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Usefulness of Delivery Methods for Climate Change Programming: Perspectives of Extension and Research Faculty

Abstract

Extension is responding to climate change through programming intended to encourage adaptation and mitigation in agricultural production and natural resources management. However, effectively engaging target audiences requires identifying appropriate delivery methods. We conducted a study to identify delivery methods researchers and Extension professionals at land-grant universities in the northeastern United States perceive as useful for climate change outreach. Respondents viewed all delivery methods as only slightly useful, though traditional options, including face-to-face interactions and the use of videos and websites, were perceived as slightly more useful than other delivery methods. Therefore, we in Extension must experiment with various delivery methods to identify those most likely to effect the adoption of adaptation and mitigation practices.

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Introduction

As climate change ticks temperatures upward, intensifies extreme precipitation events, and makes weather increasingly unpredictable (Horton et al., 2014), the Cooperative Extension System has begun responding through programming intended to encourage adaptation and mitigation in agricultural production and natural resources management (Bartels et al., 2013; Brugger & Crimmins 2015; Jones & Lenart, 2014; Layman, Doll, & Peters, 2013; Pathak, Bernadt, & Umphlett, 2014). As with all regions across the United States, the Northeast demands tailored adaptation and mitigation strategies, particularly considering the region's diversity in landscapes, land uses, and variability in farm size (U.S. Department of Agriculture National Agricultural

Statistics Service, 2015). Agriculture, fisheries, forests, and other ecosystems in the Northeast are already confronting more frequent extreme precipitation events and warmer temperatures, which can lead to crop damage, increases in flooding, shifts in wildlife migrations, and a decrease in resilience of ecosystems (Horton et al., 2014). Despite the climate change impacts occurring in the Northeast, there has been little attention dedicated to how to best connect land use managers with relevant and appropriate information to assist them in their decision making.

Given the challenges that climate change presents to agricultural producers and natural resources managers, communication of the latest climate research to target audiences is essential (Prokopy, Carleton et al., 2015). Extension is viewed by agricultural producers and natural resources managers as a critical source of relevant and trusted information (Prokopy, Morton, Arbuckle, Mase, & Wilke, 2015). Although some skepticism continues to exist regarding human-caused climate change, especially among rural and conservative audiences (Liu, Smith, & Safi, 2014; McCright & Dunlap, 2011), Extension has the potential to disseminate climate information in ways that are well received among land managers, including farmers, foresters, and other natural resources managers (Brugger & Crimmins, 2015). Therefore, identifying the most effective communication methods for disseminating information is imperative to ensuring that Extension engages successfully in climate change adaptation and mitigation (Rollins, Bruening, & Radhakrishna, 1991).

To develop and deliver programming most effectively, Extension must understand the preferred delivery methods of its target audiences. This is particularly important given that preferences often shift with demographic differences (Bardon, Hazel, & Miller, 2007; Iams & Marion, 1991; Radhakrishna, Nelson, Franklin, & Kessler 2003). For example, small-scale farmers in Oklahoma prefer direct mailings (Cartmell, Orr, & Kelemen, 2006), whereas young farmers in Florida would rather receive information via the Internet and social media (Telg & Barnes, 2012). Bardon et al. (2007) found that older forest landowners in North Carolina prefer exclusively mail-based information but that younger forest landowners are open to both mail-based and web-based information. Even as new opportunities for information dissemination emerge through web-based tools, face-to-face interactions still have value among Extension audiences (Bairstow, Berry, & Driscoll, 2002; Hobbs, 2004; Ingram, Dorsey, & Smith, 2004; Kline, Kneen, Barrett, Kleinschmidt, & Doohan, 2012).

In terms of climate change, little information exists regarding the usefulness of various delivery methods for farmers, foresters, or other natural resources managers. Much of the existing literature explores the steps that are necessary for Extension to proactively engage in climate change issues with its target audiences. Prokopy and Power (2015), for example, highlighted the skepticism that exists among Extension personnel regarding anthropogenic climate change and recommended better communication between university researchers and Extension educators as well as professional incentives to encourage engagement with climate change issues. Others have emphasized the importance of online tools, such as modeling and forecasts, and the need to train Extension educators on how to effectively use them (Dinon, Breuer, Boyles, & Wilkerson, 2012). Morris, Megalos, Vuola, Adams, and Monroe (2014) suggested that Extension will be most effective in climate change communication if it adapts its delivery strategy to the specific needs and beliefs of different audiences.

