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Assessing the Value Extension Adds to Decision-Making Among Natural Resources Leaders

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Abstract. Extension professionals face challenges in quantifying the impact of their efforts in advancing the decision-making process inherent in setting natural resources policy. We developed a flexible tool that measures the impact of improving decision makers' planning efforts. The tool consists of two sets of survey questions that can be modified to fit an Extension program's goals. We illustrated how to use the tool by surveying leaders working with private forest owners to advance natural resources management. However, the tool can be of use to Extension professionals across various program areas.

INTRODUCTION

One way the U.S. Department of Agriculture defines impact is enablement of leadership to make sound decisions (National Institute of Food and Agriculture, n.d.). Quantifying impact is also an important part of describing success in Extension (Kelbaugh & Earnest, 2008). Extension professionals who work to transfer research-based information (e.g., publications, reports) to decision makers often do so through conferences, personal communications, or science advisory groups. However, the interplay between facts and values in policy and management decisions can make it difficult for Extension professionals to describe the impact their efforts have on advancing the decision-making process (Jasanoff, 2009). One defensible approach to measuring impact is referencing the number of cited publications or received trainings that appear in leaders' planning documents. However, the science content in policy and planning documents is often concise and years in the making (e.g., Beckage et al., 2000; Davis & Martell, 1993), suggesting that the most recent research, even if considered in decision-making, may not be included. Outside of counting citations or numbers of meetings attended, there are few ways to express impact using quantified measures (e.g., Diem, 2003; Jayaratne et al., 2009; O'Neill & Richardson, 1999). Extension professionals need alternative methods for helping them understand more quickly how much their programs improve leaders' decision-making and whether they need to reevaluate programmatic approaches. Here we present a pragmatic way

of quantifying perceived impact by estimating how much value Extension services add to the decision-making process while that process is underway (i.e., short-term impact).

Leaders who manage natural resources (e.g., state agency representatives, county service foresters) are formally responsible for ensuring the well-being of both ecosystems and society. Consequently, their decision-making process is different from decision-making processes of other Extension audiences who seek information to pursue more self-interested objectives (e.g., private landowners). Leaders are obligated to be objective because they often represent various stakeholders (e.g., local community, professionals, investors). When research-based information helps leaders make more practical and objective judgments, the value of the information to them usually increases, even if they do not formally reference it in their planning documents. Extension professionals who take this perspective can evaluate their programs according to how much value their efforts add to the decision-making process by helping leaders make more sound decisions. Here we report on how we developed a unique scalar survey tool and investigated through illustration of the tool how it can measure leaders' perceptions of how much value Extension research efforts add to their decision-making process, allowing Extension professionals to quantify their impact on natural resources policy. Specifically, our illustration focused on adding value to decisions about forestry management, but the tool is adaptable and can be of use to Extension professionals across various program areas.

METHODS

LITERATURE REVIEW

We reviewed literature that focused on the role of science in policy making and identified five key perceived barriers to leaders' using research-based information in public policy and planning: uncertainty, complexity, irrelevance, lack of validity, and bias (Table 1).

Using the recommendations provided in the same literature, we developed strategies for addressing key barriers (Table 2). We assumed that the strategic elimination of these barriers should add a higher value to a leader's decision-making process.

IMPACT TOOL DESIGN

We based our tool design on the theory of planned behavior, which links attitudes about potential outcomes with intentions and behaviors (Ajzen, 1991). The tool comprises two surveys. We reconfigured the potential value-added outcomes described in Table 2 into 11 statements for use with a modified Likert scale (Figure 1). Extension researchers can use this scale to understand the perceived importance of each outcome (1 = *not important at all*, 4 = *extremely important*) and establish a baseline for determining the value of expected outcomes. We created a different scale (Figure 2)

to measure the strength of agreement (1 = *strongly disagree*, 5 = *strongly agree*) that the proposed value-added outcomes were achieved through Extension services (e.g., technical report, presentation). The survey represented in Figure 2 can be customized to be program specific.

VALUE-ADDED SCORE

We expect the perceived importance of each proposed outcome to vary among leaders because factors such as experience and values also influence the decision-making process. For example, some may want research-based information only about urgent management issues rather than about less urgent topics. The importance scale helps calibrate measures of impact expressed in the satisfaction scale by identifying which outcomes were most important to the respondent. To calculate these calibrations, users of the tool should multiply each item's response on the importance scale by the response for the same value-added item on the satisfaction scale. For example, if a respondent stated that clarity of presentation was extremely important and disagreed that the information provided was clearly presented, the calibrated value-added score would be 8 for that particular item.

