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Using Dialogue to Engage Agricultural Audiences in Cooperative Learning About Climate Change: A Strategy with Broad Implications

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Abstract

Dialogue with stakeholders has been recognized as an effective educational strategy for addressing complex topics such as climate change. We report here on the Carbon, Energy, and Climate fishbowl discussion series developed by Michigan State University Extension to assist the state's agricultural community in understanding and adapting to the changing climate. Facilitated dialogue reduced barriers to communication and promoted cooperative learning for target audiences and the project team, generating useful information on the current status of climate change adaptation within Michigan's agriculture sector and revealing needs to be addressed by future Extension programming. Using a dialogue-based approach such as the one we describe can highlight challenges and opportunities Extension faces in addressing various complex issues with diverse audiences.

Keywords: adaptation, climate change, cooperative learning, dialogue, engagement

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Introduction

Climate change is projected to have an increasingly negative effect on crop and animal agriculture in the United States (Hatfield et al., 2014). Changes in growing season length, temperature, and precipitation patterns will continue to amplify the levels of uncertainty and risk farmers face as they work to maintain sustainable crop and livestock systems (Walsh et al., 2014). Extension professionals can play an important role in helping agricultural stakeholders adapt to and mitigate climate change (Diehl, Garcia, Sloan, Dourte, & Fraisse, 2016; Fraisse, Breuer, Zierden, & Ingram, 2009; Layman, Doll, & Peters, 2013). However, the complexity of climate change and diversity of stakeholder perspectives on the topic call for innovative approaches to research and outreach. For example, Arbuckle et al. (2013) found that midwestern farmers vary in their beliefs regarding the reality of climate change and its causes, beliefs that systematically shape attitudes toward possible adaptation and mitigation strategies. Even when farmers recognize the need for adaptive management, individualized

approaches to climate adaptation are needed given the inconsistency of projected impacts across different geographies and production systems (Hatfield et al., 2014). We in Extension must then ask this: How can we design educational programming to effectively address climate change while recognizing the divergent perspectives of our target audiences?

Communication experts highlight the importance of dialogue with stakeholder groups in addressing complex topics, such as sustainability and climate variability (Moser & Dilling, 2007; National Research Council, 2009). Farmers, in particular, are known to value peer interaction and participatory experiences tailored to the contexts of their farm operations as learning tools (Franz, Piercy, Donaldson, Westbrook, & Richards, 2010). Therefore, engaging agricultural audiences in dialogue and promoting colearning between researchers and practitioners have been suggested as effective means for helping the agriculture industry adapt to a changing climate (Doll, Petersen, & Bode, 2017; Fraisse et al., 2009). Effective dialogue on climate is fostered by safe and neutral environments designed for open exchange (Layman et al., 2013). Segmenting such discussions by industry sectors, geographic locations, or cropping systems may further facilitate learning by accounting for the diversity of stakeholders' experiences and beliefs related to climate change (Arbuckle et al., 2013). Moreover, using a dialogue-based approach can be beneficial to Extension in addressing a variety of complex issues about which target audiences have diverse perspectives.

Methods

With these principles in mind, we formed an interdisciplinary group of Michigan State University (MSU) faculty, Extension specialists, and educators to develop the Carbon, Energy, and Climate series of discussion programs targeting select stakeholder groups across Michigan in 2013. Here we report on the methods used in those meetings and the themes identified from the discussions. The motivation for these discussions stemmed from a prior professional development event for Extension staff on the topic of carbon, energy, and climate in agricultural systems. At that event, disseminating current research and local data on climate variability, trends, and issues was identified as an important next step for MSU Extension in assisting Michigan producers and agribusiness professionals as they address changes in the climate.

For the Carbon, Energy, and Climate series, we set the following objectives:

- Assist the agriculture community in better understanding how climate change affects Michigan agriculture.
- Engage stakeholders in discussions about how to sustainably meet food and fuel production goals, encouraging them to think beyond the roles of their own farms, businesses, or agencies.
- Discover how MSU Extension can best assist the industry by developing relevant research projects and outreach programming on the topic of climate change.