At this point, delivering effective Extension programming on climate change adaptation and mitigation to agricultural and natural resources audiences is still in its early stages. In the Northeast, efforts have accelerated following the establishment by the U.S. Department of Agriculture (USDA) of the USDA regional climate hubs, which seek "to develop and deliver science-based, region-specific information and technologies, with USDA and partners, to agricultural and natural resource managers that enable climate-informed decision-making, and to provide access to assistance to implement those decisions" (U.S. Department of Agriculture

Climate Hubs, 2016, "Mission"). The Northeast Climate Hub, which includes the 12 states from West Virginia to Maine as well as Washington, DC, has developed partnerships between the USDA and the region's 16 land-grant universities to develop tools and community programs that assist farmers and foresters in adapting to and mitigating climate change.

The findings we report here contribute to the efforts of the Northeast Climate Hub by providing further information on which to base climate change programming for farmers, foresters, and other natural resources managers. In particular, we explored the delivery methods university researchers and Extension personnel perceive as most effective in disseminating climate information and changing practices and behaviors. Although documenting target audience preferences is no doubt essential, it is also crucial to understand the views of researchers, Extension specialists, and Extension educators, considering that individuals in each of these university appointments serve in a unique capacity within land-grant universities. Such information can help specify what those individuals conducting research and developing and delivering programs on climate change consider to be effective communication strategies and can be used as important comparative data in future studies examining preferences of Extension's target audiences.

Purpose and Objectives

The overall purpose of our study was to identify delivery methods researchers and Extension professionals at land-grant universities perceive as useful for climate change communication to farmers, foresters, and other natural resources managers. We had three main objectives:

- to describe the profile of research faculty, Extension specialists, and Extension educators working in colleges of agriculture in northeastern land-grant universities who have at least 1% of their time dedicated to climate change-related work;
- to identify perceptions of the usefulness of various delivery methods among these researchers, Extension specialists, and Extension educators; and
- to determine whether differences in perceptions of usefulness of delivery methods exist among the three groups.

Methodology

Population and Sample

The sampling frame for the study consisted of all research faculty across the 16 land-grant universities in the Northeast with appointments in colleges of agriculture and all Extension specialists and educators working in programmatic areas related to agriculture, natural resources, or forestry at the universities or in regional or county Extension offices. Although the organizational structures of the universities vary, care was taken to identify the colleges and programmatic areas at each university housing relevant disciplines (those related to agriculture, forestry, and natural resources management). Though not all individuals in these colleges and programmatic areas are engaged in research or Extension activities related to climate change, a census was nonetheless conducted so that respondents could self-identify whether and how their work intersected with climate change. In total, 3,757 research participants were sent the survey, of which 1,211 responded, for a response rate of 32.2%. Because not all respondents worked on climate change activities, we determined that

only those respondents who had indicated that at least 1% of their time was dedicated to climate change work would be analyzed. Of the 1,211 respondents, 554 (45.7%) met this criterion.

Instrumentation

The data for the study are from a larger study on the current activities and future priorities of land-grant universities related to climate change. An online survey was developed through the use of Qualtrics. Respondents indicated, through semiclosed questions, their university appointment (Extension educator, Extension specialist, research faculty, administrator/director, or other), the perceived usefulness of specific delivery methods for disseminating information (via a Likert-type scale ranging from 1, *not at all useful*, to 4, *very useful*), the perceived usefulness of specific delivery methods for changing practices and behaviors (via the same Likert-type scale), and demographic information (disciplinary focus, gender, and age). Respondents could select their areas of disciplinary focus from a list of 27 options, which were subsequently aggregated to eight categories for the purpose of analysis. When respondents answered questions regarding their perceptions of usefulness of communication strategies, they were instructed to consider their target audiences. Given the breadth of disciplinary options provided in the survey, the study assumed that respondents' target audiences would include farmers, foresters, and other natural resources managers. The online survey was reviewed by a panel of experts that included Extension personnel and research faculty and was field tested and pilot tested. Faculty and Extension professionals in the southeastern United States conducted the pilot test. For the purposes of estimating overall reliability, the 13 delivery methods were grouped into three categories: traditional written and media publications (newsletters/bulletins/fact sheets, peer reviewed publications, videos, and radio programs), electronic dissemination (websites, online decision support tools, webinars, and social media), and face-to face meetings (field tours, workshops, meetings, short courses, and formal classes) (Eberle & Shroyer, 2000; Howell & Habron, 2004; Radhakrishna et al., 2003; Richardson, 2001).

