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Profitability, Engaging Delivery, and Trust: How Extension Professionals Can Optimize Farmer Adoption of Climate-related Adaptation Strategies

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This study examined Extension professionals' perspectives on how to optimize the chances that farmers will adopt climate adaptation strategies designed to minimize risks associated with climate variability and climate change. In-depth interviews were conducted with Extension professionals in four southeastern states (Alabama, Florida, Georgia, and South Carolina). Responses were coded and analyzed, resulting in three recommendations. First, focus on profitability and issues of immediate concern to farmers. Second, use engaging delivery methods, especially field trials conducted under realistic conditions. Third, build trust with farmers, primarily by focusing on research-based information. This study has practical implications for how Extension professionals should approach the work of addressing climate issues in agriculture.

Keywords: agriculture, climate variability, climate change, adaptation, management practices, farmers, Extension, Southeast USA

Introduction

Farmer adaptation to climate variability and climate change is shaped by different factors including "the operating context within which decision making occurs, the access to effective adaptation options, and the capacity of individuals to take adaptive action" (Walthall et al., 2012, p. 6). Climatic uncertainty and the presence of risks, including water availability, increased soil erosion, and decreased crop productivity, have encouraged the development and diffusion of adaptation-oriented agricultural risk management tools (Hansen, 2002; Rejesus et al., 2008).

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These tools include modifications to management practices, such as timing of planting, sod-based rotation, soil management techniques, irrigation and water management techniques, and decision support systems (Asseng, 2013). Given the complexity of the issues and the extensive amount of information involved in this process, farmers frequently rely on the feedback provided by agricultural specialists (Prokopy et al., 2013). Extension professionals should provide producers with "research-based, locally relevant, and timely data" (Hibbs et al., 2014, p. 9) that focus on adaptation and encourage climate-related discussions.

Given the politicized nature of climate change, it is necessary to develop "specific training in the basics of climate science and how it relates to agriculture, as well as training on how to communicate climate information that will actively engage farmers" (Diehl et al., 2015, p. 28). This can be accomplished through a better understanding of both agricultural advisors (Prokopy et al., 2013) and the climate change beliefs of farmers (Arbuckle, Hobbs, Morton, Prokopy, & Tyndall, 2014). Building on an understanding of audience needs and characteristics, Extension professionals can build trust-based relationships among themselves, researchers, and farmers. It is useful to consider combining traditional Extension methods, such as research plots, on-farm demonstrations, hands-on workshops, and networking (Franz, Piercy, Donaldson, Richard, & Westbrook, 2010), with a recognition of the importance of farmers' climate beliefs and the factors farmers consider when assessing climate-related risks to inform management decisions (Arbuckle, Morton, & Hobbs, 2013).

This study builds on previous research examining climate training issues in Extension (Diehl et al., 2015), the major climate-related issues facing farmers (Diehl et al., 2017), and factors related to farmer engagement in issues related to climate and agriculture (Diehl et al., 2016). The purpose of the current study is to examine what strategies and content Extension professionals believe are critical for maximizing the likelihood that farmers will adopt new practices and adapt to the changing conditions associated with climate variability and climate change. Given the importance of issues related to climate and agriculture and the need to persuade farmers to take action (Asseng, 2013), the current study was designed to enhance program development and delivery with attention to influencing farmer behavior change.

Methods

The research team developed an interview protocol which assessed a variety of issues related to climate, agriculture, and the role of Extension in climate training. This study specifically addressed Extension professionals' recommendations for how Extension can maximize the likelihood that farmers will adapt their practices to climate variability and climate change. The 45–60 minute, semistructured interviews were conducted via phone and recorded. Respondents included 50 Extension professionals from Alabama, Florida, Georgia, and South Carolina, and represented county-level agents and faculty, state-level Extension faculty,

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researchers, and administrators with Extension experience in agricultural areas. While efforts were made to recruit a variety of Extension professionals, many interviewees were engaged in ongoing work related to climate and agriculture and were presumed to have a working knowledge of farmer needs and priorities. Participants were recruited using purposeful snowball sampling (Miles & Huberman, 1994; Yin, 2011). Team members of a USDA-funded regional research/Extension initiative focused on climate change and variability participated in the initial interviews and were asked to identify other potential respondents with an interest in climate and agriculture among faculty and administrators from their home states. Table 1 displays sample characteristics.

