

## **What Women Landowners Want to Know about Conservation**

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1                   **What Women Landowners Want to Know about Conservation**

2   **Abstract:** Women own or co-own almost half of the land in the US Midwest and women  
3 landowners are playing an increasingly important role in production and financial decision-  
4 making. However, women landowners are less involved in conservation programs and networks,  
5 and thus, the main participants in governmental and private conservation programs are still men.  
6 Using a 2021 survey of 135 women landowners who statistically represent 52,744 Iowa women  
7 landowners, this article studies women landowners’ interest in conservation topics, concerns in  
8 conservation decision-making as well as preferred information sources and educational delivery  
9 methods. We find that women landowners are most interested in government conservation  
10 programs, followed by soil erosion control, soil fertilizer improvement, and cover crops. We  
11 provide statistical evidence that more women operating landowners (WOLs) are interested in  
12 conservation topics and concerned about conservation issues than women non-operating  
13 landowners (WNOLs) in general. When we adjust for the proportion of land they personally  
14 operate versus lease out it corroborates our finding. We also explore women landowners’  
15 preferences for receiving educational information that provides policy and extension  
16 implications. Survey results show strong preferences for periodic (e-)newsletters, followed by  
17 two-page fact sheets or infographics and webinars. Women landowners over 60 years old prefer  
18 printed materials, and those younger prefer virtual meetings. Overall, women landowners prefer  
19 a mix of delivery methods with stronger preferences for virtual or printed delivery methods than  
20 in-person formats.

21   **JEL Codes:** Q15, Q16, Q56, Q12

- 22 **Keywords:** Women landowners, conservation practice, Extension and Outreach, Non-operating
- 23 landowner, Cover crops, Carbon credits, Farmer survey

24 Women own nearly half of the farmland in Iowa and make influential decisions in conservation  
25 outcomes through farmland management and practices (Sawadgo et al. 2021). However, existing  
26 data collection efforts often have limited representation of women producers and women  
27 landowners, especially regarding their conservation decision making. Previous literature  
28 indicates that women landowners have a more positive attitude than male landowners toward  
29 conservation and collaboration (Druschke and Secchi 2014). However, conservation outreach  
30 mostly targets men (Wells and Eells 2011; Meinzen-Dick et al. 2014). Women are less  
31 knowledgeable about best management practices and less actively involved in conservation  
32 programs and practices (Druschke and Secchi 2014; Eells and Soulis 2013), which can be  
33 explained by downplay of women’s identities as farmers. Traditionally, women were identified  
34 as “farm wives,” leading to a disadvantage in farming networks and a tendency to be treated as  
35 incompetent (Wright and Annes 2019; Sachs et al. 2016). However, as the proportion of women  
36 with ownership of farmland increases, more women self-identify as farmers, which contests and  
37 challenges the conventional context.

38

39 Earlier studies also show that women landowners tend to have limited involvement in  
40 conservation decision-making on their properties, especially when they inherit the land, share  
41 ownership with a sibling (Petrzelka and Marquart-Pyatt 2011), or have tenants who are relatives  
42 (Eells 2008). Carter (2016) underscores the cultural barriers preventing women from asserting  
43 themselves as active decision-makers regarding their land. Even with access to conservation  
44 program information or education, women may not be able to act on it due to prevailing  
45 patriarchal attitudes from their tenants, family, advisors, service providers, and others.

46

47 Using a 2021 survey of Iowa women operating and non-operating landowners, we aim to provide  
48 a comprehensive examination regarding what women landowners want to know about  
49 conservation, as well as their concerns on conservation issues and preferences for receiving  
50 educational programming. We evaluate the hypotheses using a representative subsample of 135  
51 responses of female landowners from the Iowa Farmland Ownership and Tenure Survey (IFOTS)  
52 (Zhang et al. 2018), which statistically represents 52,744 Iowa women farmland owners and the  
53 5,129,332 acres of farmland they own. This will help improve our understanding of women  
54 landowners' interest in conservation and inform educators and service providers as they tailor  
55 programs and services to meet the varying needs of this important yet often overlooked  
56 demographic. Our study enriches the existing literature on the conservation interests of women  
57 landowners, offering valuable insights for policy and educational initiatives aimed at bolstering  
58 their role in farm management and conservation efforts. We encourage service providers to  
59 acknowledge this significant barrier and proactively devise strategies to counteract these societal  
60 constraints, ensuring women have an informed, empowered and active role in land management  
61 decisions.

62

63 Our survey finds that women landowners owning farmland in Iowa have divergent views based  
64 on various characteristics. Overall, 75% of women landowners are interested in at least one  
65 conservation topic. However, only 36% of respondents showed interest in the top-ranked topic,  
66 government conservation programs, indicating that women landowners' interests are dispersed,  
67 with many only focusing on one specific topic. Our study emphasizes the diversity among

68 women landowners, which aligns with Goebel (2003), Leach (2007), Wells and Eells (2011), and  
69 Druschke and Secchi (2014) finding that researchers should not globally homogenize women's  
70 positions. Such findings underscore the importance for educators and service providers to tailor  
71 information to the distinct characteristics of women landowners rather than approaching them as  
72 a uniform group.

73

74 Prior research shows that non-operating landowners face more barriers to conservation and have  
75 a lower conservation adoption rate than operating landowners (Ranjan et al. 2019; Petrzalka et al.  
76 2021; Sawadgo et al. 2021). Inspired by that, we are interested in that difference in conservation  
77 interests particularly for women landowners. Our study mainly examines the hypothesis that  
78 women who identify themselves as operating landowners (WOLs) have a higher proportion  
79 indicating interest in receiving information on conservation topics than women non-operating  
80 landowners (WNOLs). This inference is further strengthened when we weight the responses  
81 based on the proportion of land they personally retain versus the land they lease out to other  
82 operators. Using the IFOTS women landowner sample, we employ descriptive and statistical  
83 methods to test for differences in different landowner groups' interest proportions in the  
84 conservation topics detailed in the survey. In addition to the groups in the hypotheses, we also  
85 investigate differences across farming status, residency, financial, and demographic  
86 characteristics.

87

88 When asked about their interest in receiving conservation information, overall, women  
89 landowners ranked government conservation programs, soil erosion control, and soil fertilizer  
90 improvement as the top three most important sub-topics, which shows their prioritization and  
91 responsiveness to traditional conservation messaging on soil management. Additionally, their  
92 interests could also potentially translate into monetary incentive, considering the cost-share  
93 payments associated with these programs and the potential for increased profitability through  
94 management of synthetic fertilizer, one of the most expensive yearly inputs on farms.