Table 1 presents the reliability estimates for the study. Most of the items approach adequate reliability (Cronbach's α = 0.70), although the scale for traditional written and media methods is low (α = 0.43) (George & Mallery, 2003). Had more items been included for each scale, internal consistency likely would have increased.

Table 1.

Reliability Estimates for Traditional Written and Media Outreach, Electronic Outreach, and Face-to-Face Outreach

Delivery method category	No. of items	Usefulness of delivery methods for disseminating information (Cronbach's α)	Usefulness of delivery methods for changing practices/behaviors (Cronbach's α)
Traditional written and media outreach	4	.43	.61
Electronic outreach	4	.72	.75

Face-to-face outreach	5	.62	.74

Data Collection and Analysis

Guided by the tailored design method (Dillman, Smyth, & Christian, 2009), we collected data over a 6-week period in April and May 2015. Deans from each university signed a letter encouraging their faculty and Extension personnel to complete the survey, and a representative from each university in the USDA Northeast Climate Hub land-grant partnership emailed this letter to assist with recruitment. However, the distribution of the survey and all follow-up contact was centralized at one university to streamline the process. We used descriptive and inferential statistics to analyze the data. Bivariate analysis addressed relationships among those in the three types of university appointments (research faculty, Extension specialist, Extension educator) as the independent variable and usefulness of delivery methods as the dependent variable. Although administrator/director was a category measured for university appointment and is reported in the demographic profile, as seen in Table 2, it was excluded from bivariate analysis because of a lack of representation in the sample. Given that analysis included only specific colleges and programmatic areas within land-grant universities in the Northeast, the findings should be interpreted carefully, for they do not represent each university in its entirety or all regions across the country.

Results

Objective 1: Demographic Profile

The demographic profile of respondents is presented in Table 2. A plurality of the respondents were research faculty (44.2%), followed by Extension educators (26.3%) and Extension specialists (22.4%). Percentage of time dedicated to climate change varied among the respondents, with a majority (70.9%) dedicating only 1%–20% of their time to climate change–related activities. The highest climate change focus area occurred in the natural resources disciplinary area (38.8%), followed by cropping systems (30.7%), social sciences (22.9%), and plants (22.0%). It should be noted that the number of individuals representing disciplinary areas collectively exceeded the total number of respondents because each respondent was permitted to select up to three areas. A majority of respondents were male (59.4%). Additionally, 453 respondents reported their ages, and the mean age was 52.4 years (*SD* = 11.3).

Table 2.

Demographic Profile of Respondents Having at Least 1% Time Dedicated to Climate Change Activities

Characteristic	No.	%
University appointment (*n* = 550)		
Research faculty (no Extension appointment)	243	44.2
Extension agent/educator	145	26.4
Faculty with Extension appointment	123	22.4

Administrator/director	37	6.7
Other	2	0.4
% of time dedicated to climate change (n = 554)		
1%–20%	393	70.9
21%–40%	84	15.2
41%–60%	30	5.4
61%–80%	26	4.7
81%–100%	21	3.8
Climate change focus area[a] (n = 554)		
Animals	82	14.8
Cropping systems	170	30.7
Engineering	38	6.9
Environment	115	20.8
Food science and nutrition	25	4.5
Forestry	70	12.6
Natural resources	215	38.8
Plants	122	22.0
Social sciences	127	22.9
Other	78	14.1
Gender (n = 539)		
Female	218	40.4
Male	320	59.4
Other	1	0.2

[a]Respondents could select up to three focus areas.

