential risks and benefits associated with norm-based messages.

Notably, in our experiment, we introduce two non-social comparison information types, addressing a messenger versus message conundrum. Our study aligns closely with the findings of Whiting et al. (2019) and Pourtaherian and Li (2023). Findings from Pourtaherian and Li (2023) suggest that scientists, when acting as messengers, were less effective compared to other sources such as non-profit organizations, policy makers, fellow farmers, and private companies, even when delivering identical information. This raises questions about the underlying factors contributing to such a pronounced difference in effectiveness. Furthermore, our analysis extends beyond the source of information to examine the structural characteristics of message content within an experimental auction framework.

This research contributes to two significant areas of literature: information nudges and technology adoption within agricultural economics. In response to recent calls for pre-registered field experiments and experimental evidence within agricultural behavioral economics (Leibbrandt et al. 2017; Palm-Forster et al. 2019; Wuepper et al. 2023), this study advances our

understanding of information nudges by investigating the effectiveness of scientific information versus marketing messages in enhancing the willingness of individuals to adopt or invest in agricultural technologies.

This study stands out as it focuses on producers who are non-consumer decision-makers, who are infrequently the subject of peer-reviewed experimental research, which typically concentrates on consumer behaviors. In contrast to the scant experimental evidence concerning agricultural producers, there is a wealth of literature on how information influences consumer choices. As discussed by Li, McCluskey, and Messer (2018), the mechanisms of information diffusion include eco-labeling and media information. However, an overload of information can adversely impact consumer willingness to pay for new technologies, with excessive details about available options sometimes providing detrimental consequences such as a decrease in the motivation to choose in some cases, as indicated by meta-analysis research from Scheibehenne, Greifeneder, and Todd (2010). Nonetheless, the effect of information on technology adoption dynamics among producers remains a largely unexplored and under-researched area.

Our study contributes to the inchoate literature using field experimental designs and agricultural producers as research participants to estimate the effects of message interventions on conservation practices adoption. In our study, we utilize an incentived Becker-DeGroot-Marschak (BDM) auction design to gauge their response to information nudges. The use of experimental auctions provides a well-established method for exploring issues related to the adoption of conservation practices or technologies (Bulte et al. 2014; Ferraro et al. 2022). Although this experimental design is applicable to various contexts of technological adoption, this particular application focuses on fertilizer management practices.

3. Experimental Setup

To investigate the relationship between information treatments and farmers' cost-share bids for beneficial management practices, we conducted a lab-in-the-field experiment using a Becker-DeGroot-Marschak (BDM) auction at Canada's Outdoor Farm Show in Woodstock, Ontario, from September 12-14, 2023, with 828 agricultural producers.

3.1. Development, review, approval, and preregistration

The study was initiated as a collaboration between researchers at the University of Guelph and the Ecological Farmers Association of Ontario (EFAO). The initial phases of development involved the selection of pertinent venue for a lab-in-the-field experiment and the identification of beneficial management practices. Subsequently, we developed the experimental protocol and design, and preliminary piloting was conducted to refine its methodology.

Our research design has been reviewed by the Research Ethics Board (REB) at the University of Guelph. The REB approved our protocol in May 2023 (REB 22-02-009). Following the approval of the research ethics board review, we preregistered our experimental design and analysis plan in August 2023. Recent literature advocates for the practice of preregistering study designs as a pivotal mechanism for upholding research quality and enhancing replicability (Abrams, Libgober, and List 2020; Ferraro and Shukla 2020; Nosek et al. 2018).

This experiment was conducted using a Python-programmed interface, implemented on iPads. This setup enabled participants to interact with web-based interfaces and participate in the cost-share auction directly on-site during our field experiment. The auction venue showcased auction items, including a fertilizer metering system in front of an experiment booth and nitrogen stabilizers on a table equipped with tablet computers preloaded with experimental content.