95

96 Regarding financial and demographic features, we observe trends linking conservation interest  
97 with increasing farmland size, off-farm income, and age. While literature often associates larger  
98 farms with a higher likelihood of adopting conservation practices (Prokopy et al. 2014;  
99 Thompson et al. 2021), we note a decline in interest of women landowners towards water quality  
100 improvement as farm size expands. Rising off-farm income corresponds with increased interest  
101 among women in solar/wind energy contracts, wildlife habitats, and water quality—possibly  
102 suggesting perceived conflicts with on-farm profitability. As for age, the percentages of interest  
103 in conservation easement and cover crops get lower as women landowners’ ages increase. This is  
104 consistent with findings from Boon et al. (2010), Petzelka and Marquart-Pyatt (2011), and  
105 Unay-Gailhard and Bojnec (2021); and, we might attributed this to the greater time and effort  
106 requirements of these practices discouraging senior women, given the potential additional  
107 challenges at their age.

108

109 We also asked women landowners their concerns on conservation issues. We statistically test the  
110 difference in the levels of concern between WOLs and WNOLs and find that WOLs are  
111 generally more concerned about conservation issues, especially those related to government  
112 programs and farm management, while WNOLs have less familiarity and fewer interactions with  
113 conservation issues. We further analyze women landowners' preferences for receiving  
114 information and educational programming by age groups and find that all ages of surveyed  
115 women prefer periodic (e-)newsletters, followed by two-page fact sheets or infographics, and  
116 webinars. Women landowners over the age of 60 prefer printed papers, and women under the age  
117 of 60 prefer virtual delivery activities. Overall, women landowners favor a mix of delivery  
118 methods with stronger preferences for virtual or printed delivery methods than in-person formats.

119

## 120 **Materials and Methods**

121 We contracted Iowa State University's Center for Survey Statistics and Methodology Survey  
122 Research Services (CSSM-SRS) to conduct a web/mail mixed-mode survey of women Iowa  
123 farmland owners in spring 2021. The survey followed the mixed Tailored Survey Design method  
124 (Dillman et al. 2014). The whole sample consists of 728 contacts, with 324 female Iowa  
125 farmland owners selected from the quinquennial IFOTS and 404 selected from recent  
126 participants in the Iowa State University Extension and Outreach Women in Ag programs. In this  
127 paper, we limit our analysis to the IFOTS subsample to mitigate any potential bias stemming  
128 from the respondents who interact frequently with the university.

129



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

140

141 After excluding male landowners, non-landowners, and deceased landowners, we received a total  
142 of 135 completed surveys from 309 eligible owners during the data collection period from July  
143 30 through October 20, 2021. When compared with the complete sample of 2017 IFOTS, where  
144 349 female landowners statistically represent a total of 132,831 Iowa women landowners, our  
145 subsample represents 52,744 Iowa women landowners who own 5,129,332 acres of farmland.  
146 With a responsive rate of 43.7%, we applied acre and owner weights in the subsample, which we  
147 stratify by crop reporting districts and geographic regions to ensure state-level  
148 representativeness. The US Department of Agriculture (USDA) defines crop reporting districts.  
149 The 1950 US Census of Agriculture identifies geographic regions. Reader can find the specific  
150 sampling process in Zhang et al. (2018). As such, our study accurately mirrors the perspectives,

151 interests, and concerns of Iowa women landowners, making it both unbiased and emblematic of  
152 the larger population.

153

154 We employ descriptive and statistical analysis to study the differences in percentages of interest  
155 showed in conservation topics between various groups. Based on the weights for farmland  
156 owners and acres, our analysis for WOL/WNOL, leasing status, and residency status ensures a  
157 comprehensive understanding of considering both the number of landowners and the amount of  
158 land they own. This dual approach allows us to account for variations arising from differing sizes  
159 of farmland owned by various groups of women landowners. For precise estimations of interest  
160 proportions of each women group in distinct conservation topics, we employ the R package  
161 “Survey” for this study (Lumley 2019).

162

163 We employ a two-group t-test (Kim 2015) to assess the null hypothesis that the proportions of  
164 women landowners expressing interest or concerns in a conservation topic are the same across  
165 both groups. The alternative hypothesis posits that these proportions differ between the groups.  
166 Since the groups in the comparisons are all mutually exclusive, the covariance of the two groups  
167 is zero. We compute the t-statistic based on the differences in these proportions and only  
168 highlight p-values exceeding the 90% significance level.

169

170 **Results and Discussion**

171

172 Table 1 summarizes the percentages of women landowners' choices to the question, "What  
173 topics related to farmland conservation are you most interested in receiving information about?"  
174 We then asked the respondents to select the three topics they were most interested in. As the  
175 third-to-last row of Table 1 shows, although 75% of women landowners showed interest in at  
176 least one conservation topic, the top-ranked topic—government conservation programs—only  
177 received interest from 36% of women. Note this 36% represents women who own 23% of total  
178 farmland acres, primarily small farms of 250 acres or less. Given that women landowners,  
179 especially on smaller parcels, often have limited access to conservation resources (Doss et al.  
180 2018), they might perceive higher risks and financial stresses. Government programs, offering  
181 financial incentives and conservation assistance, can alleviate these challenges.

182

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

188

189 Women landowners demonstrate dispersed interests in conservation topics, and many only focus  
190 on one specific topic. Overall, 60% prioritize practices benefiting both water quality and carbon  
191 emissions, with soil erosion control (29%), soil fertilizer improvement (27%), and cover crops

192 (23%) being especially popular. Among these, respondents ranked the first two practices  
193 focusing on soil enhancement as the second- and third-most interesting topics. Conservation  
194 programs also received interest from nearly half of respondents (47%). Among these programs,  
195 government conservation programs (36%) stand out as the most favored topic. In contrast,  
196 carbon credits and non-government programs drew relatively lower attention, capturing only  
197 17% and 11% of the overall interest, respectively. These findings underscore a distinct  
198 preference among women landowners for conventional soil management practices and  
199 state/federal conservation programs than those from non-government or private organizations. In  
200 addition, women with small farms of 250 acres or less also exhibited interest in wildlife habitat  
201 (24%) and water quality (22%), as indicated by the notably lower percentages of interest  
202 associated with the respective acres owned by them.