Table 1. Sample Characteristics (N = 50)

		n	**%**	
Gender				
	Male	39	78	
	Female	11	22	
Race				
	Caucasian	40	80	
	African-American	5	10	
	Latino/Hispanic	5	10	
Education				
	Bachelor's Degree	2	4	
	Master's Degree	17	34	
	Doctoral Degree	31	62	
Extension Role				
	County Faculty/ Extension Agent	13	26	
	State Extension Faculty	17	34	
	Researcher	10	20	
	Administrator/Director	10	20	
State				
	Alabama	11	22	
	Florida	18	36	
	Georgia	11	22	
	South Carolina	10	20	
Provide Climate Information				
	Yes	28	56	
	No	22	44	
		Mean	**Minimum**	**Maximum**
Age (years)		49	29	69
Extension Experience (years)		15	1	37

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To prepare the data for analysis, the interviews were transcribed. Inductive and deductive coding (Harding, 2013; Thomas, 2006) were used as part of the four-step process for thematic analysis described by Harding (2013). The analytical process focused on the meaning conveyed in the responses with an attempt to minimize preconceptions about the nature and structure of the interview content while identifying commonalities, differences, and patterns among cases (Harding, 2013). Using collaborative coding (Saldaña, 2016), the four-person coding team developed a coding framework and code definitions, and all coded responses were finalized through a consensus process. The coding process incorporated multiple elements designed to ensure rigor and maximize the trustworthiness of the qualitative conclusions (Berends & Johnston, 2005). A structured codebook and coding definitions were created through an inclusive group process, and the code definitions were systematically applied to the data. Multiple coders with a broad range of perspectives and expertise were utilized to stimulate group dialogue and diverse opinions. All tensions and questions about coding, interpretation, and presentation of the data were resolved through intensive and iterative group discussions. Given the interpretive nature of the analytical process, this agreement among coders resulting from intensive group discussion is more useful and applicable to qualitative data analysis than measures such as interrater reliability, intercoder agreement, or interpretive convergence which are more suitable for quantitative data analysis (Saldaña, 2016).

The specific question posed to respondents was

> If our goal is to get producers to change their practices to respond (or to adapt) to variability and changes in the climate (such as using new varieties of crops, shifting planting dates, etc.), what would be your suggestions for optimizing the chances that producers will adapt their practices to respond to climate variability and change?

Results

Through analysis and discussion, three main themes emerged regarding respondent perceptions of how to maximize the likelihood that producers will change their management practices in response to climate variability and climate change. The first theme was to focus on profitability and the immediate concerns facing farmers, including the following topics: cost effectiveness, benefits of production management, farmers inherently adapt, farmer success stories, increased research efforts, and providing information on incentives. The second theme was to use engaging delivery methods, including research plots, on-farm trials, and modeling. The third theme was to build trusting relationships by using farmers and agricultural agents as messengers and providing trustworthy evidence that climate change exists. See Figure 1 for a thematic breakdown and Table 2 for a full summary of results.

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Figure 1. Recommendations for Optimizing Producer Adaptation