Table 1. Results of Literature Review Regarding Perceptions of Barriers to Use of Research-Based Information by Decision Makers

Barrier	Description	Literature
Uncertainty	Research findings are perceived as leading to unknown or unexpected outcomes.	Airame, 2003; Ascher, 2004; Goodman, 1994; Mills & Clark, 2011; Reed, 2018; Weiss & Bucuvalas, 1980; White et al., 2008
Complexity	Research is perceived as abstract and difficult to understand due to technical language and/or unfamiliar methodology.	Reed, 2018; Spalter-Roth et al., 2018; Weiss & Bucuvalas, 1980
Irrelevance	Research findings and recommendations are not in line with the public will and/or the interest of influential stakeholders.	Ascher, 2004; Cashmore, 2004; Jennings & Hall, 2012; Landry et al., 2003; Maynard, 2006; McNie, 2007; Mills & Clark, 2011; Rogers & Breen, 2003; Spalter-Roth et al., 2018; Walsh et al., 2014; Weiss & Bucuvalas, 1980
Lack of validity	Research products are not perceived as being of good quality or trustworthy (i.e., not peer reviewed).	Cashmore, 2004; McNie, 2007; Mills & Clark, 2011; Weiss & Bucuvalas, 1980
Bias	Research is perceived as biased and/or not transparent.	Alpert & Keller, 2003; Goodman, 1994; McNie, 2007; Spalter-Roth et al., 2018; Steel et al., 2009; White et al., 2008
	Political party affiliations and/or internal agency culture determines how/when science is used.	Barlett & Kurian, 1999; Cheng et al., 2003; Jennings & Hall, 2012

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Table 2. Strategies for Addressing Key Barriers to Research-Based Information Transfer and Potential Value-Added Outcomes for Decision Makers

Barrier	Strategy for Extension professionals	Potential value-added outcomes
Uncertainty	<ul style="list-style-type: none"> • Acknowledge limitations in models and predictions. • Offer a range of potential alternative scenarios and their outcomes. • Present related research that validates findings and demonstrates the usefulness of recommendations. 	<ul style="list-style-type: none"> • Decision makers perceive information as transparent and trustworthy. • Decision makers can better understand the implications associated with variation and uncertainty in the findings. • Decision makers can better understand the scope and context of research findings.
Complexity	<ul style="list-style-type: none"> • Use policy to direct research questions. • Use simple logic in explaining research design. • Reduce technical language. 	<ul style="list-style-type: none"> • Decision makers can more accurately interpret research findings. • Decision makers trust that they can appropriately apply the research-based information in decision-making.
Irrelevance	<ul style="list-style-type: none"> • Asses a timely policy issue important to the public, stakeholders, and policy makers. • Seek to better understand and explain public choice regarding the issue. • Provide practical, evidence-based recommendations. 	<ul style="list-style-type: none"> • Decision makers have the opportunity to use science to address urgent policy concerns and link the policy with stakeholders' needs. • Decision makers can use existing tools and resources which can justify policy decisions.
Lack of validity	<ul style="list-style-type: none"> • Seek to legitimize research by being affiliated with known organizations and/or academic institutions and/or having it peer reviewed and published. 	<ul style="list-style-type: none"> • Decision makers can trust research credibility.
Bias	<ul style="list-style-type: none"> • Make sure that research questions, analysis, and conclusions do not reflect a political agenda. • Provide unbiased information about all potential trade-offs. 	<ul style="list-style-type: none"> • Decision makers see their stakeholders' preferences in the proposed alternatives along with broader impacts. • Decision makers can be more confident that their peers and subordinates will support policy recommendations because they are objective and not agenda based.

Tool users can calculate a total value-added score for each individual by summing the calibrated responses across all 11 items for each individual. For these scales, total scores range from 11 to 220. Scores between 11 and 80 suggest that Extension efforts likely added little value to the decision-making process. Scores between 150 and 220 suggest that the research-based information transfer potentially had a high impact on decision-making. Scores in the middle (from 81 to 149) imply a potentially moderate impact on decision-making. We expect that this tool is a valid and reliable instrument for measuring impact or value-added score because it is based on previously established barriers to the decision-making process and offers calibrated measures of satisfaction associated with important research-based information transfer outcomes.

