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Research Paper

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Abstract

Women own or co-own almost half of the land in the US Midwest and women landowners are playing an increasingly important role in production and financial decision-making. Despite their growing influence, women landowners are less engaged in conservation programs and networks, primarily due to inadequate access to conservation services and resources, leading to a scenario where men continue to dominate participation in both governmental and private conservation initiatives. The existing body of literature further echoes this disparity, with women’s perspectives and voices markedly underrepresented in the United States’ conservation discourse. Aiming to bridge this gap, this article delves into the attitudes of women landowners toward conservation using a 2021 survey conducted with 135 Iowa women landowners. The survey sought to shed light on their interests in various conservation topics, their concerns regarding conservation decision-making, and their preferences concerning the sources of information and the methods through which educational content is delivered. We find that women landowners are most interested in government conservation programs, followed by soil erosion control, soil fertilizer improvement, and cover crops. We provide statistical evidence that more women operating landowners are interested in conservation topics and concerned about conservation issues than women non-operating landowners in general. We further explore the variations in conservation interests among women landowners, considering their demographic and farm-specific characteristics, to highlight the diverse perspectives within this group. Additionally, we examine the preferred channels through which women landowners wish to receive educational information, offering valuable insights for policymaking and extension services. The results underscore a preference for a mix of delivery methods among women landowners, with a particular inclination toward virtual platforms, such as periodic (e-)newsletters and webinars, and printed materials such as fact sheets or infographics, over traditional in-person formats. This nuanced understanding of women landowners’ educational preferences and conservation interests serves as a foundational step toward fostering more inclusive conservation programs and networks that effectively engage and represent women in the agricultural sector.

Introduction

Recent studies highlight a pronounced inclination among female landowners, compared to their male counterparts, toward conservation and collaborative efforts (Druschke and Secchi, 2014), such as adopting cover crops (Wang et al., 2019). Research indicates women landowners favor sustainable agriculture due to health, safety, environmental concerns, and community well-being which often clash with the yield-focused aims of mainstream agricultural policies, leading to their underrepresentation in conservation efforts and decision-making (Eells, 2008; Wells and Eells, 2011; Sachs et al., 2016; Carter, 2019; James et al., 2021). Additionally, critiques of the US Department of Agriculture (USDA) and other conservation entities for perpetuating gender and racial stereotypes call for more inclusive representation (Fairchild and Petrzelka, 2020). While there are programs aimed at supporting female farmers, their existence highlights persistent inequalities in the sector (Schmidt, Goetz and Tian, 2021; Ball 2019).

The lack of education channels to women can be explained by a downplay of women’s identities as farmers. Traditionally, women were identified as ‘farm wives’, leading to a disadvantage in farming networks and a tendency to be treated as incompetent (Sachs et al., 2016; Wright and Annes, 2019). Despite an increase in women owning farmland and identifying as farmers, challenges persist. Women’s access to farmland often hinges on male relatives; and, due to cultural norms limiting their autonomy (Eells, 2008; Petrzelka and Marquart-Pyatt, 2011; Pilgeram and Amos, 2014), they encounter significant barriers,

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especially in conservation decisions, when inheriting or sharing land, or leasing to family. Carter (2016) underscores that even with access to conservation program information or education, women may not be able to act on it due to prevailing patriarchal attitudes from their tenants, family, advisors, service providers, and others. The disconnect between conservation agencies and women landowners, rooted in a patriarchal framework, leads to women's lower engagement and understanding of conservation practices and programs (Eells and Soulis, 2013; Druschke and Secchi, 2014; Carter and Christoffel, 2023).

Beyond conservation organizations and policy discussions, women landowners also experience underrepresentation in academic research (Jones and Solomon, 2019). Schmidt, Goetz and Tian (2021) reveal that literature on US agriculture featuring the keywords 'women, female, gender' is notably scarce, especially when comparing the focus on women farmers and their roles in the United States to that in developing countries. In the 2019 Iowa Farm Transfer survey, women landowners comprised a mere 5.6% of respondents and were severely underrepresented in the farmland succession issues (Liu, Maule and Zhang, 2023). The lack of gender-focused research hinders the attainment of equitable representation, further marginalizing women in the agricultural sector.

Addressing the underrepresentation and nuanced needs of women landowners in conservation research and policy is essential. Our study seeks to deepen understanding of women landowners' attitudes toward conservation and aims to inform more inclusive policy and educational efforts. We ask two primary research questions. The first question, 'What interests and concerns about conservation topics do women operating landowners (WOLs) and women non-operating landowners (WNOLs) have?' investigates how decision-making power impacts conservation attitudes and contrasts women who directly manage their land with those who lease it out. WNOLs typically show less interest in farmland leasing, conservation, and transition (Tong and Zhang, 2022). On conservation, the higher interest from WOLs is likely due to their hands-on involvement (Park and Lohr, 2005). Conversely, WNOLs often face social stress to defer decisions to male tenants, reflecting cultural biases toward male dominance in agriculture (Carter, 2016, 2019). This division suggests varying conservation interests between the two groups, an understudied dynamic in existing literature that our research seeks to address.

The second question, 'How does women landowners' interest in conservation topics vary across their demographic and farm characteristics?' underscores the diversity within the group of women landowners. Numerous studies highlight that numerous factors, including time, space, and social relations (Goebel, 2003; Leach 2007; Wells and Eells 2011; Trauger *et al.*, 2008; Jarosz 2011; Druschke and Secchi 2014), influence the identities, experiences, and practices of women in agriculture. Recognizing this diversity is crucial for developing adaptable and effective agricultural education and conservation strategies that address the unique and evolving roles of women in agriculture. By examining how women landowners' interests in conservation vary, we contribute to a more nuanced understanding that can guide more equitable and effective conservation initiatives.

To answer our research questions, we test the three main hypotheses: (a) more WOLs are interested in conservation topics and concerned about conservation issues than WNOLs; (b) age and farming experience matter for women landowners' interests in conservation; and (c) women landowners with different farm characteristics (e.g., leasing status, off-farm income, and farm enterprises) show varied interests in conservation topics.