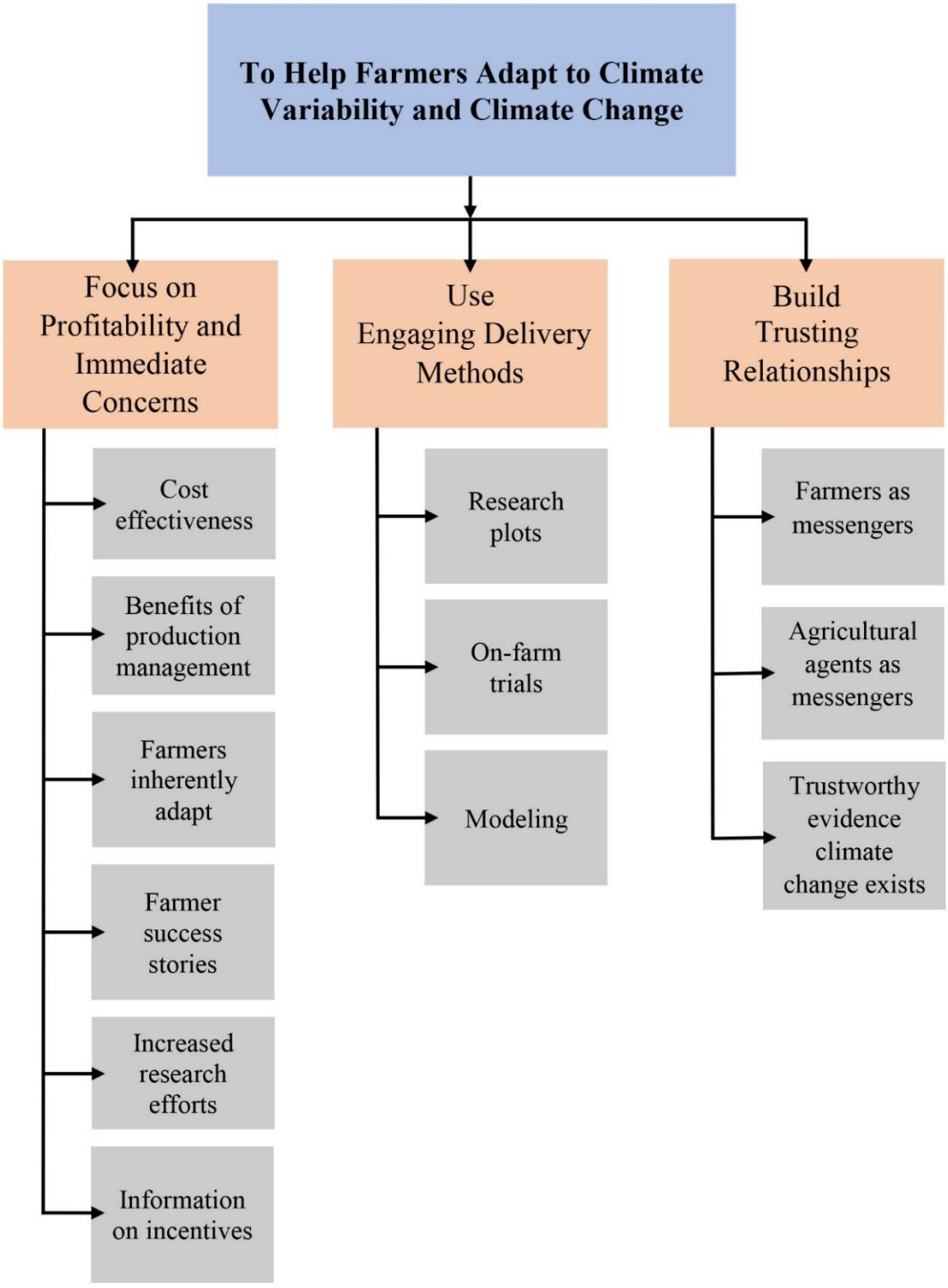

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Table 2. Tally of Coded Suggestions for Optimizing Producer Adaptation (N = 50)

Codes	Total Mentions
Focus on Profitability and Immediate Concerns	**50**
Cost Effectiveness	21
Benefits of Production Management	8
Farmers Inherently Adapt	6
Farmer Success Stories	6
Increased Research Efforts	5
Information on Incentives	3
Commodity-specific Benefits	1
Use Engaging Delivery Methods	**23**
Research Plots	7
Modeling	7
On-farm Trials	6
Demonstrations	1
Adaptation BMP Workshop	1
Hands-on Learning	1
Build Trusting Relationships	**19**
Farmers as Messengers	6
Agricultural Agents as Messengers	4
Trustworthy Evidence Climate Change Exists	4
Reaching Early Adopters	2
Conservation Emphasis	1
Reaching Small Farmers	1
Technology and Social Media	1

Focus on Profitability and Immediate Concerns

The first major category of responses focused on the importance of farmer profits and the need to address issues of immediate concern to farmers. Respondents suggested that farmers need to be convinced that adaptation strategies will be successful at addressing immediate concerns, with specific emphasis on showing profitability and consistently strong yields. Given the frequency of mentions (50), this is one of the strongest areas of recommendation resulting from this study.