203

204 These results shed light on the priorities and preferences of women landowners. We could  
205 attribute the relatively high interest in soil conservation to their immediate and long-term impacts  
206 on farm productivity. Recognizing the tangible benefits of practices like improved crop yields  
207 and soil fertility, women landowners seem driven to safeguard the continued productivity of their  
208 land. Additionally, traditional soil practices, being rooted in agricultural history and a focus in  
209 education and outreach, might resonate more than newer, less familiar techniques. For  
210 conservation programs, the preference for government-led initiatives over others suggests  
211 women landowners value policy-driven undertakings. Landowners may perceive such initiatives  
212 as more credible and stable, leading to their favored participation. This aligns with their interest  
213 in soil erosion, a topic long championed and established by the Natural Resources Conservation

214 Service. Moreover, such programs fit within the larger narrative of collective environmental  
215 stewardship, allowing women landowners to actively partake in broader sustainability efforts.  
216 Reimer and Prokopy (2013) and Welsh et al. (2018) highlight that many landowners choose  
217 government conservation programs for their environmental and financial benefits. On the  
218 contrary, the tepid response to carbon credits and non-government programs might reflect a lack  
219 of awareness or comprehension of these newer initiatives. These topics could be relatively novel  
220 and might require additional resources or administrative efforts, which could deter women  
221 landowners, especially those with smaller farms or limited resources. As indicated by Petrzelka  
222 et al. (2021), women farmers relatively lack knowledge of conservation programs and have little  
223 consultation with local professionals. Therefore, it is pivotal for extension professionals to  
224 connect with these landowners, offering tailored educational support.

225

### 226 *Farming status, land leasing, and residency*

227 We compare the interests of WOLs who personally operate their farms on a full-time or part-  
228 time basis and WNOLs who do not farm their land at all—the ratio of WOLs to WNOLs is 3:7.  
229 According to the third-to-last row of Table 1, a higher percentage of WOLs show interest in  
230 receiving information on conservation topics than WNOLs ( $p$  value =0.056). This is in line with  
231 the general opinion that non-operating landowners face more barriers to conservation and have a  
232 lower conservation adoption rate than operating landowners (Ranjan et al. 2019; Sawadgo et al.  
233 2021).

234

235 For conservation programs, 42% of WOLs expressed interest in agricultural carbon credit  
236 programs, significantly higher than the 8% of WNOLs ( $p$ -value = 0.014). This suggests WOLs  
237 may be more attuned to emerging conservation topics, like carbon credits, and are keen on the  
238 financial rewards. For conservation practices, more WOLs (44%) prefer cover crops than do  
239 WNOLs (19%,  $p$  value = 0.080). The specialized timing and management requirements of cover  
240 crops may resonate with WOLs, who are deeply involved in their farms. Roesch-McNally et al.  
241 (2017) documents the structural barriers of adopting cover crops by studying the focus groups of  
242 Iowa farmers. Cover crops also offer on-farm benefits like decreased erosion and increased water  
243 infiltration, which can intrigue WOLs with hands-on experience into adoption. Regarding water  
244 quality, 43% of WOLs showed interest, a significant contrast to 14% of WNOLs ( $p$ -value =  
245 0.051). Active farming likely intensifies WOLs' connection to the land, heightening their  
246 awareness of local water quality issues and the impact of farm management on this resource.  
247 Conversely, energy contracts for wind or solar were of interest to 23% of WNOLs, outpacing the  
248 7% of WOLs ( $p$ -value = 0.079). WNOLs might see these contracts as stable income sources,  
249 aligning with their non-operational status and a broader goal of long-term profitability.

250

251 We extend our comparisons to full-time and part-time WOLs, as well as experienced and  
252 inexperienced WNOLs, as Table 2 shows. Full-time WOLs, while stewarding similar farmland  
253 acreages, tend to own fewer but larger parcels than part-time WOLs. Among WOLs, a marked  
254 75% of the full-time group show interest in soil fertilizer improvement, a stark contrast to the 7%  
255 of part-time WOLs ( $p$  value < 0.001). On the other hand, more part-time WOLs express  
256 preference for water quality (53%), wildlife habitat (35%), and pasture and hay land

257 management (40%). This might suggest full-time WOLs lean toward practices delivering  
258 production benefits, while part-time WOLs adopt a holistic view of land stewardship,  
259 emphasizing broader environmental outcomes.

260

261 We asked WNOLs to identify themselves as experienced owners or inexperienced owners, and  
262 the two groups are evenly split. However, experienced owners command significantly larger  
263 acreages. Petrzelka and Sorensen's 2019 study from the American Farmland Trust reveals water  
264 quality as a pivotal conservation issue for WNOLs in the Corn Belt. Our findings augment this  
265 insight, showing 30% of experienced WNOLs in Iowa prioritize water quality compared to less  
266 than 1% of their inexperienced counterparts ( $p$  value = 0.002). When considering farmland acres,  
267 20% of acres are under the ownership of experienced WNOLs who manifest interest in  
268 conservation tillage, whereas a modest 6% is acres owned by inexperienced WNOLs ( $p$  value =  
269 0.089). Intriguingly, the inverse holds true for energy contracts in the wind or solar sectors, with  
270 interest displayed by a higher portion of inexperienced WNOLs (37%) in contrast to their  
271 experienced counterparts (7%,  $p$  value = 0.032). This divergence could indicate that experience  
272 fosters a deep appreciation for sustainable land management, evidenced by the focus on water  
273 quality and conservation tillage. Conversely, the enthusiasm of inexperienced WNOLs for  
274 energy contracts might hint at a modern, possibly revenue-centric outlook, spurred by the global  
275 emphasis on renewable energy and the promise of swift economic gains.

276

277 Among the women landowner surveyed, 60% lease out their land, whereas 40% do not. The  
278 WOL to WNOL ratio is roughly 8:2 for those not leasing and 3:7 for those who do. Table 3  
279 reveals that 85% of women who retain their land are interested in conservation topics, compared  
280 to 68% of those who lease out their land to other operators ( $p$  value = 0.067). This higher  
281 conservation interest among those not leasing land to other operators aligns with the trend seen  
282 between WOLs and WNOLs. Those not leasing land to others primarily show interest in soil  
283 fertilizer improvement ( $p$  value = 0.072), hay land management ( $p$  value = 0.053), non-  
284 government conservation programs ( $p$  value = 0.096), and conservation easements ( $p$  value =  
285 0.060). Notably, these preferences differ from the earlier OL versus NOL comparison that  
286 emphasized carbon credits, water quality, and cover crops. These variances indicate influences  
287 beyond the mere OL-NOL distinction. One might infer that land uses and personal management  
288 strategies significantly shape conservation priorities, underlining the need for targeted  
289 approaches when engaging different landowner groups.

290

291 Table 3 delves into the correlation between residence and conservation topic interest among  
292 women landowners. Of these landowners, 71% are in-county residents—they live and farm in  
293 the same county. Meanwhile, 21% reside in a different county than their farm, and 8% live  
294 outside of Iowa. In-county residents have a more pronounced interest in soil fertilizer  
295 improvement (32%) compared to out-of-county absentee landowners (15%,  $p$  value = 0.073).  
296 This trend aligns with the reduced fertilizer interest observed among women leasing out their  
297 land to others. When assessing by land size, 37% of out-of-county absentee landowners are  
298 interested in government conservation programs, a proportion that exceeds their in-county



299 counterparts ( $p$  value = 0.096). Importantly, this figure surpasses the overall 23% government  
300 program interest noted in Table 1 and suggests that these programs, potentially providing  
301 financial incentives and sustainability-oriented practices, could be attractive to absentee owners  
302 keen on bolstering the long-term value and productivity of their sizable land investments.