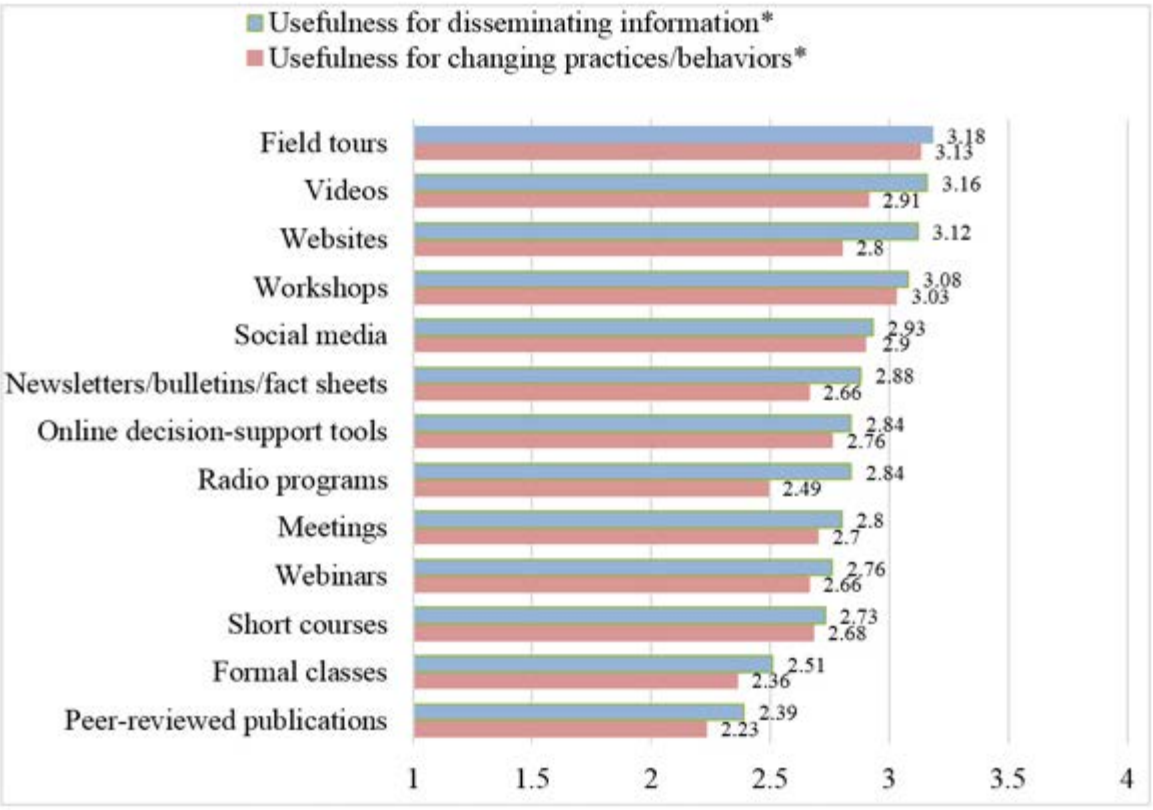
Objective 2: Usefulness of Delivery Methods

Respondents were asked to assess how they perceived the usefulness of various delivery methods for disseminating information to their target audiences and for changing practices or behaviors related to climate change. The number of respondents who answered this series of items ranged from 494 to 527 (of 554). Usefulness of each delivery method was measured on a scale of 1 = *not at all useful* to 4 = *very useful*. As the mean scores shown in Figure 1 indicate, respondents perceived each method as more useful for disseminating information than for changing practices or behaviors. For disseminating information, respondents perceived field tours (M = 3.18), videos (M = 3.16), websites (M = 3.12), and workshops (M = 3.08) as the most useful

delivery methods. Field tours (*M*=3.13) and workshops (*M* = 3.03) were also identified as the most useful delivery methods for changing practices or behaviors.

Figure 1.

Usefulness of Delivery Methods for Disseminating Climate Change Information and Changing Climage Change Practices/Behaviors



*Scale ranged from 1= *not at all useful* to 4= *very useful*.

To determine differences in the usefulness of delivery methods for disseminating information and for changing practices and behaviors, we conducted paired *t*-tests. For appropriate use of *t*-tests, we grouped the 13 delivery methods into three categories—traditional written and media outreach, electronic outreach, and face-to-face outreach. The results indicate that all methods were perceived as slightly useful, given that all mean scores were marginally above the theoretical midpoints, as shown in Table 3. In all cases, delivery methods were perceived as significantly more useful for disseminating information than for changing practices or behaviors.

Table 3.