Cost effectiveness (21 mentions). Respondents suggested that it is critical to demonstrate to farmers that climate adaptation strategies are cost-effective. One state Extension faculty member said, “If you can link the practice to making more money, they will adopt it.” An administrator emphasized that establishing a financial argument gains their attention, allowing for longer-term discussions of climate: “If it affects their bottom line, they’re going to listen. . . . Start with that and then, you know, ease into the climate change over a long period of time.” Another administrator framed the issue in terms of how farmers manage risk, saying,

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> Farmers are risk takers every time they plant something in the ground. If you can show them a way that might help them reduce their risk, reduce the financial inputs that they have, and maximize the outputs, they're going to be a little more receptive.

Benefits of production management (8 mentions). Respondents mentioned the importance of showing farmers the benefits of production management related to climate issues, including topics such as crop management (i.e., crop selection, planting dates, new varieties, water management, and commodity-specific benefits). A researcher explained that farmers are receptive to conversations about being adaptive in terms of planting dates:

> When I talk to these farmers in the focus groups, we say 'alright, what if the world is warmer? What if we have seasons that can go longer? We can plant a month earlier and harvest a month later'. . . . They're all for that, they think this is great.

A county Extension agent emphasized that farmers are receptive to variety trials that look at yield data, providing farmers with varieties that thrive in different conditions. Further, a state Extension specialist explained that educators need to provide information on "some varieties you can grow for this different planting date, or for a shorter season, or for drought tolerance."

Farmers inherently adapt (6 mentions). Six respondents suggested that farmers are not resistant to change and naturally adapt to optimize profitability and meet the agricultural challenges they face. One respondent, a researcher, suggested a failure to adapt means that "they'll lose, they won't be able to farm. They've been adapting to changes over time through generations. Farmers do that all the time, so I don't think that adaptation is such a huge struggle for farmers." Another researcher said, "Farmers adapt, probably faster than any other group. . . . They do it on their own, you know, they're pretty smart folks." This natural ability of farmers to adapt to changing pressures and changing conditions may make farmers an especially receptive audience for climate information.

Farmer success stories (6 mentions). When mentioning the value of using farmer success stories, most respondents aligned with the beliefs of an administrator who said, "You can tout success stories, show positive results, show practices that have worked in a way that our clientele can relate to." A county faculty member said, "Give them examples of success stories, even if they're not at the same scale or time frame that we're talking about, even small things, or small changes that have affected a grower, somebody that they can relate to." The concept of success stories bridges two interrelated concepts – the first being a focus on effectiveness, and the second being the focus on experiences that are relevant to farmers.

Increased research efforts (5 mentions). Respondents believed that increasing forecasting accuracy and developing new adaptation strategies would further bolster the argument that

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adaptation strategies are a cost-effective way to address issues that are of immediate concern for farmers. A state Extension faculty member discussed the need to increase forecasting accuracy in terms of confidence:

> Producers ask that question: 'Well, can you tell me if it's going to be dry this summer or not?' And inevitably, 'No, we really cannot do that. We can tell you longer term, kind of, and what the patterns are generally for an el Niño or la Niña or whatever, but we can't really tell you what the next few months is going to bring.' And a lot of producers kind of tune that out then, because they need to know, how sure, how certain, how good is your data?

This focus on ongoing research efforts is an acknowledgment that additional evidence and trials will be necessary to convince many farmers of the wisdom of climate adaptation practices.

Information on incentives (3 mentions). Three respondents suggested that farmers would be more likely to adapt if they were provided with financial incentives to do so, and that Extension professionals engaged in these climate-related discussions should be aware of incentives that are available. For example, a county Extension agent suggested that farmers would be motivated by incentives: "Money is always nice, maybe equipment or supplies, some kind of incentives. At least a carrot, to help them, to bring them along to it."

Use Engaging Delivery Methods

The next major category of codes was organized around the need to use engaging delivery methods in Extension programming. In 23 instances, respondents mentioned the need to deliver climate information in ways that are engaging for the farmer audience, including a focus on research plots, modeling, and on-farm trials. In most cases, these comments emphasized that information must be interesting and immediately relevant or useful to farmers if they are going to pay attention and adapt their practices.

Research plots (7 mentions). Research plots can be used to demonstrate how to implement adaptation strategies and production management practices, and to demonstrate the efficacy of these approaches. As one researcher stated, "If we're able to prove through numbers on the station or research, that's the best way [to encourage farmers to adapt]." A county Extension agent suggested using research plots to replicate various aspects of climate variability, saying, "We want to demonstrate plots that demonstrate the practice."