Our team hosted three meetings in March 2013 targeting stakeholders from four segments of Michigan agriculture (hereafter referred to as our target audiences):

- fruit growers,
- field crop producers,
- state/federal governmental agency staff, and

- private agribusiness professionals.

In total, 41 participants (28 farmers and 13 governmental agency or agribusiness professionals) representing 13 counties in Michigan attended one of three events (fruit grower meeting, field crop producer meeting, or government/agribusiness professional meeting). Also in attendance at each meeting were university scientists, specialists, and Extension educators. For these full-day events, we used a modified "fishbowl in the field" protocol (Cranford & Kleinschmit, 2007). A fishbowl is a communication technique that involves organizing a group into speakers and listeners (or observers) in order for all voices in a room to be heard. It usually involves two rings of chairs, an inner ring for speakers and an outer ring for listeners/observers. This format can be used for various purposes:

- Strategically selecting a few members from the group to have a focused conversation while others observe can help reveal key points of agreement or disagreement, which may advance consensus.

- In the case of strongly conflicting opinions, one group discusses their views while the other group listens, and then sides exchange locations so that both perspectives are fairly presented. In this case, equal opportunity can serve to clarify opposing perspectives.

- In situations where one group is usually considered learners, listeners, or followers and the other group is usually considered teachers, speakers, or leaders, the fishbowl technique allows learners to speak while teachers listen, a turnabout in roles. This approach can reduce hegemony-related barriers to communication and information generation.

Each meeting began with an hour-long opportunity for the target audience to engage in a facilitated discussion while scientists and Extension professionals only listened. Participants were asked to share their initial thoughts on challenging weather, experience with climate variability in the past, and how observed changes in climate had affected their farm operations and/or the agricultural industry to date. These discussions were followed by three 30-min educational presentations featuring overviews of current research on climate change and adaptive production practices. Presentations were given by MSU Extension specialists and educators on the following topics: trends and projections for long-term weather and climate in Michigan; a case study demonstrating potential impacts of carbon trading schemes on Michigan corn growers, including nitrogen management for carbon credits; and information on how bioenergy crop production might fit into current farming systems, creating new opportunities for Michigan producers. During the afternoon, facilitated discussions were resumed with the target audience remaining at the primary table and MSU faculty and staff sitting on the outside. Farmers, agribusiness representatives, and government agency staff were asked to describe how they foresaw agriculture's responding to climate variability in the future. Participants reflected on possible motivations for reducing energy consumption, sequestering carbon, or producing/using bioenergy on their farms. The final line of questioning focused on needs assessment, stimulating target audiences to identify ways MSU researchers and educators could specifically help them or their clientele adapt to climate variability. Until that point, MSU staff sat around the outside of the room listening and taking notes, preparing responses and further questions for the target audience. To conclude the experience, MSU researchers and educators were asked to join the conversation and respond to what they had heard throughout the day.

Results

Each event was audio recorded and transcribed into Microsoft Word documents. We then imported those documents into NVIVO 9 software so that we could select and categorize quotes to code against themes and use in reports. In addition, we used surveys of participants to obtain information about the effectiveness of the fishbowl discussion format.

Thematic Analysis

Seven themes from the collective dialogues were summarized. For examples of specific participant comments related to each theme, see Table 1 at the end of this section.

1. Observations of Climate Variability and Change

All stakeholder groups communicated perceived changes in Michigan climate conditions, discussing observed trends and greater variability, including more extreme weather events than in the past. Many participants noted warmer winter temperatures, less snow cover, and less ice cover on the Great Lakes. Farmers said they were experiencing earlier spring warm-ups, leading to longer growing seasons for field crop farmers, but also increased risk of spring frost/freeze events complicating management of fruit crops. Each group had noticed changes in rainfall patterns and intensity and suggested that rains are coming harder and faster now, rains seem to be more localized, and there are longer dry periods between rains in the summer. Fruit crop farmers articulated the most detailed observations of long-term changes and subsequent effects on their operations. Some field crop producers attributed climate changes primarily to natural cycling, an opinion that was not expressed by fruit growers.