In hypothesis (b), we posit that longer-term farm planning perspectives drive conservation interest in more younger women landowners (Soule, Tegene and Wiebe, 2000; Prokopy *et al.*, 2008; Unay-Gailhard and Bojnec, 2021). The decision-making involvement can be dynamic as women landowners' ages increase (Carter, 2016), with younger women more actively engaged (Petrzelka and Marquart-Pyatt, 2011). Turning our attention to WNOLs, a previously understudied group (Eells and Soulis, 2013; Druschke and Secchi, 2014; Petrzelka, 2022), we explore differences based on farming experience. Experienced WNOLs likely possess greater decision-making authority and a stronger focus on conservation practices related to farming, whereas inexperienced WNOLs may lean toward economic incentives or traditional soil practices, with some showing little interest in conservation due to a lack of active farming involvement (Petrzelka *et al.*, 2020).

In hypothesis (c), we analyze the conservation interests among women landowners by weighting survey responses based on the proportion of land they directly maintain vs the land they lease out to other operators to substantiate hypothesis (a), since more WOLs tend to farm the land by themselves while WNOLs, by definition, tend to lease the land out. Barbercheck *et al.* (2014) find that women with off-farm jobs are more likely to adopt conservation practices like hay planting and soil testing in the northeastern United States, suggesting those with off-farm income might lean more toward conservation. Diversity in farming practices could affect conservation adoption positively, through increased experimentation, or negatively, by presenting too many choices (Rahelizatavo and Gillespie, 2004; Barbercheck *et al.*, 2014). Thus, we suggest a higher proportion of women managing diverse enterprises, such as livestock or pastures, are interested in conservation than are women with only row crops.

To test our hypothesis, we analyze 135 responses from Iowa female landowners, drawn from a 2021 survey and aligned with the Iowa Farmland Ownership and Tenure Survey (IFOTS) by Zhang, Plastina and Sawadgo (2018), which represents 52,744 women landowners and 5,129,332 acres. Our methodology involves descriptive and statistical analysis to assess differences in conservation interest across various women landowner groups. We further assess women landowners' preferred ways to receive educational programming and analyze their preferences by age groups. This will help improve our understanding of women landowners' convenience in accessing education resources and inform educators and service providers as they tailor programs and services to meet the varying needs of this important yet underrepresented demographic. We encourage service providers to proactively devise strategies to counteract these societal constraints, ensuring women have an informed, empowered, and active role in land management decisions.

Materials and methods

We contracted Iowa State University's Center for Survey Statistics and Methodology Survey Research Services (CSSM-SRS) to conduct a web/mail mixed-mode survey of women Iowa farmland owners in spring 2021. The survey followed the mixed Tailored Survey Design method (Dillman, Smyth and Christian, 2014). The whole sample consists of 728 contacts, with 324 female Iowa farmland owners selected from the quinquennial IFOTS and 404 selected from recent participants in the Iowa State University Extension and Outreach Women in Ag programs. In this paper, we limit our analysis to the IFOTS subsample to

mitigate any potential bias stemming from the respondents who interact frequently with the university.

The IFOTS subsample is selected from 40-acre tracts of Iowa farmland, which were chosen in 1988 on a random basis and continuously used today. Selection of tracts emphasized ensures a geographically balanced distribution of samples across each county. Within each of these sample selections, a 40-acre unit was chosen at random in every county. Subsequently, all landowners within these chosen units were identified, making them potential candidates for the survey. Responses from IFOTS are compiled and scaled to the state level, using specific weights for both farmland and landowners. Through these weights, we can infer the representative proportion of landowners and the scope of farmland they own within Iowa. A comprehensive overview of the questionnaire, alongside detailed information on the sampling design and the methodology for weight calculations, is available in the appendix of Zhang, Plastina and Sawadgo (2018).

After excluding male landowners, non-landowners, and deceased landowners, we received a total of 135 completed surveys from 309 eligible owners during the data collection period from July 30 through October 20, 2021, equaling a response rate of 43.7%. Compared with the complete 2017 IFOTS sample, where 349 female landowners statistically represent 132,831 Iowa women landowners, our subsample represents 52,744 Iowa women landowners who own 5,129,332 acres of farmland. In the following analyses, we only employ the owner weights in the subsample, which we stratify by crop reporting districts, defined by the USDA, and geographic regions, defined by the 1950 US Census of Agriculture. Readers can find the specific sampling process in Zhang, Plastina and Sawadgo (2018). As such, our study mirrors the perspectives, interests, and concerns of a fair portion of Iowa women landowners, making it emblematic of the potential larger group of women landowners.

We employ descriptive and statistical analysis to study the differences in percentages of interest shown in conservation topics between various groups. For precise estimations of interest proportions of each women group in distinct conservation topics, we employ the R package 'Survey' for this study (Lumley, 2019), which uses the weights and the stratification in calculating the shares of women interested in a conservation topic. We employ a two-group *t*-test to assess the null hypothesis that the proportions of women landowners expressing interest or concerns in a conservation topic are the same across both groups (Kim, 2015). The alternative hypothesis posits that these proportions differ between the groups. Since the groups in the comparisons are all mutually exclusive, the covariance of the two groups is zero. We employ 'svyglm' from R to compute the *t*-statistic based on the differences in these proportions. The validity of the statistical inference derived from this survey-design-based method does not rely on any distribution assumption of the variables tested (Lumley, 2011). Since the variables we are interested in are whether women are interested in conservation topics or not, we also apply a logistic regression to justify the difference between various groups assuming that the variables of interest follow a binomial distribution. The coefficient is the difference between the two groups—we mainly care about the statistical significance of the coefficient instead of the magnitude. Specifically, we apply both a *t*-test and logistic regression when testing the groups of WOLs and WNOLs, experienced and inexperienced WNOLs, leasing and non-leasing land, and farms planting only crops and those that are not only crops. For the continuous variables of age and the percentages of off-farm income, we use

logistic regression to observe the correlations between these factors and the possibility of women landowners being interested in each topic. The results from the two methods are very similar for the two-group tests, and we only highlight the topics with the *P*-values exceeding the 90% significance level from both methods. For simplicity, we will only report the *P*-values from the logistic regression.