Modeling (7 mentions). Although modeling may not seem to be an engaging delivery method, respondents focused on how climate modeling can be tailored to local conditions and used as a way to get farmers to start talking about climate change. Three respondents suggested modeling

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is most beneficial when done on a one-to-one basis using a farmer's historic yield data to build trust in the models, then using the models to provide meaningful forecasts. One administrator said, "Looking at their five-year history or something like that, or their 10-year history of, 'here's the climate and here's your yield, and if you would have done this, our predictions say that you could have gotten this.'"

On-farm trials (6 mentions). Working with farmers to set up an on-farm trial (also referred to as a pilot strategy, a test plot, or an experimental plot) was considered a strong method for encouraging small-scale adoption of an adaptation strategy. One state Extension faculty member said, "Pilot strategy is probably the best way to do this. Start small and ask them to test your strategies in just a little bit of their farm, and I think this is a good way to do it." This strategy allows the farmer to experience the practice on a small scale while minimizing the risks associated with taking on new practices.

Build Trusting Relationships

The final major category of codes focused on the need to build trusting relationships with farmers. Respondents stressed the benefits of and ways to build trust between Extension professionals and farmers (19 mentions) in terms of using farmers and agricultural Extension agents as messengers and providing trustworthy evidence that climate change exists.

Farmers as messengers (6 mentions). Farmers who hear other farmers talk about their experiences with a particular adaptation strategy may be more likely to adopt those strategies. A state Extension faculty member said other farmers will listen and trust when another farmer says, "This is how I'm using this information. This is how it's important to me. This is what has worked. This is what hasn't worked." In addition to directly interacting with other farmers regarding adaptation strategies, producers are aware of what is working or not working on the farms around them. An administrator said,

> Once people see those individuals adapt those technologies and successfully use them to enhance their profitability, then you have other people that [are] maybe not quite as efficient, maybe not quite as innovative, but still good producers, that they can be pulled into that and increase their productivity and their efficiency also.

Agricultural agents as messengers (4 mentions). Based on the interviews, one way to build a trusting relationship is to use agricultural Extension agents as messengers on climate issues, as opposed to Extension agents with expertise in natural resources, community development, or other related areas. One state Extension faculty member said,

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> If the agronomy specialist has been working with the climate Extension specialists, and the agronomy specialist is confident or is aware of the strong relationship that climate forecast has with a specific management practice, he is going to be the first advocate for that change. And he is the one that is going to be the linkage between our group and the farmer.

In the context of agriculture, Extension agents with specific content knowledge of agricultural issues and established relationships with producers appear to be trusted sources of information.

Trustworthy evidence climate change exists (4 mentions). Extension professionals in this category expressed that information on the existence of climate change must be presented scientifically, with one administrator saying, "Show them that based on what we know from the best science we have, 'Here are some things that we think are going to occur.'" A county Extension agent simply said, "Let them know that it [climate change] is real and show the ways to adapt." Given the controversial nature of climate issues, it is especially important that Extension professionals present their information with a strong scientific basis.

Discussion

Extension professionals stressed the need to provide farmers with research-based evidence that adaptation strategies can offer solutions to existing climate-related concerns, thereby increasing profitability and reducing climate-related risks. These findings are consistent with Hibbs and colleagues (2014), who found that regardless of their views on climate change causality, farmers "expressed concerns related to climate changes" and that "these concerns were generally linked to future productivity and profitability of farming" (p. 6). Our interviews with Extension professionals complement and reinforce these findings, suggesting a convergence between the perspectives of farmers and Extension professionals. Consistent with the findings of Breuer, Cabrera, Ingram, Broad, and Hildebrand (2008), respondents also suggested that to improve the applicability of climate information, researchers must increase forecasting accuracy before suggesting adaptation strategies for reducing risk and preparing farmers for future climate variability and change.