2. Effects of Climate on Management

All farmers shared that their management practices had changed significantly in the preceding decade as climate conditions, pest populations, and technology had coevolved. Some noted having to work harder than in the past to produce and protect crops, given rising input costs and greater financial risk in agriculture. Climate variability was viewed as an increasingly significant category of management uncertainty and risk, making investment in risk management technologies such as irrigation, frost protection, and crop insurance more attractive. This expanding risk was also recognized as costly in terms of human capital, causing managers stress and feelings of vulnerability. Each of the target audiences cited different management approaches to commonly observed phenomenon such as earlier spring warm-ups and extreme weather events. Field crop producers, agribusiness professionals, and government agency staff emphasized adaptability, discussing the need for larger equipment that permits greater flexibility in reacting to weather conditions and use of practices such as earlier and/or more rapid planting schedules. Fruit growers linked weather patterns viewed as more favorable for pest and disease development to experiences with emerging pest species, greater pest injury, difficulty of pest and disease control, and costs associated with pest and disease control.

3. Ways Agriculture Can Respond to Future Climate Variability

These Michigan agriculture stakeholders felt that it is the responsibility of their industry to adapt successfully to future climate variability. According to participants, this responsibility is partially assigned by society through the demand for food and ecosystem services from agriculture. It is also inherent in producers' self-identified role as land-based business managers with the goal of maintaining operationally viable cropping systems. Participants

recognized the responsibility of their industry to adapt to climate variability regardless of their diverse beliefs concerning human-influenced climate change. The participants expected that successful responses to climate variability would be based on a model of sustainable intensification, resulting in fewer greenhouse gas emissions (and other negative environmental impacts) while also benefiting farm/industry viability. The desire for and acceptability of particular adaptations among stakeholders is greatly influenced by the unique agroecological contexts of different production systems. For example, field crop producers and industry representatives focused on adaptation as responsive management within the annual cropping cycle. Conversely, fruit growers and industry representatives highlighted the need for proactively collecting long-term climate data to inform adaptive precision and added diversity in perennial cropping systems.

4. Motivations to Produce or Use Bioenergy Crops

Farmers expressed that they may be willing to produce bioenergy crops, given increasing demand and the development of favorable market outlets for biomass. Government agency staff suggested that viable bioenergy crops will need to be high yielding and also supported by adequate policy providing financial incentives such as tax credits/deductions for growers. Many comments centered on the idea that potential trade-offs in bioenergy systems need to be clearly communicated and addressed, including the idea that biofuels should generate a positive energy balance, producing more energy than it takes to create them, and should not compromise food security. Further promise was recognized in biomass production systems designed to maintain soil health by incorporating reduced tillage, cover crops, and crop germplasm selected for higher biomass yield. It was emphasized that many private landholdings in Michigan support a significant volume of woody biomass, yet most associated landowners are unaware of its potential value as bioenergy feedstock.

5. Motivations to Reduce Energy Use

Farmers, agribusiness professionals, and public agency stakeholders discussed reducing energy use through nitrogen fertilizer rate reduction, irrigation efficiency, reduction or elimination of tillage, and general energy efficiency. They focused on the economic implications of reducing energy use, suggesting that some approaches to reducing energy use in these areas would be cost effective for farmers whereas other practices might increase costs and decrease net income. Due to this complexity, third-party technical assistance and/or cost share for implementing energy saving technologies and practices were suggested as possible incentives. Stakeholders also questioned the effectiveness of existing energy policies. For example, farmers expressed concern that federal Tier 4 emission standards had reduced fuel efficiency in large diesel engines. Given the contrast between farmers' working to cut energy use by reducing tillage intensity while at the same time using 15%–20% more fuel in new equipment, one participant wondered, "How is that balancing?"