Results and discussion

Figure 1 presents an overview of our sample's composition and the descriptive statistics for the variables of interest. Demographically, the majority of women landowners in our study are aged between 60 and 80 years, accounting for 60% of the sample, with an average age of 70. No women under 40 years of age responded. However, based on the 2017 and 2022 IFOTS, 5 and 4% of all women landowners are under 40, respectively (Zhang, Plastina and Sawadgo, 2018; Tong and Zhang, 2023). Hence, we hope this absence will not significantly skew the overall viewpoints of Iowa women landowners within our findings. In terms of operating status, we asked women if they categorized themselves as WOL who actively operate their farms or WNOL who do not farm their land at all. The distribution between WOLs and WNOLs is approximately 3:7, reflecting a more frequent representation of non-operator perspectives. We further asked WNOLs to identify themselves as experienced owners or inexperienced owners, and the two groups represented at the state level are evenly split. Regarding the leasing status, 60% of the women landowners lease out their land, whereas 40% do not. The leasing vs non-leasing ratio is roughly 2:8 for WOLs and 7:3 for WNOLs. Regarding farm-related income, 13% of the participants reported deriving all their income from farming activities, with the average off-farm income constituting 62% of their total income. Our analysis also categorizes landowners based on their farming focus: those specializing in row crops, those integrating row crops with livestock, and those combining row crops with pasture management. The data reveal that 70% of the women-owned farms are focused on row crops, with only 10% incorporating livestock and 20% engaging in pasture management.

General interest in conservation topics

Table 1 summarizes the percentages of women landowners' choices to the question, 'What topics related to farmland conservation are you most interested in receiving information about?' We then asked the respondents to select the three topics they were most interested in. As the last row of Table 1 shows, 75% of women landowners showed interest in at least one conservation topic. However, only 36% of respondents showed interest in the top-ranked topic, government conservation programs, indicating that women landowners' interests are dispersed, with many only focusing on one specific topic. This interest alignment is mirrored in the actual participation in government conservation programs. The 2022 IFOTS indicates a modest increase in the adoption of government conservation programs among land owned by women, increasing from 48% in 2017 to 52% in 2022, despite a consistent overall farmland holding by women. Our data show that these women interested in government programs own primarily small farms of 250 acres or less. Given that women landowners, especially on smaller parcels, often have limited access to conservation resources (Doss et al., 2018), they might perceive higher risks and financial stresses. Government programs,

Figure 1. Depiction of Iowa women landowners' characteristics in the sample survey.

Note: We use *n* to indicate the number of respondents in the sample survey and *N* to indicate the number of women landowners represented at the state level. The survey asked whether the women consider themselves operating or non-operating landowners. The number of respondents decreases in operating status, farm enterprises, and farming experience due to the missing answers from some respondents. We weight women landowners using the shares of acres leased out. Since the weighted numbers can be non-integers, we can only report the represented respondents regarding land leasing status.

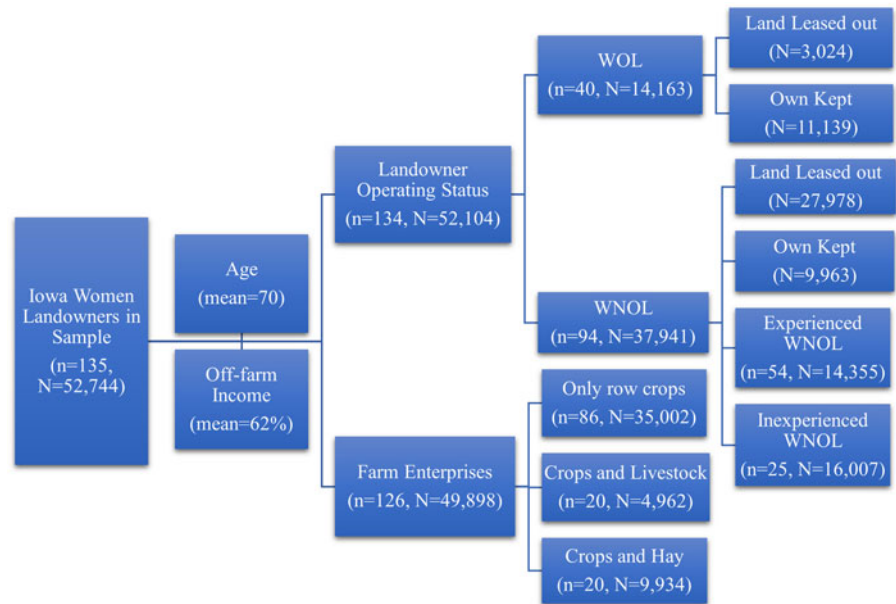


Table 1. Operating vs non-operating women landowners' rates of interest in receiving information about conservation topics

	Percent of respondents expressing interest		
	Total	WOL	WNOL
Conservation programs			
Agricultural carbon credits programs	17%	42%***	8%***
Government conservation programs	36%	28%	35%
Non-government conservation programs	11%	21%	8%
Primarily benefit water quality			
Water quality improvement	22%	43%**	14%**
Primarily benefit net carbon emission			
Conservation easements	8%	4%	10%
Benefit both water quality and net carbon emission			
Soil erosion control	29%	15%*	31%*
Soil fertilizer improvement	27%	20%	27%
Cover crops	23%	44%**	19%**
Pasture and hay land management	19%	34%	12%
Conservation tillage	13%	16%	13%
Benefit neither water quality nor net carbon emission			
Wildlife habitat improvement	24%	28%	23%
Energy contracts for wind or solar	15%	7%	23%
No Interest	25%	12%*	31%*

Note: Table 1 shows the percentages of women landowners' choices to the question, 'What topics related to farmland conservation are you most interested in receiving information about' within each owner type. We asked respondents to select the three topics they were most interested in receiving information about. The farmland tenure sample allows us to calculate the representative interest percentages of Iowa female landowners with owner weights. We compare the percentage of respondents showing interest in each topic between operating owners and non-operating owners. * $P < 0.10$; ** $P < 0.05$; *** $P < 0.01$.

offering financial incentives and conservation assistance, can alleviate these challenges.

For further clarity, we categorized topics into five groups. Beyond conservation programs, we classified topics based on their main benefits: water quality, net carbon emission, both, or neither, referencing Du, Feng and Zhang (2022) and Delgado et al. (2011). Delgado et al. (2011) further delineates practices benefiting net carbon emissions into categories such as soil carbon sequestration, greenhouse gas emission, and upstream or process emissions.

Overall, 60% prioritize practices benefiting both water quality and carbon emissions, with soil erosion control (29%), soil fertilizer improvement (27%), and cover crops (23%) being especially popular. Among these, respondents ranked the first two practices focusing on soil enhancement as the second- and third-most interesting topics. Conservation programs also received interest from nearly half of respondents (47%). Among them, government conservation programs (36%) stand out as the most favored topic, and carbon credits and non-government programs drew relatively lower attention, capturing only 17 and 11% of the overall interest, respectively. These findings underscore a distinct preference among women landowners for conventional soil management practices and state/federal conservation programs than those from non-government or private organizations.