3.2. Population and recruitment

Each participant bid on a fertilizer metering system and a nitrogen stabilizer, which are two types of popular products used for the 4R (Right Source, Right Rate, Right Time, Right Place) fertilizer management. The Canada's Outdoor Farm Show is the largest outdoor farm show in Eastern Canada that attracts numerous agricultural producers and relevant stakeholders across the country. In the year 2023, 36,516 visitors attended the show to experience the latest technology shaping the future of farming. Recruiting from this event allowed us to collect data from a representative population of Ontario farmers.

Table 1: Experimental procedure

Step	Description
1. Set up the experiment	Introduction to study and participant consent
2. Beginning of the experiment	Experiment procedure instruction
3. Participant training	Test of participant understanding of procedure
4. Information treatment	Information treatment before auctioning
5. BDM auction	Producer evaluation of BMP products
6. Post-experiment survey questionnaire	Questions regarding socioeconomic characteristics
7. Transaction under BDM rule	Random draw of one of two products and bid evaluation
8. Conclusion of the experiment	Information about the result of the experiment

Participants were recruited by approaching individuals at the farm show and inviting them to take part in a research study on economic decision making. Alternatively, individuals could also approach visible members of the research team at each location to express interest. Prior to commencing the experiment, participants were provided with a link to a written consent form to review. Following instructions, which included detailed examples of the auction process, participants underwent comprehension checks consisting of multiple-choice questions aimed at familiarizing them with the BDM mechanism (See Table 1). This practice enhances participants' comprehension and understanding of the auction mechanism being utilized (Briz, Drichoutis, and

Nayga 2017). Each participating farmer who completed the experiment received $20 CAD as compensation for their participation in the experiment.

3.3. Choice environment and auction mechanism

Farmers placed their cost-share bids on a scale ranging from 0% to 100% regarding beneficial management practices, which included nitrogen stabilizers and fertilizer metering systems tailored to individual farm needs. Both types of products were presented in randomized order to all participants. Following bid submission, farmers completed a post-experiment questionnaire containing standard demographic and farm-specific questions.

In our BDM auction, one in every hundred farmers was randomly selected by computer for evaluation of one of their bids. An "experimental cost-share payment rate" was determined randomly by a computer program. If their bid exceeded the "experimental cost-share payment rate", they were given a chance to purchase the product at the discounted price corresponding to the "experimental cost-share payment rate," with the project subsidizing the remaining cost.

4. Treatment Design and Hypotheses

4.1 Treatments

This study randomly allocates two treatment options to participants. Participants were also randomly assigned to a "scientific information" treatment or a "marketing appeal" treatment. Employing two information treatments (specifically, emphasizing the scientific aspects of fertilizer management practices as opposed to emphasizing their market appeal) in a between-subjects design allows us to examine the influence of these treatments on the bidding behavior of farmers.

Treatment 1 (Scientific Information)

Followed by a basic product description, participants receive supplementary scientific information before placing their bids. This information highlights the significant benefits of optimizing agronomic nitrogen use, including the reduction of nitrous oxide emissions, ammonia volatilization, and nitrate leaching, alongside increased profits. Furthermore, it underscores the implications of these findings for supporting sustainable production practices and enhancing soil health, as evidenced by recent studies.

The exact wording of the scientific information treatment is as follows:

Agronomic fertilizer management practices are important for sustainable production, which promotes various aspects of soil health.[1] On average, optimized agronomic nitrogen use decreases nitrous oxide (N_2O) emissions, ammonia (NH_3) volatilization, and nitrate (NO_3^-) leaching by 29.4%, 90.3%, and 72.3%, respectively, and increases profit by 39.5%.[2]

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1. Qiao, Lei, *et al.* "Soil quality both increases crop production and improves resilience to climate change." *Nature Climate Change*, 12.6 (2022): 574–580.
2. De Laporte, Aaron, *et al.* "Economic and environmental consequences of nitrogen application rates, timing and methods on corn in Ontario." *Agricultural Systems*, 188 (2021): 103018.

Treatment 2 (Marketing Appeal)

Following the initial product overview, participants allocated to this treatment will receive a marketing appeal message before bidding. This message will convey how fertilizer management products can enhance profitability, efficiency, and sustainability in agricultural pursuits, akin to strategies employed by marketing companies.