6. Motivations to Sequester Carbon

Stakeholders commented that farmers already were sequestering carbon on farms without financial incentives or penalties, with many taking steps to build soil organic matter and improve soil health. A few expressed the view that some form of carbon taxation seems inevitable and noted monitoring carbon taxation efforts in Canada and Europe to understand future implications for U.S. policies. Farmers were skeptical that there would be compensation available for those already engaged in sequestering carbon. Motivations to sequester carbon identified by participants were multifaceted and included potential benefits to crop production and profitability as well as broader environmental and social goods. Cherry farmers were unique in their attention to carbon cycling

and ability to pursue sequestration by maintaining living ground cover and recycling pruning residues in perennial orchard systems.

7. Research and Educational Needs

Stakeholders expressed confidence in the basic Extension model: educators working in the field to identify industry needs, provide technical assistance, and deliver educational programming and demonstrations based on university research. They viewed land-grant universities as an especially trustworthy source of information. However, participants also suggested that the traditional Extension model should be updated and fine-tuned to best meet the specialized needs of agricultural practitioners working to address climate change.

For example, participants shared the view that although the university is trustworthy and thorough, it tends to be "way too late" in meeting needs. Private industry was deemed reliable for delivering cutting-edge technology and recognized as providing information quickly to farmers. Target audiences communicated their desire to access separate basic and advanced educational content, noting that "one-size-fits-all" programs were not the best use of their time. They shared that direct email communication of relevant information from Extension is preferable to general information posted on a website.

Farmers expressed interest in further engagement with university research to generate locally relevant data on weather and climate that could be used in management decision making. They requested that university personnel use their expertise to teach producers how to independently collect, analyze, and use data. There was also discussion regarding the data collection capabilities of modern farm equipment and a desire expressed by some producers to share their agricultural data with the university if barriers could be removed to make doing so efficient and effective. At the same time, others had reservations about how ownership of intellectual property should be handled when farmers, universities, and industry collaborate. Farmers also questioned the overhead fringe rates of university grants and stated that they commonly judge research efforts on the basis of funders backing the project.

Table 1.

Participant Quotes from Climate Change Meetings with Agricultural Audiences

Theme	Participant quote	Stakeholder audience
Observations of climate variability	"When we first got involved in farming back in the '70s, the bets during the winter would always be 'What day would West Bay freeze over?' Then in the late '80s and '90s, it became 'Is it going to freeze over this year?' And now we don't even think about West Bay freezing over anymore."	Fruit grower
Observations of climate variability	"No longer will we get a 2- [or] 3-day rain; we just have extremes. We have large storms that come quick, but we have long periods of drought with high heat . . . we're getting large swings and the type of storms that we get now are hard to	Government agency/agribusiness professional

	manage."	
Observations of climate variability	". . . the extreme weather in the spring is probably one of my biggest hurdles. It gets warm early; well, do you go plant? Well, maybe not. You can pretty well depend on getting one pounding rain someplace in there, and that's the hardest thing for me to manage because . . . what I can control [is limited]: how I plant, when I plant, and when I go out there. After that, unless I want to buy some irrigation, I have really nothing to do with it. With all the input costs, you [have] got to buy crop insurance just for a safety method in there. It makes you sleep better too."	Field crop producer
Effects of climate on management	"The average start date is certainly much sooner. I agree . . . [about] the extreme . . . complexity of pest management now up here . . . between resistance and new insects. It's gotten much more complicated, much more expensive than it was when we started. It's an amazing change . . . I think we had apple programs that might have cost $200–$300 per acre, and now they're $1,000 an acre per year, give or take a hundred bucks . . . those are some things I've noticed."	Fruit grower
Effects of climate on management	"I think with the weather now, and because of the cost of doing business and the amount of impact it has on your checkbook, your bottom line, every time we do have a dry streak of weather, it makes you shudder. It makes your heart skip a beat or two because you [have] got more at risk, and there's more reward and risk involved now than there ever used to be. A bad weather scare can take you right out of business, whereas in the '50s or '60s, a bad weather scare would put a hardship on you, but you would probably still be there. Now, it could actually physically take you out of the game. It puts a little more stress or mental impact on you than it ever used to because the stakes are higher."	Field crop producer
Ways agriculture can respond	"I just think that there's great potential for more diverse crop systems. Should we be raising chickens there? I don't know, but the whole multicropping thing, I think, is something we need to look at more as a way to be more	Fruit grower