In this study, Extension professionals recognized that farmers, in general, are a group that is used to adapting to changing conditions in all aspects of their business and are therefore aware of the benefits of adaptation. In these interviews, Extension professionals suggested that actively demonstrating adaptation strategies to farmers is key to capturing their attention. Similarly, Hansen, Marx, and Weber (2004) articulated "description-based" and "experience-based" communication strategies, finding that the experience-based approaches were more accessible for farmers (p. 15). Marx and her colleagues (2007) distinguished between "analytic" and "experiential" processing related to climate decisions asserting that these two processes are both

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central to decision making, and ideally, should be integrated. However, in the context of climate uncertainty, they propose that we have overestimated the importance of the analytic role in decision making and have ignored the experiential role. The active demonstration of adaptation strategies to farmers is a natural bridge between the analytic and experiential processes for farmers, demonstrating effectiveness of adaptation strategies (analytic process) in contexts that are familiar to and relevant for farmers (experiential process).

Extension can also maximize the accessibility of information by tailoring content to be culturally relevant to farmers in their immediate contexts. Given that weather conditions can be highly variable and localized, it is important to demonstrate the effectiveness of adaptation strategies in specific local areas for farmers. In their systematic review, Mase and Prokopy (2014) cited the "need to provide information that is useful, relevant, and context specific for a given agricultural sector" (p. 59) as a recurrent finding in the literature. This need to provide locally and contextually relevant information presents a challenge for Extension and agricultural advisors because tailored information delivery requires additional research and refinement, in contrast to broader efforts that can provide more general, but less useful, information for farmers.

Interviewees also suggested engaging farmers by applying climate models to an individual farmer's historical yield data to illustrate potential increases in profitability and reduction of risk. This participatory modeling approach holds great promise for linking data to local conditions and engaging farmers in meaningful dialogue about climate issues (Roncoli, 2006). Further, the use of research plots and on-farm trials engages farmers in an experiential learning opportunity that also provides useful data to inform management decisions. Bartels and her colleagues (2013) emphasized the importance of engaging farmers in ongoing, respectful dialogues that are the foundation for creating new climate knowledge at the intersection among farmers, researchers, and Extension. Collaboration between producers, advisors, and researchers represents a promising strategy for creating trust, building buy-in, and creating optimal conditions for farmer adaptation (Mase & Prokopy, 2014).

Extension professionals also recognized that it is pivotal to build trusting relationships among all stakeholders, including researchers, state Extension faculty, county Extension agents, and farmers, especially given the contentious nature of climate issues in the United States. In the context of climate variability and climate change, respondents stressed the importance of providing unbiased scientific evidence that climate change exists. In addition to science-based messaging, respondents also recognized the importance of the messenger, suggesting that farmers trust other farmers to share the pros and cons of implementing climate-related adaptation strategies. In the same vein, interviewees perceived agricultural agents and agronomists to be trustworthy sources of climate information because of their established relationships with farmers. Previous research (Prokopy et al., 2015) has found that Extension is a highly trusted source of agricultural information for farmers, reinforcing the constructive role Extension can

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play in advancing the dialogue about climate and agriculture. Through forging these partnerships, Extension professionals can build a more inclusive and well-rounded circle of participants (Bartels et al., 2013).

Although the current research identified several opportunities for maximizing the likelihood of farmer adaptation to climate variability and climate change, this work has challenges as well. Other researchers (Haigh et al., 2015; Prokopy et al., 2015) have suggested that, due to declining resources and influence, the Extension system should focus on providing climate information through intermediaries, such as private advisors, rather than providing information directly to farmers. While this recommendation makes sense from a resource perspective, we assert that Extension must find ways to continue engagement with farmers to maintain and further build trust and to deliver the most relevant and precise information at the local level.

Dilling, Daly, Travis, Wilhelmi, and Klein (2015) have also provided a thoughtful critique of the limitations associated with focusing on climate adaptation in the context of the relatively near future (i.e., climate variability), as opposed to longer time periods associated with climate change. These researchers present the argument that adaptation to climate variability is constrained by a variety of key factors, including that some adaptation strategies may not address related risks and may actually introduce additional risks for farmers; weather and climate conditions may reach critical thresholds or tipping points at which current adaptations may not be effective; and vulnerability to climate should be viewed as a dynamic phenomenon that is situated in a complex system where a variety of factors affect decision making, and decisions have rippling effects on other factors in the system. While these critiques are worthy of consideration, we believe that ongoing attention to adaptation to climate variability is a highly constructive process that engages farmers in meaningful dialogue that can contribute to their immediate success. This dialogue can also build the foundation for future work that more fully addresses the strategies that will be critical to addressing the potentially more volatile and extreme conditions associated with long-term climate change.

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