Paired *t*-Test Results for Comparing Three Delivery Methods for Disseminating Information and Changing Practices/Behaviors

		Usefulness for disseminating information	Usefulness for changing practices/behaviors
Delivery	**No.**		

method category	of items	M^a	*SD*	M^a	*SD*	Mean difference	*t*	Effect size
Traditional written and media outreach[b]	4	11.29	1.72	10.27	2.11	1.01	13.47*	0.53
Electronic outreach[b]	4	11.65	1.92	10.86	2.32	0.79	10.23*	0.37
Face-to-face outreach[c]	5	14.30	2.37	13.89	2.62	0.41	4.37*	0.16

[a]Mean for each item was computed on a scale of 1 = *not at all useful* to 4 = *very useful*. [b]The theoretical range was 4–16, with a theoretical midpoint of 10. [c]The theoretical range was 4–20, with a theoretical midpoint of 12.
*$p < .001$

Objective 3: Differences Among Three Groups of Respondents

To determine differences in perceptions of the usefulness of the delivery methods among research faculty, Extension specialists, and Extension educators, we conducted analyses of variance. We used the same three categories (traditional written and media outreach, electronic outreach, and face-to-face outreach) for classifying delivery methods. Table 4 shows that the analyses of variance results revealed a significant model for traditional written and media delivery methods for disseminating information ($F = 3.63$, $df = 2$, $p < .05$), although the Scheffe post-hoc analysis indicated that no significant differences existed among the three groups. Analysis of variance results revealed that no significant differences existed related to disseminating information through electronic outreach or face-to-face outreach.

Table 4.

Analyses of Variance for Comparing Respondent Groups Relative to Methods for Disseminating Information

	Traditional mass media				Online mass media				Face-to-face interaction			
Group	***n***	M^a	***SD***	***F***	***n***	M^a	***SD***	***F***	***n***	M^a	***SD***	***F***
Extension educator	129	11.07	1.68		134	11.70	1.86		133	11.89	1.95	
Extension specialist	118	11.08	1.77	3.63*	115	11.44	2.02	0.56	117	11.49	1.74	3.70
Research faculty	220	11.50	1.66		216	11.60	1.89		221	11.32	1.88	

Total	467	11.28	1.70	465	11.59	1.92	471	11.53	1.88

aMean for each item was computed on a scale of 1 = *not at all useful* to 4 = *very useful*; means could range from a low of 4 to a high of 16, with a theoretical midpoint of 10. bMean for each item was computed on a scale of 1 = *not at all useful* to 4 = *very useful*; means could range from a low of 4 to a high of 20, with a theoretical midpoint of 12.
*$p < .05$

Regarding usefulness of delivery methods for changing practices or behaviors, we found significant differences among the three groups of respondents and their preference for face-to-face delivery methods for changing behaviors ($F = 6.81$, $df = 2$, $p < .001$). Further examination of mean scores (Scheffe post-hoc analysis), as shown in Table 5, revealed that Extension educators preferred face-to-face methods significantly more than Extension specialists. However, no significant differences were found relative to electronic outreach or traditional written and media delivery methods.

Table 5.

Analyses of Variance for Comparing Respondent Groups Relative to Methods for Changing Practices/Behaviors

	Traditional mass media				**Online mass media**				**Face-to-face interaction**			
Group	***n***	***M*[a]**	***SD***	***F***	***n***	***M*[a]**	***SD***	***F***	***n***	***M*[a]**	***SD***	***F***
Extension educator	132	10.17	1.95		131	10.93	2.27		131	12.01A	1.77	
Extension specialist	114	9.94	2.18	2.53*	112	10.53	2.44	1.02	113	11.10A	2.09	6.81*
Research faculty	204	10.46	2.05		209	10.84	2.24		209	11.40	2.10	
Total	450	10.24	2.07		452	10.78	2.30		453	11.50	2.04	

aMean for each item was computed on a scale of 1 = *not at all useful* to 4 = *very useful*; means could range from a low of 4 to a high of 16, with a theoretical midpoint of 10. bMean for each item was computed on a scale of 1 = *not at all useful* to 4 = *very useful*; means could range from a low of 4 to a high of 20, with a theoretical midpoint of 12. AMean scores followed by same letter are significantly different from one another; mean scores without a letter are not significantly different.
*$p < .001$

Conclusions and Discussion

Our findings provide insight into the delivery methods that land-grant university research and Extension personnel in the Northeast perceive as most useful for disseminating information and changing practices or behaviors related to climate change. Study respondents represented research faculty, Extension specialists,

and Extension educators from the 16 land-grant universities in the northeastern United States. For the overwhelming majority of respondents, only 1%–20% of their time was dedicated to climate change, an indication that climate change is one of many issues that university researchers and Extension personnel are addressing. Given the significant impacts of climate change on agriculture and natural resources, universities will be better positioned to respond to relevant challenges if they invest in positions that allow for dedication of more time to climate change research and communication activities. Even though scant resources plague Extension across the country, Prokopy and Power (2015) recommended incentivizing work on climate change through promotion and tenure.