	resilient against the variability of weather that we're going to see."	
Ways agriculture can respond	"Farmers are pretty good at [adapting to weather] because there's no 2 years that are the same, so they're used to adjusting for what weather throws at them, and they do pretty well at it."	Government agency/agribusiness professional
Ways agriculture can respond	"When the shift went from talking about global warming to climate change, then they had something to talk about because better than anybody, the farmers pay attention to the weather."	Government agency/agribusiness professional
Ways agriculture can respond	"It's working with Mother Nature, to be ready when it's ready. Adapt quickly."	Field crop producer
Ways agriculture can respond	"The big thing is every spring is going to be different. You never want to figure, 'Well, it worked this way last year, and I'm going to do it this way this year.' It's never going to be that way. This year will definitely be different this spring than it was last year."	Field crop producer
Growing bioenergy crops	"Changes are expensive. To be able to make those changes, to have a cost-share system out there [to plant and grow bioenergy crops] . . . makes it possible for those changes to occur. We'd like to think that people would do it just because it's the right thing to do, and a lot of times they'd like to do it because it's the right thing to do; they don't have the financial backing to make the change."	Government agency/agribusiness professional
Growing bioenergy crops	"We raise some wheat. Do you remove the straw? You could use it for bioenergy, but then you take away the organic matter, [and] there's nutrient value in the straw. But then you [have] got to replace it by buying chemical fertilizers, so you [have] got all these trade-offs. I don't know what the answer is. I don't know if I ever will."	Field crop producer
Reducing energy use	"Probably the biggest motivator in reducing energy consumption is the economics of it."	Fruit grower
Reducing energy use	"There's going to be a lot more motivation to try new, innovative ways of doing whatever when the	Government agency/agribusiness

	cost [of energy] increases."	professional
Sequestering carbon on the farm	"It's going to be on a field-by-field basis, just depending on the history of the field and the operation, whether or not you're going to be able to sequester carbon."	Government agency/agribusiness professional
Sequestering carbon on the farm	"Some form of carbon tax is probably going to happen someday; the question is the timing."	Government agency/agribusiness professional
Sequestering carbon on the farm	"I think to a large extent . . . we can improve [carbon sequestration] if we have better life in the soil. I think we're recognizing more and more that half of what we grow is in the ground and the other half is sticking up in the air. As we see more weather variability that buffers that part sticking up in the air, we need to strengthen the other part of the plant that's in the soil to help it survive."	Field crop producer
Research and education needs	"One thing that would be really useful for us is to set up a program right now where we get really good data on a bunch of different parameters that we have right now. So we have baselines; we have baselines on temperature, we have baselines on precipitation, we have baselines on sunlight, any factors that we can think of where we have real, honest-to-God data instead of my notes. I have my notes, and it's all anecdotal; it really doesn't mean anything. If MSU can come up with a program where you work with interested growers—the group that's right here—if we work with these growers right here and compile a way to just start getting data on these things that we're worried about changing and the things that we think we're going to have to deal with, I think that would be great, and I don't think it would be that expensive."	Fruit grower
Research and education needs	"I think one thing that's so different in fruit than it is in field crops is [that] in field crops you [have] got really big companies investing a huge amount of money in genetic research. There's lots of money for Pioneer and so on to develop seeds for corn and soybeans. It's not that situation [in fruit production]; we have no private breeding	Fruit grower

	programs looking at the genetics, and if we're really going to be successful in the long run, we're going to have to have changes in our genetics of the crops we're growing that give us better resistance to cherry leaf spot or give us delayed bud development in the spring . . . and still have fruit quality the market needs. . . . That's a big area and not one that's going to be done in the private sector; it's going to have to be done at the universities. . . . That's going to be critical in the long run."	
Research and education needs	"There's a lot of things we've mentioned today that seem like researchable events that need research. I think just from the soil—ways of handling soil, ways of building up the bio-matter, and that sort of thing . . . water management, irrigation management; a lot of those things need research, and that, of course, needs some dissemination."	Fruit grower

Note. MSU = Michigan State University. Each quote illustrates one of the seven themes that came from the discussions.