These results shed light on the priorities and preferences of women landowners. We could attribute the relatively high interest in soil conservation to their immediate and long-term impacts on farm productivity (Wiebe and Gollehon, 2006). Additionally, traditional soil practices, being rooted in agricultural history, and a focus in education and outreach, might resonate more than newer, less familiar techniques. Brevik, Kržić and Uchida (2022) highlight the usefulness of resonating with individuals in soil education, advocating for the perception of soil management as a long-term and multi-generational commitment. For conservation programs, the preference for government-led programs over others suggests that women landowners may perceive such initiatives as more credible and stable, leading to their favored participation. Adhikari et al. (2022) suggest that government conservation programs receive substantial federal funding, which enhance their

geographical reach in addressing diverse natural resource issues and long-term operation to establish information dissemination. Hence, familiarity with the programs and feedback mechanisms can contribute to heightened participant satisfaction. This aligns with women's interest in soil erosion, a topic established and long championed by the USDA Natural Resources Conservation Service. Moreover, such programs fit within the larger narrative of collective environmental stewardship, allowing women landowners to actively partake in broader sustainability efforts. Reimer and Prokopy (2013) and Welsh, Webb and Langen (2018) highlight that many landowners choose government conservation programs for their environmental and financial benefits.

On the contrary, the tepid response to carbon credits and non-government programs might reflect a lack of awareness or comprehension of these newer initiatives. These topics could be novel and require additional resources or administrative efforts, which could deter women landowners, especially those with smaller farms or limited resources. As indicated by Petrzelka et al. (2021), women farmers lack knowledge of conservation programs and have little consultation with local professionals. Consequently, it is crucial for local extension professionals to engage with landowners, providing customized educational support that includes workshops, field days, and informative fact sheets specifically on carbon credits and non-government programs. This approach furnishes women landowners with enhanced technical assistance and facilitates their familiarity with conservation programs, potentially mitigating any sense of alienation. Cortés-Capano et al. (2021) underscore this importance, noting that landowners often find technical support more valuable and preferable to financial incentives offered by conservation programs.

Interest among WOLs vs WNOLs

According to the last row of Table 1, a higher percentage of WOLs show interest in receiving information on conservation topics than WNOLs (P value = 0.075). This is in line with the common opinion that non-operating landowners face more barriers to conservation and have a lower conservation adoption rate than operating landowners (Ranjan et al., 2019; Sawadgo, Zhang and Plastina, 2021). For women farmers, there is empirical evidence that WNOLs demonstrate less engagement with farm management and conservation issues compared to WOLs (Rogers and Vandeman, 1993). Tong and Zhang (2022) surveyed Iowa women landowners and corroborated that WNOLs are overall less interested in farmland leasing and succession issues. Contrary to prevalent assumptions that non-operators prioritize financial gains above all and are indifferent toward land stewardship, Petrzelka et al. (2020) present a nuanced perspective. They argue that WNOLs are, in fact, supportive of conservation efforts undertaken by their tenants and are willing to facilitate such actions, challenging the stereotypes of apathy toward land conservation. Ulrich-Schad et al. (2016) also emphasize the diversity among non-operators and indicate their overall support for conservation is high but varies by type of practice.

The variability in WNOLs' interests is further evidenced in their responses to conservation programs. For conservation programs, 42% of WOLs expressed interest in agricultural carbon credit programs, significantly higher than the 8% of WNOLs (P value = 0.002). This suggests WOLs may be more attuned to emerging conservation topics, like carbon credits, and are keen on the financial rewards. Interestingly, the difference in interest

levels for government conservation programs between WNOLs (35%) and WOLs (28%) is not statistically significant, indicating a comparable level of engagement with these programs across both groups. Despite Petrzelka et al. (2020) noting WNOLs' limited awareness of their involvement in government conservation programs, our survey presents an optimistic view, showing a considerable proportion of WNOLs eager to enhance their understanding of such programs, despite initial unfamiliarity.

For conservation practices, more WOLs (44%) prefer to cover crops than do WNOLs (19%, P value = 0.029). The specialized timing and management requirements of cover crops may resonate with WOLs, who are deeply involved in their farms. Roesch-McNally et al. (2017) document the structural barriers of adopting cover crops by studying the focus groups of Iowa farmers. Cover crops also offer on-farm benefits like decreased erosion and increased water infiltration, which can intrigue WOLs with hands-on experience in adoption. Regarding water quality, 43% of WOLs showed interest, a significant contrast to 14% of WNOLs (P value = 0.021). Active farming likely intensifies WOLs' connection to the land, heightening their awareness of local water quality issues and the impact of farm management on this resource. Dell (2019) corroborates this by noting the significant nitrate contributions to the Gulf of Mexico from regions dominated by non-operating landownership, aligning with the observed lower interest among WNOLs from our survey and underscoring the urgency of enhancing water conservation on rented farmlands. Conversely, soil erosion control is of interest to 31% of WNOLs, outpacing the 15% of WOLs (P value = 0.089). This is consistent with Ulrich-Schad et al. (2016) and Dell (2019) that non-operators, and particularly WNOLs as noted by Petrzelka and Sorensen (2019), prioritize soil quality in conservation efforts. The non-significant portions of interest in soil fertilizer improvement and conservation easements between WNOLs (27 and 10%, respectively) and WOLs (20 and 7%, respectively) suggest that motivations for these practices among WNOLs may be linked to their commitment to long-term farmland sustainability and succession, as suggested by Petrzelka et al. (2020).