Across all the delivery methods measured, respondents indicated that each method was more useful for disseminating information than for changing practices or behaviors. This finding should not come as a surprise, for behavior change is a long-term and difficult outcome to achieve in programming. In terms of specific delivery methods, the findings indicate that respondents considered field tours, videos, websites, and workshops as the best options for disseminating information and field tours and workshops as most useful for changing practices and behaviors (Figure 1). Together, these findings suggest that traditional Extension delivery methods that include face-to-face interactions are perceived by research faculty and Extension personnel as useful ways to engage with audiences about climate change. This finding is consistent with previous work that has shown continued relevance of face-to-face interactions for Extension programming (Bairstow et al., 2002; Hobbs, 2004; Kline et al., 2012). Given the skepticism regarding climate change that often exists among farmers (Arbuckle et al., 2013) and foresters (Boby, Hubbard, Megalos, & Morris, 2016), face-to-face interaction likely provides the best method for having "meaningful dialogue" (Morris et al., 2014). Although online decision-support tools are no doubt important in their ability to provide farmers with up-to-date data, they were not identified by study participants as among the more useful delivery methods.

Regarding differences in perceptions of usefulness of delivery methods among research faculty, Extension specialists, and Extension educators, mean scores indicated that research faculty perceived traditional written and media methods as more useful for disseminating information than the other two groups did. This may be explained by research faculty's typical responsibilities related to producing written work. Extension educators, however, valued electronic methods and face-to-face interactions as more useful than the other two groups did. These valued methods may be similarly explained by the typical responsibilities of Extension educators, who generally engage directly with their audiences more than either researchers or Extension specialists. However, significant differences did not exist related to electronic methods and face-to-face interactions, and the mean scores for all methods were only slightly above the theoretical midpoints. In terms of changing practices or behaviors, Extension educators placed significantly more emphasis on face-to-face interactions than did Extension specialists or research faculty. As the group responsible for delivering programs, Extension educators have more experience evaluating the kinds of interactions that foster behavior change and, therefore, likely value personal connections more than their counterparts. Still, each delivery method was evaluated by respondents collectively as only marginally useful.

The lukewarm perceptions of the usefulness of various delivery methods suggest the need for more documentation of how these different delivery methods lead to varying outcomes. Given that some skepticism still exists among farmers and other natural resources managers regarding human-caused climate change, Extension should carefully consider how to develop and deliver information. Although these findings indicate the need for continued monitoring and evaluation, they also suggest that a multipronged approach to information dissemination will be essential in assisting land managers with their strategies for adaptation and

mitigation.

Recommendations

Based on our findings, we make the following recommendations:

- Extension programming on climate change should include components that rely on face-to-face interactions with target audiences. In particular, field tours and workshops should be pursued, given that these two types of face-to-face interaction were perceived as among the most useful methods for disseminating information and changing behaviors (Figure 1). Such programming should not come at the expense of other delivery methods that are perceived as useful, such as videos and websites, but these types of resources cannot substitute for face-to-face interactions.

- Future pilot testing of programs should involve evaluation of various delivery methods so that the most useful and effective methods for a particular target audience can be identified.

- Impact studies should assess outcomes regarding adoption of climate change adaptation and mitigation practices relative to specific delivery methods.

- Future studies should address target audiences' perceptions of the usefulness of delivery methods to allow for comparison with the findings presented here and determination of whether gaps exist.

- Given that the findings from our study indicate tepid perspectives of innovative delivery methods, including certain electronic methods, further research should focus on whether these types of methods, such as online decision-making tools and webinars, are actually useful and/or whether they need to be advertised and packaged to target audiences in different ways.

Although land-grant universities in general and Extension services in particular have been facing ongoing resource constraints, the importance of climate change–related research and communication to agricultural and natural resources audiences should not be underestimated. With dedicated funding and careful analysis of what works with target audiences, land-grant universities and Extension services are well-positioned to provide their target audiences with the information and tools that will help them address the challenges presented by climate change.

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