303

### 304 *Financial Characteristics*

305

306 Table 4 summarizes women landowners' interests based on acres of landholdings and percentage  
307 of off-farm income. The farmland size ranges from 11 to 2,500 acres, with a median size of 344  
308 acres and a mean size of 446 acres. Using classifications from the USDA Economic Research  
309 Service (2022) and the USDA National Agricultural Statistics Service – Iowa (2022), we  
310 categorize farms by sales volume and small farms include low-sales farms and moderate-sales  
311 farms. Accordingly, women landowners with farmland acres of <250, 250–499, 500–999, and  
312 1000+ respectively fall into the categories of owning low-sales, moderate-sales, midsize, and  
313 large-scale volume farms. From the first panel of Table 4, the women landowners with low-  
314 sales-volume farms have the highest percentages of interest in wildlife habitat improvement  
315 (29%,  $p$  value = 0.013) and pasture management (23%,  $p$  value = 0.071) compared to other  
316 groups. Meanwhile, as the farmland size increases, the percentage of interest in water quality  
317 improvement decreases, and typically the women owning large scale farms are least interested in  
318 this topic (3%,  $p$  value = 0.008). In general, women owning small farms are more interested in  
319 pasture management, water quality, and wildlife habitat.

320

321 Of respondents that reported their percentage of off-farm income, 13% receive all their income  
322 from farming. A lower percentage of women with 20% or less of off-farm income are interested  
323 in pasture management (2%,  $p$  value = 0.007), solar/wind energy contracts (3%,  $p$  value =  
324 0.012), wildlife habitat (<1%,  $p$  value < 0.001), and water quality (10%,  $p$  value = 0.085).  
325 Typically, as off-farm income increases, so does interest in the last three topics mentioned.  
326 Women earning over half of their income off-farm—61% of our sample—are significantly  
327 interested in wildlife habitat improvement (40%,  $p$  value = 0.003). This seems to indicate that  
328 respondents believe on-farm profitability conflicts with wildlife habitat improvement, which  
329 might be viewed as financially risky. In addition, women deriving 21%–50% of their income off-  
330 farm exhibit the most pronounced interest in soil erosion control (68%,  $p$  value = 0.016).  
331 Conversely, those with over half their income sourced off-farm display the least interest in soil  
332 fertilizer improvement (20%,  $p$  value = 0.050). This may suggest that women landowners less  
333 reliant on on-farm income might have diminished interest in soil conservation practices.

334

### 335 *Demographic Characteristics*

336 Table 5 describes women landowners' interests by farm enterprise type and age groups. We  
337 differentiate between landowners focusing on row crops, those integrating row crops and  
338 livestock, and those combining row crops with pasture. Seventy percent of women-owned farms  
339 specialize in row crops, while a mere 10% incorporate livestock. Landowners concentrating  
340 solely on crops display a limited inclination towards conservation easements (1%,  $p$  value =

341 0.068), which contrasts to landowners engaged in diversified farming enterprises. This may hint  
342 at a broader ecological or long-term land health perspective when multiple farming activities are  
343 pursued. Women who operate crop-only farms display a relatively minimal interest in pasture  
344 and hay land management (4%,  $p$  value = 0.001), while there is a marked increase in interest  
345 from women involved in both crop and livestock (43%,  $p$  value = 0.059) and those managing  
346 both crop and pasture (57%,  $p$  value = 0.002). This likely stems from the value of pasture both as  
347 livestock feed and for hay land management. Interestingly, those combining crops and livestock  
348 exhibit a heightened interest in water quality improvement (57%,  $p$  value = 0.021) but lower  
349 interest in carbon credits (1%,  $p$  value = 0.007) and solar/wind energy contracts (2%,  $p$  value =  
350 0.034). The high interest in water quality from these women may stem from their holistic  
351 approach to farm management, especially in diverse operations that include livestock. They  
352 recognize the synergies between the off-farm impacts (e.g., water quality) and livestock. Excess  
353 nutrients from livestock manure can contaminate water bodies, which inversely affects the health  
354 of livestock. For the low interest in carbon credits and energy contracts, while women understand  
355 their potential benefits, the complexities and costs associated with altering farm management—  
356 particularly for those operating both crops and livestock—might demotivate them from pursuing  
357 these practices.

358

359 We also compare women landowners' interest in conservation topics by age groups. With an  
360 average age of 70, most women landowners fall between the ages of 60 and 80 (60%). Due to  
361 data limitation, we cannot observe the perspectives from Iowa women landowners under 40.  
362 However, based on the 2017 and 2022 IFOTS, 5% and 4% of all women landowners are under

363 40, respectively. Hence, we hope the missing responses would not affect the perspectives of  
364 Iowa women landowners. The second panel of Table 5 divides respondents into four age groups.  
365 We find that only 1% of women over 80 show interest in conservation easements ( $p$  value =  
366 0.064), a level far lower than other age groups, especially compared to women between 40 and  
367 59 (25%). Similarly, women over 80 show the least interest in cover crops (9%,  $p$  value = 0.031),  
368 and more younger women landowners are interested in cover crops. Compared to other groups,  
369 the youngest group, 40–59, has the highest proportion showing interest in cover crops (35%,  $p$   
370 value = 0.059) and wildlife habitat improvement (45%,  $p$  value = 0.099), which aligns with the  
371 literature that younger women farmers are more likely to adopt agri-environmental practices and  
372 programs (Boon et al. 2010; Unay-Gailhard and Bojnec 2021). Petrzelka and Marquart-Pyatt  
373 (2011) suggests that older non-operating landowners may be less active on their land and are less  
374 likely to be involved in conservation practices than younger non-operating landowners.  
375 Conservation easements and cover crops require more time and connection with land managers  
376 or tenants, and senior women landowners are likely unable to adopt these practices due to ability  
377 or distance to engage in the “extra” work that might be involved at their age.

378

### 379 *Conservation Concerns*

380 For each conservation-related issue, we asked respondents to rank their level of concern from 1  
381 (not concerned at all) to 4 (very concerned). Table 6 shows the percentages of respondents who  
382 are at least slightly concerned ( $>1$ ) about the issues and summarizes the statistics by WOLs,  
383 WNOLs, and total landowners. Women landowners are most concerned with the number of  
384 requirements associated with government conservation programs (62%), which matches women

385 landowners' highest interest in government conservation programs generally. The remaining  
386 concerns are doubts about the true environmental value of the practices (47%), interference with  
387 the ability to change land management practices (43%), low cost-share payments (39%), and  
388 demands on time and labor (39%). Perry-Hill and Prokopy (2014) shows that female landowners  
389 are less likely to enroll in conservation programs than are male landowners. Combining this with  
390 the high interest in programs from our survey, we can see women's concerns about conservation  
391 programs mentioned above are essential barriers for women landowners' conservation  
392 participation.