The exact wording of the marketing appeal treatment is as follows:

Healthy soil, healthy profit through fertilizer management

Unlock your soil's potential by adopting sustainable fertilizer management practices. You work hard for your success, make sure your soil is working for you. Healthy soil is one of the greatest assets you'll pass on to the next generation. Fertilizer management products are profitable, efficient, and sustainable.

4.2. Hypotheses and analysis

As specified in the pre-analysis plan, we conducted a field experiment to answer research questions about whether providing scientific information to agricultural producers can affect their willingness to adopt. With the common null hypothesis being a treatment that does not have a statistically significant effect on any measured outcome, two testable alternative hypotheses are listed below.

- H1: Information treatments (i.e., scientific information versus market appeals) significantly impact farmers' cost-share bids for fertilizer BMP products.
- H2: Farmers' individual characteristics influence their cost-share bids for fertilizer beneficial management practice products as well as their responses to different information.

For our analysis, we employ linear models with Ordinary Least Squares (OLS) estimators and include control variables to assess the impact of scientific information and marketing appeals on farmers' bidding behavior for the tested products. Additionally, we utilize hurdle and Tobit models, to accurately estimate the effects on the upper and lower bounds of the bid distribution.

Our main model is

$$Y_{ij} = \beta_0 + \beta_1 X_{ij} + \beta_2 Z_i + u_i + \varepsilon_{ij},$$

where Y_{ij} is the cost-share bid by participant *i* for the type of product *j*, X_{ij} is a vector of treatment dummy variables representing the scientific information and market appeal; and Z_i is a vector of demographic controls, u_i is a between-entity error term and ε_{ij} is a within-entity error term.

5. Results and discussion

5.1. Demographic balance between treatment groups

Table 2 and 3 report a summary of the demographic characteristics of the 828 individuals represented in the sample. Only 20% of participants were female. The average age of the participants was 42 years old; the oldest was 89 and the youngest was 18. In terms of political affiliation, 52% of respondents identified themselves as conservatives. 26.7% of participants completed some college degree and 9 people was from indigenous group (First Nations in Canada). For treatment assignment, we have two treatments equally balanced. We accomplish this by assigning treatment at the beginning of the experiment.

Table 2. Summary of Treatment Balance on Demographic Variables

		Information Treatments	
Categories		Scientific information	Marketing Appeal
Gender (N=860)	Man	77.8%	78.6%
	Woman	19.6%	18.8%
	Other	2.6%	2.6%
Age (N=844)	Mean	42	43
	Minimum	18	18
	Maximum	83	89
Political Affiliation (N=844)	Conservative	52.7%	50.7%
	Liberal	5.64%	5.45%
	Neutral	13.7%	16.3%
	Other (including no answer)	27.9%	27.5%
Education (N=860)	Apprentice-ship training trades	10.6%	7.44%
	Completed college/ university	32.4%	35.3%
	Completed graduate education	3.37%	3.95%
	High school graduate	24.0%	22.3%
	Professional degrees	2.64%	2.33%
	Some college	17.6%	16.7%
	Some graduate education	0.48%	1.86%
	Some high school	8.89%	10.0%

Note: The total number of experiment participants was 879, however, survey questions were not mandatory, therefore there are missing values in some questionnaires, and the number of observations is slightly lower for the above categories.

Table 3. Summary of Treatment Balance on Demographic Variables

Variables	Scientific (T1)	Marketing (T2)	Total Sample
Mean Age (Years)	41.7	43.1	42.4
Female (%)	20.1	19.3	19.2
Political Conservatives (%)	52.7	50.7	51.7
College education (%)	25.4	28.0	26.7
Indigenous	4	5	9
N	408	422	828

5.2. Bid characteristics

Figure 1 illustrates the impact of different types of information (scientific vs. marketing) on farmers' willingness to financially support two agricultural technologies. For both types of information, the bids ranged from 0% (no willingness to pay) to 100% (full willingness to pay the cost). Product 1 is nitrogen stabilizer and product 2 is the fertilizer metering system. To mitigate ordering effects, the sequence in which these products were presented was randomized among participants. The similar means and ranges indicate that the type of information does not significantly alter overall bids, though it may slightly affect individual decision variability, as indicated by the means and standard deviations.