Interest across demographic characteristics: farming experience and age

Figure 2 delineates the diversity in women's interests in conservation topics, informed by their demographic and farm-specific attributes, in alignment with hypotheses (b) and (c). Despite the generally modest interest in carbon credits among WNOLs, the data reveal that experienced WNOLs exhibit significantly more interest (12%) than their inexperienced counterparts (3%, P value = 0.062), reflecting a trend where experienced WNOLs, akin to WOLs, are more receptive to emerging conservation themes, a pattern less evident among inexperienced WNOLs. Petrzelka and Sorensen's study (2019) from the American Farmland Trust reveals water quality as a pivotal conservation issue for WNOLs in the Corn Belt. Our findings augment this insight, showing 30% of experienced WNOLs in Iowa prioritize water quality compared to less than 1% of their inexperienced counterparts (P value < 0.001). Intriguingly, the inverse holds true for energy contracts in the wind or solar sectors, with interest displayed by a higher portion of inexperienced WNOLs (37%) in contrast to their experienced counterparts (7%, P value = 0.011). This divergence could indicate that experience fosters a deep appreciation for sustainable land management, evidenced by the focus on water quality and carbon credits. Conversely, the

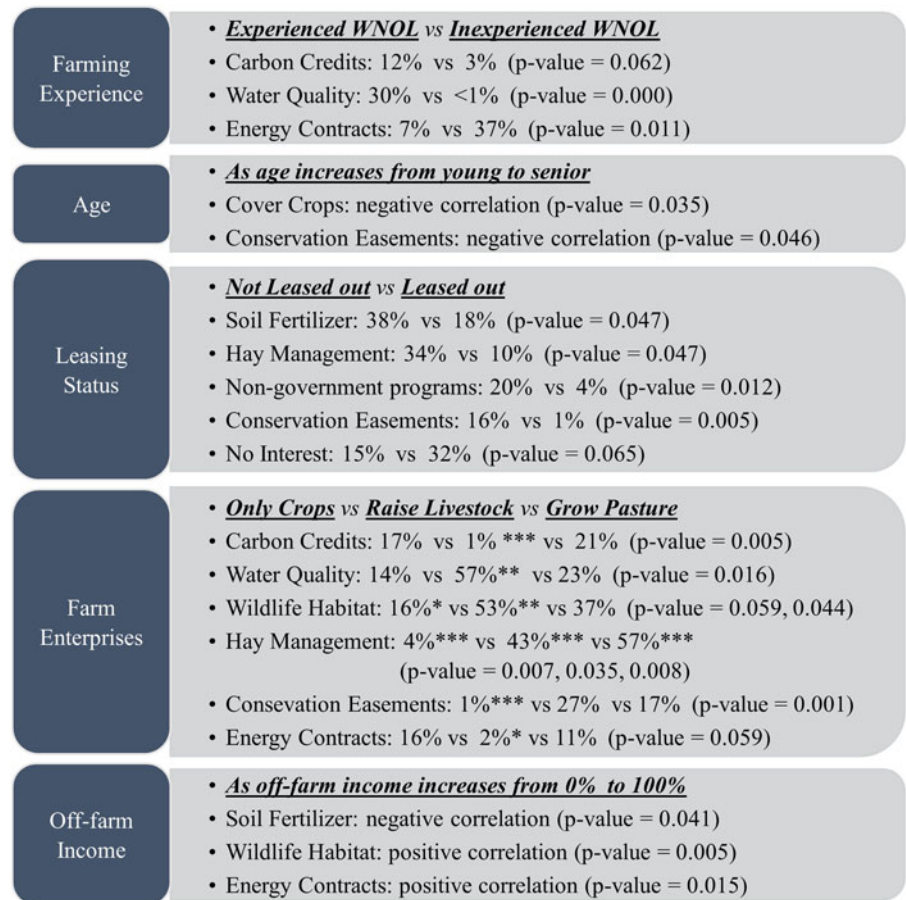


Figure 2. Differences in interest in farmland conservation topics by women landowners' demographic and on-farm characteristics.

Note¹: Figure 2 shows the percentages of women interested in the topics within each owner type. Only the comparison of farming experience is specifically for non-operating women landowners. All other comparisons are for all women landowners responded from the survey.

Note²: For farm enterprise types, we use the farmland with only crops as the base group and compare the other two with the baseline. We then compare the base group with the farms growing not only crops as one group. The *P*-values are reported for each group showing statistically significant differences, respectively. **P* < 0.10; ***P* < 0.05; ****P* < 0.01.

enthusiasm of inexperienced WNOLs for energy contracts might hint at a modern, possibly revenue-centric outlook, spurred by the global emphasis on renewable energy and the promise of swift economic gains.

We also compare women landowners' interest in conservation topics by age as shown in the second panel of Fig. 2. We find that younger women landowners are more likely to be interested in cover crops (*P* value = 0.035) and conservation easements (*P* value = 0.099), which aligns with Unay-Gailhard and Bojnc (2021) that younger women farmers are more likely to adopt agri-environmental practices and programs. Petrzalka and Marquart-Pyatt (2011) suggests that senior non-operating landowners may be less active on their land and are less likely to be involved in conservation practices than younger non-operating landowners.

Interest across farm characteristics: leasing status, farm enterprises, and off-farm income

The last line of the third panel in Fig. 2 reveals that 85% of women who retain their land are interested in conservation topics, compared to 68% of those who lease out their land to other operators (*P* value = 0.065). This higher conservation interest among those not leasing land to other operators aligns with the trend seen between WOLs and WNOLs. Those not leasing land to others primarily show interest in soil fertilizer improvement (*P* value = 0.047), hay land management (*P* value = 0.047), non-government conservation programs (*P* value = 0.012), and conservation easements (*P* value = 0.005). Notably, these preferences differ from

the earlier WOL vs WNOL comparison that emphasized carbon credits, water quality, and cover crops. These variances indicate influences beyond the mere WOL-WNOL distinction. One might infer that land uses and personal management strategies significantly shape conservation priorities, underlining the need for targeted approaches when engaging different landowner groups.

The fourth panel of Fig. 2 illustrates the divergence in conservation interests among women landowners based on their farm's diversification level. Landowners concentrating solely on crops display a limited inclination toward conservation easements (1%, *P* value = 0.001) and wildlife habitat improvement (16%, *P* value = 0.059), which contrasts to landowners engaged in diversified farming enterprises. This may imply a more economically oriented mindset among monoculture practitioners. Roesch-McNally, Arbuckle and Tyndall (2018) observe that the dominance of corn and the costs associated with altering farming systems (e.g., tile drainage) have prompted a shift from integrated crop-livestock systems to monoculture. Specialization and financial concerns may limit their interest in these conservation topics. Women who operate crop-only farms display a relatively minimal interest in pasture and hay land management (4%, *P* value = 0.007), while there is a marked increase in interest from women involved in both crop and livestock (43%, *P* value = 0.035) and those managing both crop and pasture (57%, *P* value = 0.008). This likely stems from the value of pasture both as livestock feed and for hay land management. Barbercheck et al. (2014) also show evidence that women landowners integrating crops and livestock present a higher likelihood adopting hay or pasture

planting. Additionally, those farms with a certain number of animals or a feeding operation are required to adopt nutrient management plans, which are linked to water quality enhancements (Iowa Department of Natural Resources, 2021).