393

394 Although fewer respondents stated concern with the statements "Not familiar with practices"  
395 (34%) or "Don't know anyone implementing the practices" (28%), the actual adoption of key  
396 conservation practices in Iowa remains low. According to the 2017 and 2022 IFOTS, only 5%  
397 and 7% of Iowa landowners adopted cover crops and 21% and 26% of Iowa landowners adopted  
398 no-till (Sawadgo et al. 2021; Tong and Zhang 2023). Paired with the second-largest concern of  
399 questioning the environmental value of the practices, respondents may have overstated  
400 familiarity with conservation practices, which shows a significant need for extensive and  
401 innovative educational efforts directed toward women landowners. Alternatively, cultural  
402 barriers caused by gender-based discrimination can hinder women from implementing  
403 conservation practices despite their knowledge and willingness, as indicated by Wells and Eells  
404 (2011) and Carter (2016). Their male tenants, advisors, and service providers might disregard or  
405 undervalue their input, potentially limiting the adoption of conservation measures. Such

406 challenges highlight the imperative for educators to foster a more inclusive conservation culture  
407 when engaging with women landowners.

408

409 According to Druschke and Secchi (2014), female landowners often possess less knowledge  
410 about conservation practices compared to their male counterparts. Typically, WNOLs are  
411 frequently sidelined from farming decisions, including those related to conservation, due to gaps  
412 in technical knowledge (Carolan et al. 2004; Carter 2016; Ranjan et al. 2019). Our survey  
413 underscores a compelling trend: women landowners who identify as having limited conservation  
414 knowledge are more interested in the subject than those without such perceived gaps. We define  
415 limited knowledge based on concerns about familiarity with conservation practices, perceived  
416 value of these practices, access to equipment and program information, and lack of a supportive  
417 network. Remarkably, only 16% of these women report no conservation interest, in contrast to  
418 46% of those without these concerns ( $p$  value = 0.011). Specifically, these knowledge-  
419 constrained women show heightened interest in government programs (46%,  $p$  value = 0.009),  
420 pasture management (28%,  $p$  value = 0.006), and cover crops (28%,  $p$  value = 0.079).

421

422 Respondents ranked communications with tenants (21%), family/co-owners (19%), or neighbors  
423 (18%) as the least important concerns. This finding is in line with the results from the 2019  
424 American Farmland Trust survey that “neighboring landowners” and “surrounding communities”  
425 are less important influencers for WNOLs that make decisions about conservation practices  
426 (Petrzelka and Sorensen 2019). Ulrich-Schad et al. (2016) also surveyed Indiana’s out-of-state

427 landowners and find their relationships with tenants generally play no role in conservation  
428 adoption decisions.

429

430 Both WOLs and WNOLs rank the top five concerns about conservation practices similarly.  
431 However, WOLs put more weight on government red tape, financial issues, and farm  
432 management, which is reflected in their emphasis on excessive government requirements (87%,  
433  $p$  value < 0.001), insufficient cost-share payments (72%,  $p$  value = 0.001), and the difficulty in  
434 altering existing management practices (66%,  $p$  value = 0.028). In contrast, WNOLs show less  
435 concerns in the value of conservation practices, supported by fewer WNOLs being uncertain  
436 about the environmental benefits of practices (33%,  $p$  value = 0.063) and fewer concerns that  
437 these practices might devalue the land (24%,  $p$  value = 0.042). WNOLs generally have less  
438 concerns on conservation issues, which likely relates to their lower interest in conservation topics  
439 overall.

440

#### 441 ***Educational Preferences***

442 We asked women landowners to select the top three ways they would like to receive information  
443 and educational programming. From Figure 1, 63% of respondents prefer a periodic newsletter  
444 or e-newsletter for receiving information and about one-third of respondents prefer receiving  
445 information through two-page fact sheets or infographics. Webinars are the third-most popular  
446 delivery method (23% of respondents prefer this method). Overall, women landowners prefer

447 virtual or printed delivery methods to in-person formats. WOLs are generally more willing to  
448 receive educational information than WNOLs.

449

450 Figures 2a and 2b compare the preferred communication methods by WOL and WNOL age  
451 groups. The average WOL in our sample is 67 years old and the average WNOL is 71 years old.  
452 As age increases, more WOLs choose (e-)newsletters and large-font notebooks (see figure 2a).  
453 Younger WOLs prefer fact sheets/infographics, webinars, and half-day in-person educational  
454 meetings. For WNOLs (see figure 2b), senior owners typically prefer large font notebooks; and,  
455 younger owners prefer webinars, multi-series educational meetings, virtual field days, and  
456 women landowner learning circles. We note that the interest in a large font book increases for  
457 WOLs in their 60s–70s and WNOLs in their 80s. Previous research shows that, compared to  
458 presentations or the internet, both male and female landowners prefer to receive educational  
459 information through postal mail and informal occasions where they can interact with each other  
460 in person, for example, learning circles (Eells and Adcock 2012; Petrzelka et al. 2019; Fairchild  
461 et al. 2022). From our survey, there is a noticeable rise in the percentages of respondents under  
462 the age of 60 choosing half-day in-person educational meetings for WOLs and choosing virtual  
463 field days and women landowner learning circles for WNOLs. In summary, senior landowners  
464 over the age of 60 prefer printed papers, and younger landowners under the age of 60 prefer  
465 virtual delivery. Women landowners of all ages welcome receiving information through periodic  
466 (e-)newsletters.

467



468 *Implications for Extension and Conservation Professionals*

469 Our findings can guide extension and conservation professionals as they develop programs and  
470 resources to reach women landowners and achieve conservation goals. Time and funding  
471 limitations often lead to selecting one format or mode of program and educational content  
472 delivery; however, the survey results encourage extension and outreach professionals to diversify  
473 delivery methods and content to meet WOL and WNOL needs and preferences. Periodic mailed  
474 or emailed newsletters and two-page fact sheets ranked highly for both WOL and WNOLs  
475 indicating interest in information that is brief and available to review on their schedule.  
476 Flexibility is also important for interactive learning opportunities. Offering both printed papers  
477 delivery and virtual learning sessions address preferences by both WOL and WNOLs, increasing  
478 opportunities to engage, learn and build community around conservation efforts.