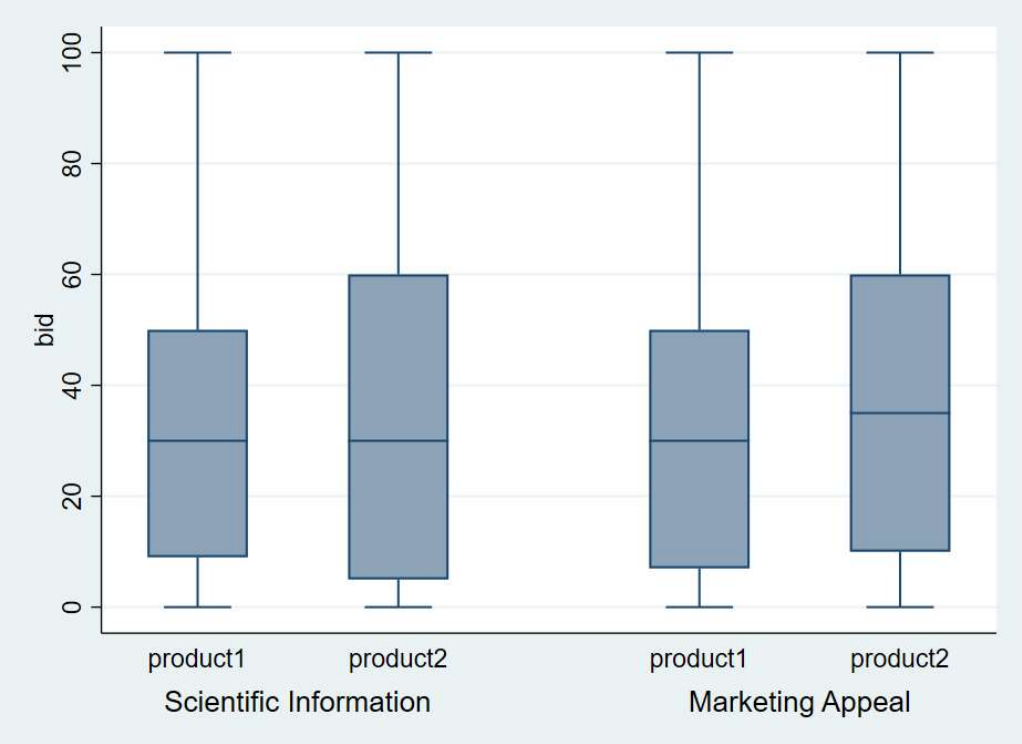
The box-whisker plot compares the farmers' average bids and ranges under each treatment by product type. For the scientific information treatment group, product 1 was evaluated by 439 participants and product 2 was evaluated by 441 participants. For the marketing information treatment group, both products were evaluated by 439 participants.

For product 1, on average, participants in the scientific treatment were willing to bid 33.3% of the cost, while those in the marketing treatment were willing to bid slightly less, at 32.9%. For scientific information, the standard deviation is 26.8, and for marketing information, it is 27.0, indicating similar variability in bid percentages for both types of information.

For product 2, participants exposed to scientific information bid an average of 37.3%, compared to 37.9% for those exposed to marketing information, suggesting slightly higher willingness to pay when marketing information is used. The standard deviation is 32.1 for scientific information and 30.4 for marketing information, again showing similar variability in bid percentages.

Based on these descriptive statistics alone, it appears that both types of information—scientific and marketing—similarly influence participants' bidding behavior. It is noteworthy that these average bids closely align with actual cost share bids observed in conservation auctions in the U.S. and Canada. In the following section, we conduct further analysis to determine if there are statistically significant differences between the responses to scientific and marketing information.