Women engaging in combined crop–livestock farming exhibit a heightened interest in water quality improvement (57%, P value = 0.016) and wildlife habitat improvement (53%, P value = 0.044) but lower interest in carbon credits (1%, P value = 0.005) and solar/wind energy contracts (2%, P value = 0.059). The high interest in water quality from these women may stem from their holistic approach to farm management, especially in diverse operations that include livestock. Sachs et al. (2016) highlight that women farmers enhance biodiversity on their farms through diverse cropping and livestock integration, with many utilizing pasture planting, nutrient management plans, grassed waterways, and riparian buffers for conservation. They recognize the synergies between the off-farm impacts (e.g., water quality) and livestock. Excess nutrients from livestock manure can contaminate water bodies, which adversely affects the health of livestock. For the low interest in carbon credits and energy contracts, while women understand their potential benefits, the complexities and costs associated with altering farm management—particularly for those operating both crops and livestock—might demotivate them from pursuing these practices. As one interviewee in Sachs et al. (2016) noted, balancing a small-scale diversified livestock farm with off-farm employment constrains the labor and time available for farm activities.

The final panel of Fig. 2 indicates that as off-farm income increases, women landowners exhibit greater interest in wildlife habitat improvement (P value = 0.005) and energy contracts (P value = 0.015). This trend aligns with earlier suggestions by Blasé and Timmons (1961), positing that off-farm income could help finance conservation efforts. However, contrasting views suggest that off-farm income might primarily supplement family and essential farm expenses, potentially leaving less time and resources for conservation practices (Ervin and Ervin, 1979; Fernandez-Cornejo et al., 2007). Given our survey's focus on women with relatively large farms—ranging from 11 to 2500 acres, with median and mean sizes of 308 and 446 acres, respectively—we lean toward the interpretation that increased off-farm income facilitates an interest in wildlife habitat and energy contracts due to financial capacity for conservation investments. In contrast, women who derive more income from farming show a higher interest in soil fertilizer improvement (P -value = 0.041), hinting that those less dependent on on-farm earnings may prioritize soil conservation less. Gedikoğlu, McCann and Artz (2011) note that off-farm employment encourages the adoption of capital-intensive conservation practices yet deters engagement in labor-intensive practices, which may elucidate the higher interest in capital-intensive activities like wildlife habitat improvement and wind/solar panel installation, as opposed to the more labor-demanding soil fertilization efforts.

Conservation concerns among WOLs and WNOLs

For each conservation-related issue, we asked respondents to rank their level of concern from 1 (not concerned at all) to 4 (very concerned). Table 2 shows the percentages of respondents who are at least slightly concerned (>1) about the issues and summarizes the statistics by WOLs, WNOLs, and total landowners. Women landowners are most concerned with the number of requirements associated with government conservation programs (65%), which

Table 2. Operating vs non-operating women landowners' concerns about conservation-related issues

Conservation-related issues	% of respondents concerned or very concerned		
	Total	WOL	WNOL
Too much paperwork related with government programs	65%	91% ***	55% ***
Unsure of the true value of the practices to the environment	49%	63%	44%
Interference with ability to change land management practices	45%	70% **	35% **
Low cost-share payments	42%	76% ***	30% ***
Time consuming and laborious	41%	61% **	33% **
Incorporating the practices into leases	38%	44%	36%
Conservation practices may decrease the value of land	37%	56%*	29%*
Hard to find information about state/federal programs	37%	47%	33%
Not familiar with conservation practices	36%	47%	31%
Don't know anyone implementing conservation practices	30%	46%	23%
Access to conservation equipment needed	29%	48%*	22%*
Communication with tenants	23%	30%	21%
Discussion of the practices may upset family or co-owners	19%	30%	16%
Disapproval from neighbors	19%	31%	15%

Note: We asked respondents to rank their level of concern from 1 (not concerned at all) to 4 (very concerned). Table 2 shows the percentages of respondents who are at least slightly concerned (>1) about the conservation issues within each group. We only report the results with owner weights for simplicity and statistical differences between WOLs and WNOLs equal to or larger than the 90% significant level. * $P < 0.10$; ** $P < 0.05$; *** $P < 0.01$.

matches women landowners' highest interest in government conservation programs generally. The remaining concerns are doubts about the true environmental value of the practices (49%), interference with the ability to change land management practices (45%), low cost-share payments (42%), and demands on time and labor (41%). Perry-Hill and Prokopy (2014) shows that female landowners are less likely to enroll in conservation programs than are male landowners. Combining this with the high interest in programs from our survey, we can see women's concerns about conservation programs mentioned above are essential barriers for women landowners' conservation participation.

Although fewer respondents stated concern with the statements 'Not familiar with practices' (36%) or 'Don't know anyone implementing the practices' (30%), the actual adoption of key conservation practices in Iowa remains low. According to the 2017 and 2022 IFOTS, only 5 and 7% of Iowa landowners adopted cover crops and 21 and 26% of Iowa landowners adopted no-till (Zhang, Plastina and Sawadgo, 2018; Tong and Zhang, 2023). Paired with the second-largest concern of questioning the environmental value of the practices, respondents may have overstated familiarity with conservation practices, which shows

a significant need for extensive and innovative educational efforts directed toward women landowners. Alternatively, cultural barriers caused by gender-based discrimination can hinder women from implementing conservation practices despite their knowledge and willingness, as indicated by Wells and Eells (2011) and Carter (2016). Their male tenants, advisors, and service providers might disregard or undervalue their input, potentially limiting the adoption of conservation measures. Such challenges highlight the imperative for educators to foster a more inclusive conservation culture when engaging with women landowners.

According to Druschke and Secchi (2014), female landowners often possess less knowledge about conservation practices compared to their male counterparts. Typically, WNOLs are frequently sidelined from farming decisions, including those related to conservation, due to gaps in technical knowledge (Carolan et al., 2004; Carter, 2016; Ranjan et al., 2019). Our survey underscores a compelling trend: women landowners who identify as having limited conservation knowledge are more interested in the subject than those without such perceived gaps. We define limited knowledge based on concerns about familiarity with conservation practices, perceived value of these practices, access to equipment and program information, and lack of a supportive network. Remarkably, only 16% of these women report no conservation interest, in contrast to 46% of those without these concerns (P value = 0.011). Specifically, these knowledge-constrained women show heightened interest in government programs (46%, P value = 0.009), pasture management (28%, P value = 0.006), and cover crops (28%, P value = 0.079).