479

480 **Summary and Conclusions**

481 This study contributes to the current literature in four ways. First, using a statistically  
482 representative sample of Iowa female landowners, we provide one of the first comprehensive  
483 analyses of understudied women landowners' views on farmland conservation topics based on  
484 their operational status, farming time and experience, land leasing status, residency, and financial  
485 and demographic characteristics. We underscore the heterogeneity among women landowners  
486 and shed light on how important these factors are in shaping their interest in conservation topics.  
487 We find statistical evidence that more WOLs are interested in conservation than WNOLs. Land

488 leasing status further supports this observation—a higher proportion of women who retain their  
489 land, rather than leasing it out to others, express interest in conservation.

490

491 Second, our results indicate that women landowners' interests are dispersed among conservation  
492 topics, and the proportion of uninterested women landowners is nontrivial and mainly derives  
493 from inexperienced WNOLs. Also, government conservation programs and soil management  
494 practices play an essential role in women landowners' interest in conservation, which indicates  
495 their focus on the long-established programs and time-tested soil management practices. Such  
496 preferences may also hint at their financial inclination towards program payments and the  
497 enhanced production yields offered by effective soil management. The higher interest in the  
498 traditional practices paired with low conservation adoption rates overall among women  
499 landowners may reflect their unfamiliarity with alternative approaches, underscoring the  
500 potential benefits of targeted educational outreach from professionals.

501

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

509

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

517

518

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

530 approaches, and other strategies could be applied to improve participation and efficacy of  
531 outreach according to various groups' preferences.

532

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

539

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654

655 **Table 1.**

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

	Percent of respondents expressing interest					
	<b>Total</b>		<b>Own-operating</b>		<b>Non-operating</b>	
	Owner	Acre	Owner	Acre	Owner	Acre
<b>Conservation programs</b>						
agricultural carbon credits programs	17%	17%	42%**	27%	8%**	14%
Government conservation programs	36%	23%	28%	20%	35%	24%
Non-government conservation programs	11%	11%	21%	15%	8%	8%
<b>Primarily benefit water quality</b>						
Water quality improvement	22%	15%	43%*	14%	14%*	14%
<b>Primarily benefit net carbon emission</b>						
Conservation easements	8%	6%	4%	6%	10%	6%
<b>Benefit both water quality and net carbon emission</b>						
Soil erosion control	29%	34%	15%	18%**	31%	39%**
Soil fertilizer improvement	27%	31%	20%	44%*	27%	26%*
Cover crops	23%	21%	44%*	37%**	19%*	15%**
Pasture and hay land management	19%	9%	34%	16%	12%	6%
Conservation tillage	13%	17%	16%	16%	13%	16%
<b>Benefit neither water quality nor net carbon emission</b>						
Wildlife habitat improvement	24%	11%	28%	11%	23%	10%
Energy contracts for wind or solar	15%	12%	7%*	5%**	23%*	17%**
No Interest	25%	29%	12%*	22%	31%*	33%
Number of landowners represented	52,744		14,163		30,362	
Number of acres represented		5,129,332		1,310,411		3,186,207

657 Notes: Table 1 shows the percentages of women landowners' choices to the question, "What topics related to farmland conservation  
658 are you most interested in receiving information about" within each owner type. We asked respondents to select the three topics they  
659 were most interested in receiving information about. The farmland tenure sample allows us to calculate the representative interest  
660 percentages of Iowa female landowners and of farmland acres owned by these female landowners with both owner and acre weights.

661 The survey asked whether consider themselves operating or non-operating landowners. A few respondents did not report their  
 662 operating status. We use a t-test to compare the percentage of respondents and their acres between operating owners and non-operating  
 663 owners. \*: p-value < 0.10; \*\*: p-value < 0.05; \*\*\*: p-value < 0.01.

664

665 **Table 2.**

666 **Differences in interest in farmland conservation topics by women landowners' farming status.**

Conservation topics	Percent of respondents expressing interest			
	<b>Own-operating</b>			
	<b>Full-time WOL</b>		<b>Part-time WOL</b>	
	Owner	Acre	Owner	Acre
Pasture and hay land management	10%*	18%	40%*	13%
Soil fertilizer improvement	75%***	73%***	7%***	18%***
Water quality improvement	<1%***	<1%**	53%***	27%**
Wildlife habitat improvement	<1%**	<1%**	35%**	20%**
Number of landowners represented	2,714		11,449	
Number of acres represented	622,508		687,903	
Conservation topics	<b>Non-operating</b>			
	<b>Experienced WNOL</b>		<b>Inexperienced WNOL</b>	
	Owner	Acre	Owner	Acre
Conservation tillage	19%	20%*	8%	6%*
Energy contracts for wind or solar	7%**	14%	37%**	25%
Water quality improvement	30%***	20%***	<1%***	<1%***
Number of landowners represented	14,355		16,007	
Number of acres represented	2,266,393		919,814	

667 Note: Table 2 shows the percentages of people interested in the topics within each land and owner type. We use a t-test to compare the  
 668 percentage of respondents expressing interest between full-time and part-time WOLs and between experienced and inexperienced  
 669 WNOLs. A few respondents did not report their farming status. We only report statistical differences equal to or larger than the 90%  
 670 significant level. \*: p-value < 0.10; \*\*: p-value < 0.05; \*\*\*: p-value < 0.01.

671

672 **Table 3.**

673 **Differences in interest in farmland conservation topics by women landowners' land leasing status and Iowa residency.**

Conservation topics	Percent of respondents expressing interest			
	<b>Land leasing status</b>			
	<b>Not lease</b>		<b>Lease out</b>	
	Owner	Acre	Owner	Acre
Conservation easements	16%*	9%	1%*	3%
Non-government conservation programs	20%*	11%	4%*	10%
Pasture and hay land management	34%*	15%**	10%*	4%**
Soil fertilizer improvement	38%*	37%	18%*	26%
No interest	15%*	23%	32%*	33%
Number of landowners represented	20,747		30,308	
Number of acres represented	1,889,437		2,945,266	
Conservation topics	<b>Residency</b>			
	<b>Resident</b>		<b>Absentee</b>	
	Owner	Acre	Owner	Acre
Government conservation programs	36%	19%*	35%	37%*
Soil fertilizer improvement	32%*	32%	15%*	29%
Number of landowners represented	37,490		15,254	
Number of acres represented	3,836,170		1,293,162	

674 Notes: Table 3 shows the percentages of people interested in the topics within each land and owner type. We weight acres and owners  
 675 using the share of acres leased out. A few respondents did not report their leasing status. We combine in-state absentees and out-of-  
 676 state absentees into the category of absentees. All respondents reported their residency. We only report statistical differences equal to  
 677 or larger than the 90% significant level. \*: p-value < 0.10; \*\*: p-value < 0.05; \*\*\*: p-value < 0.01.