TOOL ILLUSTRATION

To illustrate how to use the tool in practice, we created a hypothetical Extension program targeting leaders who work in natural resources and private lands management. We sought to estimate how much value our hypothetical program added to decision-making process about forest owner outreach campaigns. Specifically, by using a hypothetical program, we could account for different types of participants and potential bias associated with evaluating established programs. We developed a selection of Extension outputs consisting of recent research by Butler et al. (2018) and included a brief summary of the research, a 10-min video presentation, and a copy of the original research article.

Before we introduced our program to 450 professionals (i.e., conservation district managers, service foresters, state

In general, when you use scientific findings to inform policy decisions, how important are the following?					
<i>(Select one response per statement)</i>	I don't know 0	Not important at all 1	Slightly important 2	Moderately important 3	Extremely important 4
Research reports and presentations are easy to understand.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Researchers discuss urgent issues rather than less urgent topics or new ideas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Those that conduct research or offer research findings (e.g., extension agents) are familiar with my organization and my type of information needs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Researchers describe potential trade-offs among alternative scenarios when making policy recommendations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Researchers are transparent when describing the limitations of their study design and models.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To my knowledge, the research is in agreement with the larger body of research.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Researchers discuss, along with their findings, potential impacts on the economy and public welfare.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The research is published in a peer-reviewed source.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The research approach is unbiased regarding how all stakeholders may be affected.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The research helps identify outcomes that groups with different opinions can agree on.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Research recommendations could be implemented using the tools and resources that are available to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 1. Survey questions identifying importance of value-added outcomes to leaders' decision-making.

Regarding the information we sent you about _____, how strongly do you agree with the following statements?					
<i>(Select one response per statement)</i>	Strongly disagree 1	Disagree 2	Neither agree or disagree 3	Agree 4	Strongly agree 5
The research was clearly presented/written and easy to interpret.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The study was useful regarding my immediate needs (e.g., developing an outreach campaign).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The authors understood the type of data or information I would need for decision making.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Potential trade-offs were meaningfully described.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Descriptions of study limitations were appropriate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To my knowledge, the study agreed with the larger body of research on relevant stakeholders.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discussions about potential impacts on the economy and public welfare were useful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The study was published in a reputable source.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The study fairly represented the opinions of most stakeholders.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The study helped me identify areas where different stakeholders might have conflicting opinions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Study recommendations could be implemented using existing tools and resources.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 2. Survey questions evaluating level of satisfaction associated with the achievement of the value-added outcomes.

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agency personnel, and county commissioners) throughout Pennsylvania, we pretested our impact tool and updated it on the basis of the received feedback. We used the Qualtrics system to distribute our survey to the professionals' email addresses obtained from their organizations' websites. A total of 78 professionals (17.3%) agreed to participate in the hypothetical program, and 100% of those participants completed the program and answered all survey questions.

During the program, participants had to imagine that they needed to contact forest owners about an important issue. Participants received access to our Extension products containing research-based information about how to best initiate contact with forest owners. Before reviewing the information, participants had to rank the general importance of the value-added outcomes described in Figure 1. After participants reviewed the research-based information, they had to respond to the questions measuring their perceptions about how strongly the value-added outcomes, presented in a customized program-specific version of the survey (Figure 2), were recognizable in the information they reviewed. We used participants' answers to the two surveys to quantify how successful our program was in adding value to their decision-making processes.

TOOL ILLUSTRATION RESULTS

Demographic characteristics of study participants are shown in Table 3. The majority of participants were male. The largest proportion of participants were between 45 and 64 years old, and most had either a bachelor's or graduate degree. The majority of participants had been involved in professional decision-making for longer than 10 years and considered themselves very knowledgeable in science, technology, engineering, and math topics.

The highest proportions of participants rated most of the value-added outcomes as extremely important, which we expected (Table 4). According to the respondents, the most important ways to add value to decision-making were through clarity enhancement, transparency, and unbiasedness. More variation among responses occurred regarding items that addressed urgent issues, agreement with the larger body of research, and identification of outcomes that help bring together groups with opposing opinions.

Most survey participants (67%) reviewed only one format of research information presented to them. The executive summary was the most popular format (75%) among this group of participants. Smaller portions of participants only read the original article (13%) or watched the video presentation (12%). Almost a quarter of participants (23%) reviewed the information in two formats. Eight participants (10%) reviewed all three materials.