Figure 1. Mean Bids by Information Treatment Types



5.3. Regression and marginal effects

Table 4 presents regression results across three models (M1, M2, M3) using different methodologies: two Ordinary Least Squares (OLS) models and a censored regression model for handling specific data characteristics, namely a Tobit model. In our experimental design, which lacks a control group and features two treatments randomized between subjects, treatments 1 and 2 are collinear. Consequently, the row for the Scientific Information treatment is empty across all models. In the Market Appeal treatment, it shows a coefficient of 0.06 in M1 but does not appear significant in any models, as the standard errors and p-values suggest no strong impact on the dependent variable.

In the estimation results, including control variables, the variable *Farming Experience* shows positive coefficients in M2 and M3 (0.04 in each), but none are statistically significant, given their standard errors. The coefficient for *Age* is negative in M2 and M3 (e.g., -0.13 for the OLS model, with a significance level of $p<0.1$), indicating that older farmers tend to bid lower, albeit with a small level of statistical significance. The estimate for the variable *Education* shows a strong positive impact on the dependent variable in M2 and M3 (3.42 and 4.26 in each), with $p<0.05$, suggesting that higher education levels are associated with higher bids. The coefficient for the variable *Women* indicates a significant negative impact in all models where it appears (e.g., -6.41 in M2 and -8.34 in M3 with $p<0.01$), suggesting that female participants tend to bid lower than males. Lastly, the political variable *Liberal* shows a positive coefficient in M2 and M3 (6.45 and 8.89 in both with $p<0.1$), indicating that self-identified liberal participants tend to bid higher, though this effect is not consistently significant across models. The constant term is significantly positive across all models, indicating the baseline level of the dependent variable when all other

variables are zero. The number of observations varies across models, which may reflect different sample sizes used due to the requirements of each model or the availability of data.

Table 4. Regression Results – Pooled

	M1	M2	M3
VARIABLES	OLS	OLS	Tobit
Scientific information			
Market appeal	0.06	-0.16	0.02
	(0.96)	(1.47)	(1.83)
Farming Experience		0.04	0.04
		(0.08)	(0.10)
Age		-0.13*	-0.16
		(0.08)	(0.09)
Education		3.42**	4.26**
		(1.52)	(1.89)
Women (=1 if women, 0 otherwise)		-6.41***	-8.34***
		(1.89)	(2.337)
Liberal (=1 if liberal, 0 otherwise)		6.45*	8.89*
		(3.32)	(4.09)
Constant	35.3***	38.8***	36.7***
	(0.00)	(2.24)	(2.79)
Observations	1,758	1,590	1,590
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1			

These results suggest nuanced impacts of demographic and attitudinal factors on bidding behaviors in this agricultural context, with education and age showing consistent effects across different modeling approaches. Due to unreliability of some of the farm characteristics variables, these variables such as “Organic” or “Commercial Farm” are omitted from the regression analysis. Additionally, data such as “Operational land”, “Percentage Rented”, “Historical Cover Crop Use” were not collected in the year 2023.

Table 5 presents the regression results from two Tobit models that analyze the effect of treatment and various demographic factors on bids for two different products, labeled as Product 1 and Product 2. The Tobit model is used because of the censored nature of the dependent variable, *bids*, which include 21% zero bids in our dataset. A product-specific breakdown of the regression reveals a more nuanced impact of demographic variables on the bidding process for each product. The number of observations for each model is close, with 794 for Product 1 and 796 for Product 2, providing a robust sample size.

Table 5. Regression Results – By product

VARIABLES	Tobit (Product 1)	Tobit (Product 2)
Scientific information		
Market appeal	0.05	0.02
	(2.37)	(2.75)
Farming Experience	0.15	-0.07
	(0.13)	(0.16)
Age	-0.22*	-0.10
	(0.12)	(0.14)
Education	5.12**	3.28
	(2.45)	(2.85)
Women (=1 if women, 0 otherwise)	-4.57	-12.2***
	(3.08)	(3.57)
Liberal (=1 if liberal, 0 otherwise)	9.83*	7.83
	(5.30)	(6.18)
Constant	33.2***	40.3***
	(3.63)	(4.19)
Observations	794	796
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1		