678

679

680 **Table 4.**

681 **Differences in distribution of interest in farmland conservation topics by women landowners' financial characteristics.**

Conservation topics	Percent of respondents expressing interest			
	<b>Landholdings (acres)</b>			
	<b>0-249</b>	<b>250-499</b>	<b>500-999</b>	<b>1000+</b>
Pasture and hay land management	23% *	7%	9%	11%
Water quality improvement	23%	19%	13%	3% ***
Wildlife habitat improvement	29% **	5%	11%	22%
Number of landowners represented	40,138	5,910	4,221	997

Conservation topics	<b>Landowner's percentage of off-farm income</b>		
	<b>0-20</b>	<b>21-50</b>	<b>51-100</b>
Energy contracts for wind or solar	3% **	11%	26%
Pasture and hay land management	2% ***	28%	25%
Soil erosion control	18%	68% **	27%
Soil fertilizer improvement	42%	46%	20% *
Water quality improvement	10% *	25%	28%
Wildlife habitat improvement	<1% ***	10%	40% ***
Number of landowners represented	9,039	7,513	25,390

682 Note: Table 4 shows the percentages of people interested in the topics within each owner type. For landholdings, we compare the  
683 smallest group with respondents in general and similarly for the largest group. We then compare groups of landholdings with less than  
684 and more than 500 acres. The average percentages of these two groups are not reported in the table. For the percentages of off-farm  
685 income, we compare the groups between 20% and the groups between 50%. We only report the results with owner weights for  
686 simplicity and the statistical differences equal to or larger than the 90% significant level. \*: p-value < 0.10; \*\*: p-value < 0.05; \*\*\*:  
687 p-value < 0.01.

688

689 **Table 5.**

690 **Differences in distribution of interest in farmland conservation topics by women landowners' farm enterprise and**  
 691 **demographic characteristics.**

Conservation topics	Percent of respondents expressing interest				
	<b>Farm enterprise types</b>				
	<b>Only crop</b>	<b>Crop and livestock</b>	<b>Crop and pasture</b>		
Agricultural carbon credits programs	17%	1%***	21%		
Conservation easements	1%*	27%	17%		
Energy contracts for wind or solar	16%	2%**	11%		
Pasture and hay land management	4%***	43%*	57%***		
Water quality improvement	14%	57%**	23%		
Number of landowners represented	35,002	4,962	9,934		
Conservation topics	<b>Landowner's age groups</b>				
	<b>40-59</b>	<b>60-69</b>	<b>70-79</b>	<b>80+</b>	
	Conservation easements	25%	5%	5%	1%*
	Cover crops	35%*	33%*	17%*	9%**
	Wildlife habitat improvement	45%*	12%	15%	30%
Number of landowners represented	9,699	16,929	14,129	11,305	

692 Note: Table 5 shows the percentages of people interested in the topics within each owner type. For farm enterprise types, we use the  
 693 farmland with only crops as the base group and compare the other two with the baseline. We then compare the base group with the  
 694 other farm types. For age groups, we compare the smallest group with respondents in general and similarly for the largest group. We  
 695 then compare the age groups below and above 70. The average percentages of these two groups are not reported in the table. We only  
 696 report the results with owner weights for simplicity and statistical differences equal to or larger than the 90% significant level. \*: p-  
 697 value < 0.10; \*\*: p-value < 0.05; \*\*\*: p-value < 0.01.

698

699

700



701 **Table 6.**

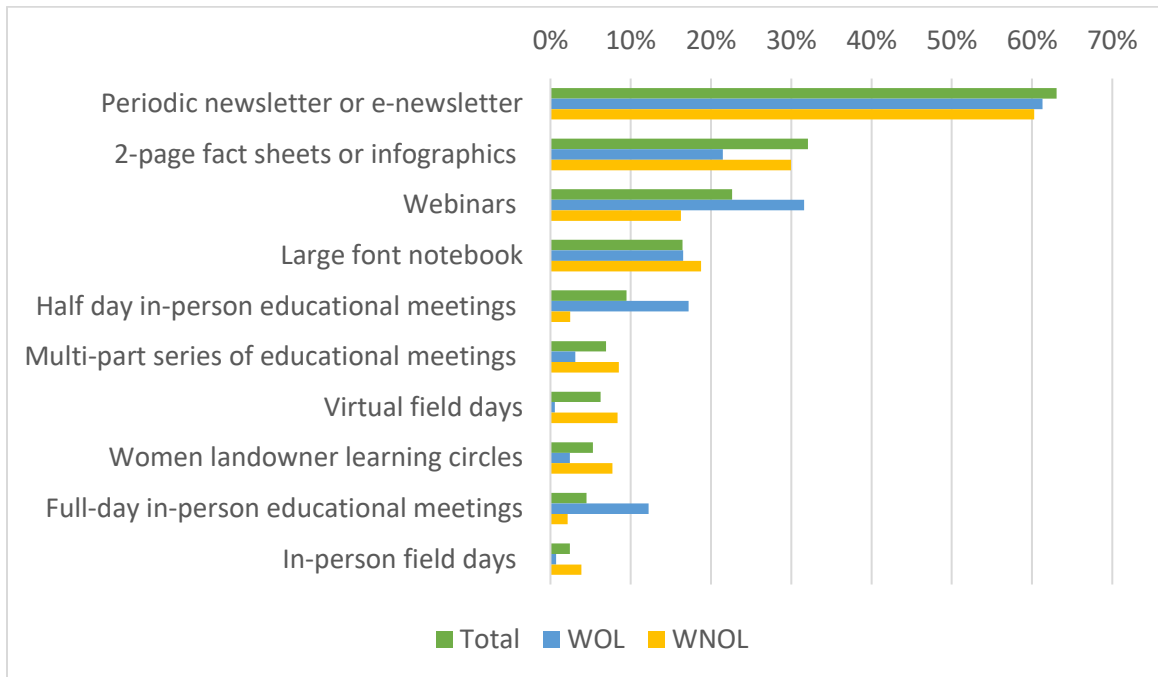
702 **Operating vs. non-operating women landowners' concern about conservation-related issues.**

Conservation-related issues	% of respondents concerned or very concerned		
	Total	Operating owner	Non-operating owner
Too many paperwork related with government programs	62%	87%***	50%***
Unsure of the true value of the practices to the environment	47%	60%*	33%*
Interference with ability to change land management practices	43%	66%**	37%**
Low cost-share payments	39%	72%***	32%***
Time consuming and laborious	39%	59%	36%
Incorporating the practices into leases	37%	43%	29%
Conservation practices may decrease the value of land	35%	53%**	24%**
Hard to find information about state/federal programs	35%	46%	32%
Not familiar with conservation practices	34%	44%	29%
Don't know anyone implementing conservation practices	28%	43%	21%
Access to conservation equipment needed	27%	46%	23%
Communication with tenants	21%	26%	21%
Discussion of the practices may upset family or co-owners	19%	30%	17%
Disapproval from neighbors	18%	29%	13%
Number of landowners represented	52,744	14,163	30,362

703 Note: We asked respondents to rank their level of concern from 1 (not concerned at all) to 4 (very concerned). Table 6 shows the  
 704 percentages of respondents who are at least slightly concerned (>1) about the conservation issues within each group. We only report  
 705 the results with owner weights for simplicity and statistical differences between WOLs and WNOLs equal to or larger than the 90%  
 706 significant level. \*: p-value < 0.10; \*\*: p-value < 0.05; \*\*\*: p-value < 0.01.