Most participants (over 50%) indicated that they were satisfied (i.e., somewhat agreed and strongly agreed) with how our Extension outputs added value to their perceptions

Table 3. Demographic Characteristics of Study Participants

Characteristic	Observations	%
Occupation		
County commissioner	10	13
Conservation district manager	13	17
Service forester	12	15
Professional manager in the private sector	43	55
Gender		
Male	49	63
Female	28	36
Prefer not to say	1	1
Age		
25–44	31	40
45–64	35	45
65 and over	12	15
Education		
More than high school diploma, less than bachelor's degree	9	12
Bachelor's degree	35	45
Graduate degree	34	44
Years of experience		
Less than 1	2	3
1–5	11	14
6–10	12	15
Over 10	48	62
Irrelevant	5	6
Self-evaluation of STEM knowledge		
None or minimal knowledge	13	17
Somewhat knowledgeable	24	31
Very knowledgeable	41	53

Note. STEM = science, technology, engineering, and math.

about forest owner outreach (Table 5). Participants most substantially agreed that the research-based information was clearly presented, included study limitations, and came from a reputable source and that existing tools and resources were sufficient for implementing study recommendations. More variation occurred among the responses about the outcomes related to fair representation and potential impacts on forest owner welfare.

ESTIMATED VALUE-ADDED SCORES

The value-added scores indicated that research-based information had a moderate impact on most participants'

Table 4. Percentages of Respondents by Level of Importance Associated With Value-Added Outcomes

Item	Not at all important (1)	Slightly important (2)	Moderately important (3)	Extremely important (4)
1. Research reports and presentations are easy to understand. ^a	0%	4%	23%	73%
2. Researchers discuss urgent issues, rather than less urgent topics or new ideas.	9%	18%	51%	21%
3. Those that conduct research or offer research findings (e.g., extension agents) are familiar with my organization and my type of information needs.	8%	13%	38%	40%
4. Researchers describe potential trade-offs among alternative scenarios when making policy recommendations.	0%	10%	37%	53%
5. Researchers are transparent when describing the limitations of their study design and models.	0%	1%	24%	72%
6. To my knowledge, the research is in agreement with the larger body of research.	13%	23%	42%	19%
7. Researchers discuss, along with their findings, potential impacts on the economy and public welfare.	3%	18%	38%	41%
8. The research is published in a peer-reviewed source.	4%	12%	32%	47%
9. The research approach is unbiased regarding how all stakeholders may be affected.	0%	3%	24%	68%
10. The research helps identify outcomes that groups with different opinions can agree on.	10%	22%	44%	21%
11. Research recommendations could be implemented using the tools and resources that are available to me.	4%	10%	40%	45%

Note. Items that do not sum to 100% exclude “I don’t know” responses, which we offered as an option.

^a We expected participants to consider the research-based information formats they most often use when responding to this statement.

decision-making process (Table 6). The research-based information added a lot of value to 11 participants’ (14%) hypothetical landowner outreach campaign, indicating a high impact.

When comparing scores across participants’ occupations, we determined that our program added the most value to county commissioners’ decision-making processes (Figure 3). Impact on service foresters was more variable—their occupation had the largest percentage associated with the low value-added score, but for most of them, the research-based information had a moderate impact on their planning. The hypothetical Extension program had a moderate impact on decision-making across all occupations.

DISCUSSION AND CONCLUSIONS

In this article, we reported how we developed a unique impact-measuring tool and illustrated how Extension

professionals can use it in practice to understand how much value their program adds to a leader’s decision-making process in natural resources. Our findings indicated that research-based information transfer strategies might increase the perceived value of Extension programs when they are successful at helping natural resources leaders make more practical and objective judgments in their decision-making process. We also demonstrated how the value-added scores could account for different types of decision makers and their varying preferences. Assessing impact relative to occupation shows potential differences in information needs among decision makers and allows Extension professionals to learn what research-based information transfer methods are most helpful for specific audiences. Although all leaders are likely knowledgeable about the issues they work on, some may be more familiar with certain topics. For example, county commissioners generally work less frequently with forest owners, but a service forester’s job is to connect with

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Table 5. Percentages of Respondents Who Agreed That the Value-Added Outcomes Were Achieved

Item	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
1. The research was clearly presented/written and easy to interpret.	0%	5%	13%	42%	40%
2. The study was useful regarding my immediate needs (i.e., developing an outreach campaign to forest owners).	1%	10%	22%	47%	19%
3. The authors understood the type of data or information I would need for planning the outreach program.	3%	6%	31%	42%	18%
4. Potential trade-offs were meaningfully described.	3%	14%	24%	46%	13%
5. Descriptions of study limitations were appropriate.	1%	4%	18%	47%	29%
6. To my knowledge, the study agreed with the larger body of research on forest owners.	3%	4%	40%	37%	17%
7. Discussion about potential impacts to forest owner welfare was useful.	1%	19%	36%	38%	5%
8. The study was published in a reputable source. ^a	0%	1%	33%	42%	23%
9. The study fairly represented the opinions of most forest owners.	9%	21%	45%	22%	4%
10. The study helped me identify areas where different forest owners might agree or disagree.	3%	17%	32%	44%	5%
11. Study recommendations could be implemented using existing tools and resources.	1%	9%	17%	60%	13%

Note. The values for some items do not sum to 100% due to rounding.