Respondents ranked communications with tenants (23%), family/co-owners (19%), or neighbors (19%) as the least important concerns. This finding is in line with the results from the 2019 American Farmland Trust survey that 'neighboring landowners' and 'surrounding communities' are less important influencers for WNOLs that make decisions about conservation practices (Petrzelka and Sorensen, 2019). Ulrich-Schad et al. (2016) also surveyed Indiana's out-of-state landowners and find their relationships with tenants generally play no role in conservation adoption decisions.

Both WOLs and WNOLs rank the top concern about conservation practices similarly. However, WOLs put more weight on government red tape, financial issues, and farm management, which is reflected in their emphasis on excessive government requirements (91%, P value = 0.001), insufficient cost-share payments (76%, P value < 0.001), difficulties in altering existing management practices (70%, P value = 0.018), time and effort consumption (61%, P value = 0.044), practices might devalue the land (56%, P value = 0.077), and access to necessary equipment (48%, P value = 0.075). WNOLs exhibit greater concern for integrating conservation practices into leases and accessing information about programs—areas not ranked within the top five concerns for all women but prominently featured among the top concerns for WNOLs. WNOLs generally have less concerns on conservation issues, which likely relates to their lower interest in conservation topics overall.

Implications for extension and conservation professionals

Our findings can guide extension and conservation professionals as they develop programs and resources to reach women landowners and achieve conservation goals. With 75% of women landowners indicating interest in at least one conservation topic, professionals should consider incorporating women-focused

programming in their outreach plans. However, it is important to avoid a narrow focus on a small number of practices and tools to address resources concerns. Agricultural carbon credit programs, water quality improvement, and cover crops were ranked significantly higher among WOLs compared to WNOLs, highlighting the importance of customizing outreach materials for WOLs while also increasing WNOLs' engagement with these topics. Moreover, with 49% of survey respondents questioning the environmental efficacy of conservation practices, education on their value and impact emerges as a key need. While federal and private sector funding for conservation practices have increased, our findings point to the reality that education about the value of these practices may still be our greatest barrier to higher adoption, and we should not assume that women inherently value conservation.

In addition, our results guide the development of targeted educational materials, suggesting a focus on specific interests like carbon credits for experienced WNOLs, and developing strategies to engage inexperienced WNOLs and livestock-owning women more effectively. For the way to deliver information to non-operating owners, Ranjan et al. (2024) found that intermediaries between NOLs and tenant farmers view NOLs as more influenced by tenants than by intermediaries themselves, indicating the need for a holistic conservation education approach that considers the trust and impacts between NOLs, intermediaries, and operators. Carter and Christoffel (2023) also emphasize the need for women landowners to access conservation networks and local communities. They advocate for conservation professionals to use a personalized, interactive educational approach, promoting active dialogues for women landowners, especially WNOLs, with tenants and advisors, rather than passive reception.

Extension and conservation professionals are often constrained by time and funding when planning for and conducting conservation outreach. This can lead to selecting one format or mode of program and educational content delivery, such as in-person field days. The survey results indicate that diversifying delivery methods and content may increase engagement with WOLs and WNOLs in their project areas. We asked women landowners to select the top three ways they would like to receive information and educational programming. Sixty-three percent of respondents prefer a periodic newsletter or e-newsletter for receiving information and about one-third of respondents prefer receiving information through two-page fact sheets or infographics, with webinars being the third-most popular delivery method (23%, Fig. 3). WOLs are generally more willing to receive educational information than WNOLs and women landowners prefer virtual or printed delivery methods to in-person formats.

According to the 2022 IFOTS, Iowa landowners above 65 in 2022 held 66% of the land, up from 48% in 2002, highlighting the aging demographic and the slow transition of farmland. This underscores the importance of studying senior women landowners' communication preferences to improve outreach. Figure 4 illustrates these preferences across age groups: below 55, 55–65, 65–75, and over 75, based on the 2022 IFOTS findings. Younger women display a broader receptiveness to various formats, showing a marked preference for fact sheets/infographics, webinars, and half-day in-person educational meetings. Senior women landowners above 65 demonstrate a preference for (e-)newsletters and large-font notebooks. Women landowners of all ages generally welcome periodic (e-)newsletters. This divergence in preferences highlights the need for customized outreach strategies within women landowners' communities, ensuring that

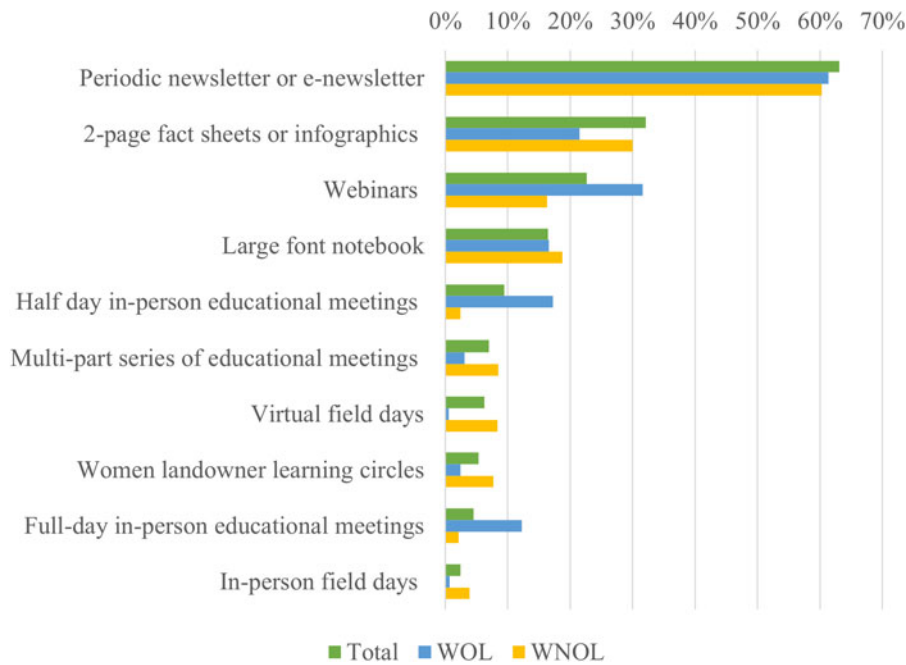


Figure 3. Women landowners' preferred ways to receive information and educational programming. Note: We asked respondents to select the top three delivery methods they prefer for receiving information and educational programming. We rank methods according to the percentages of total responses from high to low.