707

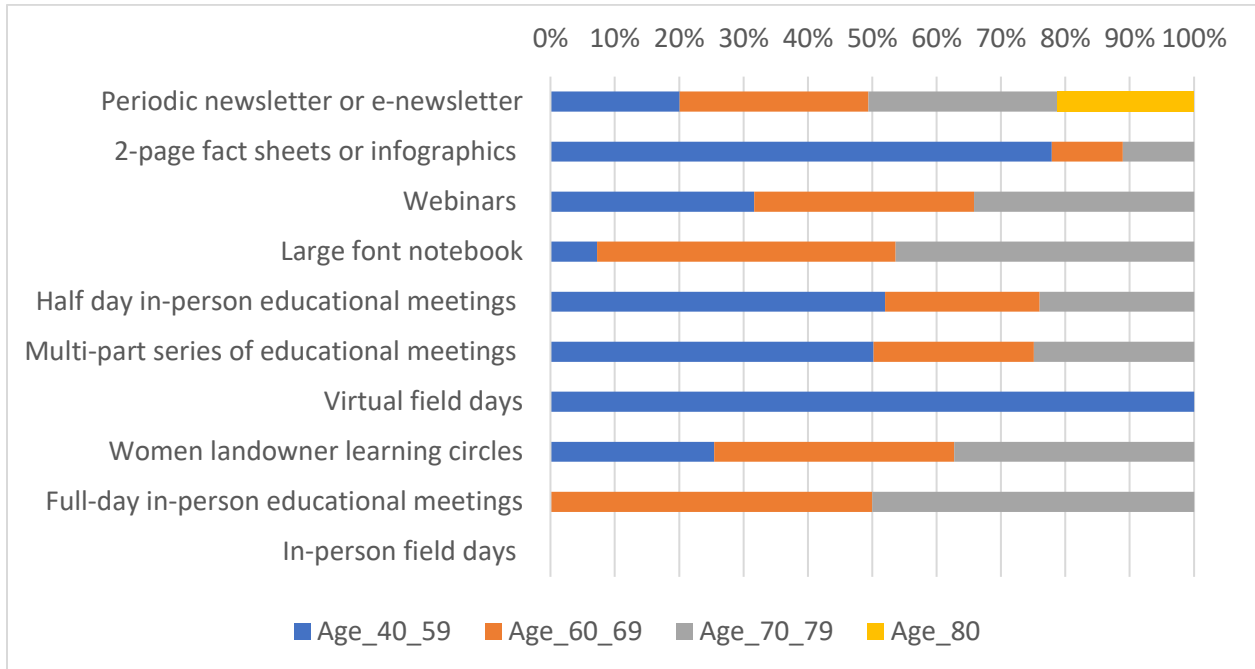
708 **Figure 1. Women Landowners' preferred ways to receive information and educational**  
 709 **programming.**



710

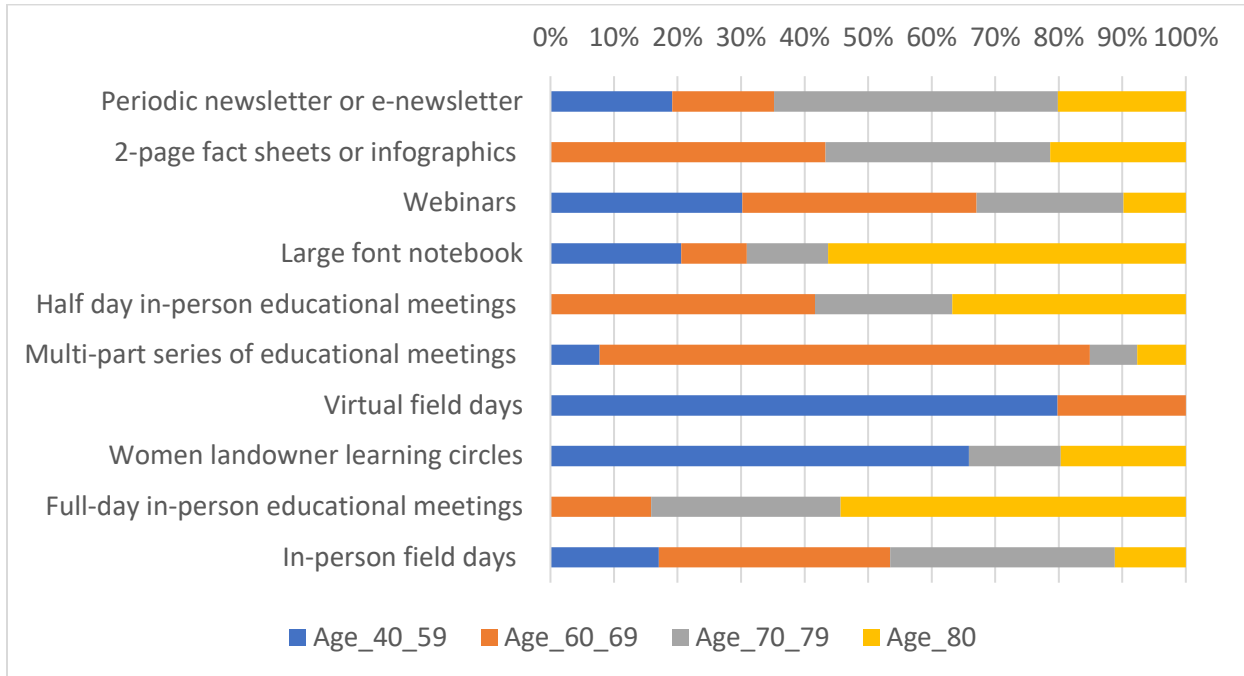
711 Note: We asked respondents to select the top three delivery methods they prefer for receiving  
 712 information and educational programming. We rank methods according to the percentages of  
 713 total responses from high to low.

714 **Figure 2a.**  
 715 **Women landowners' preferred methods of receiving information and educational**  
 716 **programming by age group.**  
 717 Operating owners' preferences by age groups



718  
 719  
 720

721 **Figure 2b.**  
 722 **Women landowners' preferred methods of receiving information and educational**  
 723 **programming by age group.**  
 724 Non-operating owners' preferences by age groups



725