For Product 1, the coefficient of market appeal is 0.05 with a standard error of 2.37, suggesting a positive significant impact on bids. For Product 2, the coefficient is 0.02 with standard error of 2.75, also indicating a positive impact, though smaller in magnitude. The *farming experience* does not appear to be statistically significant as the t-values are large. The coefficient is 0.15 for product 1 and -0.07 for product 2, suggesting a negative impact on bids, though this too lacks statistical significance. For Product 1, the *age* coefficient of -0.22 ($p<0.05$) suggests that older farmers bid significantly less. For Product 2, the *age* coefficient of -0.10 ($p<0.05$) again suggests that older farmers bid less, with a smaller effect size. In case of education, there's a significant positive coefficient of 5.12 ($p<0.05$) for product 1, indicating that higher education levels correspond with higher bids. For Product 2, the coefficient is 3.28, positive but not statistically significant within the model. The coefficient of the variable *women* is -4.57, indicating that female participants tend to bid lower for product 1, but it's not statistically significant. For Product 2, the coefficient is -12.2 ($p<0.01$), showing a significant and much larger negative impact from female participants. Lastly, the coefficient of the political orientation variable *liberal* for product 1 is 9.83 ($p<0.1$), suggesting a significant positive impact on bids from liberal participants. For Product 2, the coefficient is 7.83, indicating a positive effect, though not statistically significant.

4.4 Implications

The treatments did not significantly increase farmers' bids for BMPs. A key insight from our study is that the adoption of BMPs is not solely constrained by the availability of scientific information or marketing appeals. While information is essential, it alone is not enough to ensure adoption.

The analysis shows variability in how demographic and attitudinal factors impact bidding behavior across different products. Education consistently shows a positive effect on bids for both products. Age negatively impacts bids across both models, more so for Product 1. The impact of

gender is particularly notable for Product 2, where women tend to bid significantly less than men. Political orientation (liberal) also influences bidding behavior, particularly for Product 1, where it increases bids. This detailed breakdown helps identify which factors are most influential for different types of products in this specific agricultural context.

5. Conclusion

The agricultural industry stands out as the primary contributor to water pollution. In response, government initiatives have aimed to curtail nutrient runoffs by embracing cutting-edge, scientific innovations like nitrogen stabilizers, cover crops, and precision agriculture technology. However, despite these endeavors, widespread adoption of beneficial management practices remains elusive. One possible factor is farmers' reluctance to embrace new technology, perhaps due to skepticism towards the outcome of new technologies. With a pre-registered field experiment, we investigate how message framing influence farmers' decision making. We observe the revealed preference of agricultural producers through direct elicitation of their bids following information treatment.

While information framing is commonly employed across various sectors like biotechnology, medicine, and energy to encourage greater uptake of new technology, there is a scarcity of real-world evidence regarding its effectiveness of scientific information in agricultural technology adoption in a developed economy. In this study, we scrutinize the impact of message framing on technology adoption among agricultural producers, who bear responsibility for their farms' input decisions. As a result, we find farmers were unresponsive to either of two main interventions: scientific information and marketing appeal.

This study contributes to existing literature by investigating whether public unresponsiveness towards scientific knowledge stems primarily from limited access to knowledge itself or from other factors like message framing, communication channels, or messenger credibility. Furthermore, we explore how demographic variables may influence bidding behavior in response to information nudges.

Our research indicates that detailed scientific information are not as valuable nor effective tools as other information nudges for encouraging the adoption of conservation practices. Our findings align with the conclusions drawn in Reddy et al. (2020), which suggest that offering individuals more detailed information does not lead to a notable increase in the adoption of conservation practices.

While we refrain from making broad generalizations based on our findings, particularly concerning the sustainability of behavioral outcomes, our interventions could potentially be refined or motivated further by emphasizing alternative behavioral strategies like social norms and peer effects. Due to the study's scope and timeframe, we did not explore these avenues, leaving them open for future investigation.

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