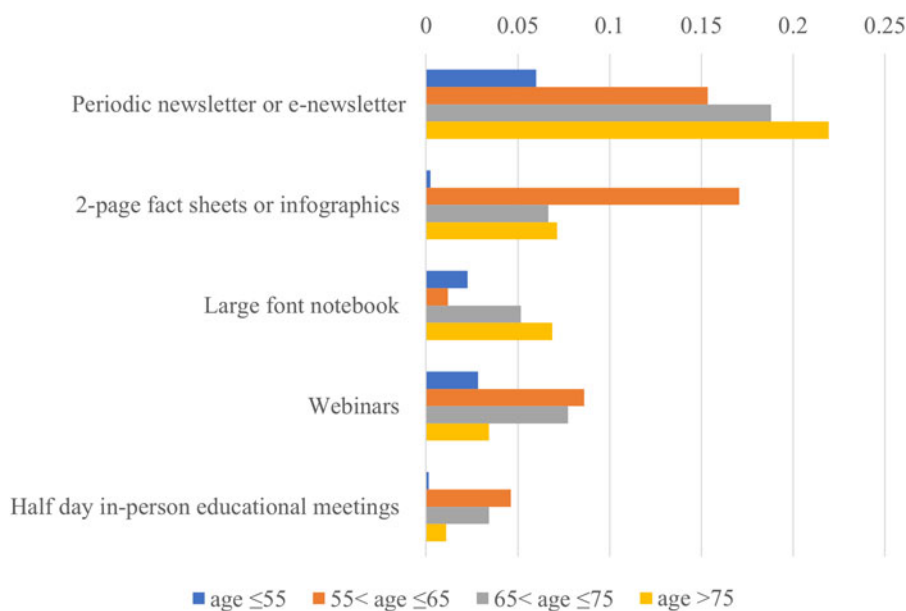


Figure 4. Women landowners' top five preferred methods of receiving information and educational programming by age groups.

educational resources are accessible and engaging for all age groups.

Previous research shows that, compared to formal presentations or web-based information, both male and female landowners prefer to receive educational information through postal mail and informal occasions where they can interact with each other in person, for example, learning circles (Eells and Adcock, 2012; Petrzela et al., 2019; Fairchild et al., 2022). However, Carter (2019) cautions that social norms limiting women's role in farmland decisions also restrict their access to management information, potentially causing reluctance among participants at field days and learning circles to share experiences due to the presence of familiar community members, co-owners, or tenants.

This may explain why these in-person activities ranked low in our survey. Interest in newsletters, fact sheets, infographics, and webinars indicate interest in brief information available on the user's schedule delivered right to their home. Removing several barriers to information access and offering flexibility is important for engaging both WOLs and WNOLs in learning opportunities that increase knowledge, conservation actions, and building an inclusive community around conservation efforts.

Summary and conclusions

This study contributes to the current literature in four ways. First, using a statistically representative sample of Iowa female

landowners, we provide one of the first comprehensive analyses of understudied women landowners' views on farmland conservation topics based on their operational status, farming experience, age, land leasing status, farm diversification, and off-farm work. We underscore the heterogeneity among women landowners and shed light on how important these factors are in shaping their interest in conservation topics. We find statistical evidence that more WOLs are interested in conservation than WNOLs. Land leasing status further supports this observation—a higher proportion of women who manage their land, rather than leasing it out to others, express interest in conservation.

Second, our results indicate that women landowners' interests are dispersed among conservation topics, and the proportion of uninterested women landowners is non-trivial, which cautions the assumption that women inherently value conservation. Also, government conservation programs and soil management practices play an essential role in women landowners' interest in conservation, which indicates their focus on the long-established programs and consistently messaged soil management practices. Such preferences may also hint at their financial inclination toward program payments and the enhanced production yields offered by effective soil management. The higher interest in traditional practices paired with low conservation adoption rates overall among women landowners may reflect their unfamiliarity with alternative approaches, underscoring the potential benefits of targeted educational outreach from professionals.

Third, we connect women landowners' interests with their concerns on conservation issues and explain the differences between WOLs and WNOLs. In general, WOLs are worried more about government red tape, financial considerations, and farm management ability, and WNOLs have less knowledge and networks related to conservation practices and implement conservation relying on leases. From the concerns shown in the survey, it appears women are suspicious of the value of conservation practices in general. Hence, extension professionals and educators need to validate these practices in the outreach materials and not assume that women landowners already understand the value.

Fourth, our work provides an important reference for supporting and connecting women landowners with land grant university extension resources by investigating how they prefer to receive educational information for each conservation topic they are interested in. Periodic (e-) newsletters can efficiently convey conservation information given the interest from both senior and younger women landowners. Extension and conservation professionals can employ various methods to reach women of various age groups based on our survey finding that senior landowners prefer printed materials while younger landowners prefer online meetings.

For policy implications, landowner groups' differing interests and concerns may help policymakers formulate optimal policy designs for various target groups. Since government conservation programs are of top interest among women landowners, it should be impactful, especially for WOLs if policymakers address their concerns by reducing the paperwork needed for programs and emphasize financial incentives. Opportunities to overcome financial and operational barriers to conservation may attract WOLs to the conversation and lead to future educational event participation. Educational and engagement opportunities designed for WNOLs are important, given their unfamiliarity and lack of interest in conservation. Education may be more effective for younger women landowners based on their relatively high interest in conservation and educational programming. When designing outreach segments for WOLs and WNOLs, customization based on

stated barriers, varying in-person and technological approaches, and other strategies could be applied to improve participation and efficacy of outreach according to various groups' preferences.

There are two limitations to our work. First, our sample is not representative of all women landowners in Iowa, and our results would be more informative and comprehensive if we had a larger number of respondents from IFOTS in our sample. Second, we only collected women landowners' responses but not male landowners' responses as a comparison, though we did review literature on gender differences in conservation knowledge and decision making. Future studies could use the same questionnaire and gather responses from both female and male landowners to compare survey results and analyze gender differences.

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