^aThe term “reputable source” is expected to be understood subjectively and is a measure of perception.

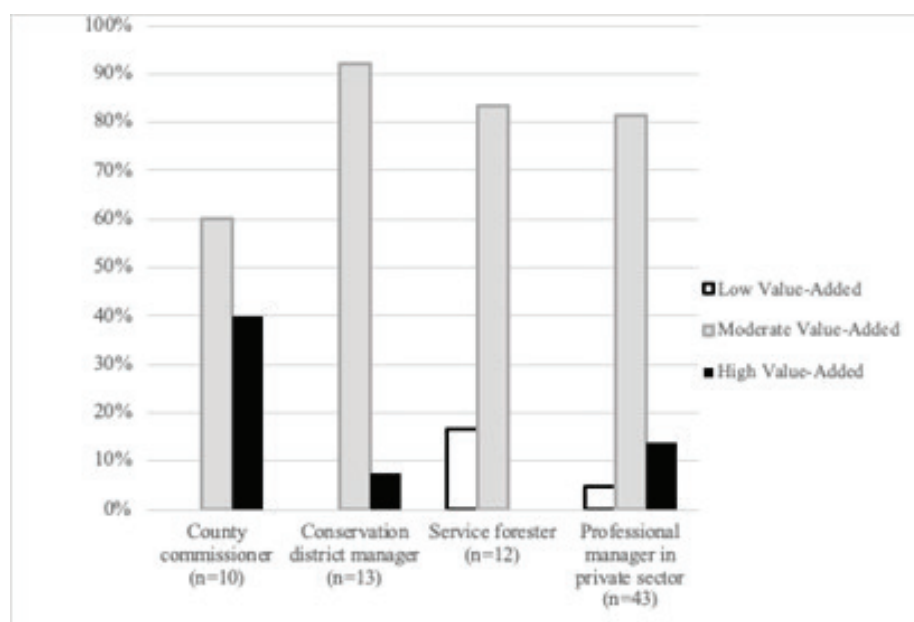


Figure 3. Levels of value added by participant occupation.

Table 6. Estimated Impact Score Indicating How Much Value Was Potentially Added to the Decision-Making Process

Value-added score	Impact	Observations	%
11–80	Low	4	5
81–149	Moderate	63	81
150–220	High	11	14

forest owners. Therefore, service foresters may have a greater understanding of strategies for connecting with landowners than commissioners, which may explain why the information presented in our program had only a moderate impact on the service forester audience. It is important to note that our study's goal was to demonstrate how the impact tool could be used in practice and how variation in responses among different occupations could be measured. We could not draw broader conclusions about the professions represented in our study because we did not collect a representative sample of these groups. An extension of our study could be a continuation of the hypothetical program allowing us to collect more data and determine what causes differences in value-added scores.

Our impact-measuring tool is flexible and can be modified to fit a particular Extension program's specific needs. The tool may be most useful when first developing an Extension program, evaluating a program at strategic intervals, or understanding the value of key outputs (e.g., guidebooks, courses). The evaluation process could be split into two phases. In the first phase, Extension professionals may seek to only better understand what their target audience thinks is important. On the basis of the received answers to the importance scale questions, in the second phase Extension professionals may modify or use only some of the scalar questions assessing satisfaction regarding the value added to a decision-making process. For example, in the first phase, Extension researchers might determine that some managers are not interested in public choice information; then, in the second phase, researchers could omit this metric from their further analysis of this particular audience. Researchers also can combine the value-added scores with other types of data (e.g., location, demographic characteristics) to conduct different statistical analyses (e.g., regression to predict a broader impact).

The impact assessment tool presented herein is a valid and reliable tool that can help Extension professionals better understand how their programs add value to the decisions made by leaders who use research-based information. The opportunity to receive timely and targeted quantitative feedback can help Extension professionals become more effective in helping their audiences make better informed decisions.

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