Program Evaluation

Participants completed a one-page survey at the end of each Carbon, Energy, and Climate event that included process-focused questions so that we could determine the effectiveness of the fishbowl discussion format. Results from these short-term evaluations can inform the planning of future events with agricultural audiences.

The field crop producers stated that the meeting was effective:

- All (100%) agreed that the discussion format was a comfortable setting.
- Most (98%) felt completely listened to at the event and agreed that they gained something from the discussion.
- All (100%) agreed that the discussion was an effective way to gather information.

Fruit growers were asked a slightly different set of questions and replied as to how information on climate variability might help with management of their farm operations in the future.

- All (100%) agreed that the discussion on climate variability and agriculture was beneficial to them and their farm operations.
- All (100%) agreed that they would like to participate in further discussions related to climate and weather variability.

- Most (85%) agreed that the discussion helped them think differently about climate variability.
- Many (83%) agreed that the discussion helped them think more broadly about bioenergy.
    - Half (50%) indicated that they would further research bioenergy options for their farms in the subsequent 1 to 4 years.
    - Many (83%) said they learned more about carbon trading and how it might be an option for Michigan agriculture.
- Some (62%) reported being very likely to change or adopt new practices in the subsequent 1 to 2 years as a result of the discussion, and most (85%) reported being very likely to change or adopt new practices in the subsequent 5 to 10 years as a result of the discussion.
- Many (73%) said they would be interested in collaborating with MSU researchers.

Participants noted that the program helped better frame some of the climate change issues agriculture is facing, asking that MSU make this sort of programming available more frequently. One stakeholder elaborated, "I think that agriculture is poised to be able to adapt and respond to climate variability. We talked this morning that we have different tools that are already developed or [are] being developed, and I think that we're in a good position to be able to respond . . . if we keep learning and communicating with our industry and moving together."

Conclusions

Using a dialogue-based approach to engage stakeholders in conversation about climate change highlighted many challenges and opportunities Extension faces in addressing complex issues—climate change or otherwise—with diverse audiences. Here, we discuss some overarching aspects of our experience.

- Building an interdisciplinary project team helped us recruit key stakeholders and provided the expertise necessary to facilitate dialogue and give technical presentations.
- Using dialogue to approach the topic of climate, instead of a more traditional expert lecture format, reduced barriers to communication and promoted cooperative learning. Having farmers and other stakeholders speak first acknowledged their expertise, setting the stage for honest and respectful dialogue throughout the day.
- Framing the conversations in terms of adapting to climate variability created space for diverse perspectives. Even when participants did not acknowledge anthropogenic climate change, they readily described the changes in climate they had experienced and discussed ways to adapt to future change.
- We noted differences in how fruit growers and field crop producers discussed climate change and strategies for adaptation, which may reflect rational interpretations of the inherent differences between specialty and commodity or perennial and annual crop production systems. Further research is needed to fully understand these differences. Yet this observation highlights the importance of not generalizing across stakeholder groups when addressing climate change or other complex topics.

- Stakeholders were forthright with praise for and critiques of Extension when prompted, a unique level of candor that set our discussions apart from other Extension programs. Participants also communicated an innovative vision for how Extension might evolve to address complex issues such as climate change in the future. These honest exchanges further highlight the potential value of dialogue-based Extension programs.

- Farmers recognized value in our unique approach to addressing the topic of climate change and expressed interest in continuing the conversations with one another and the project team. Support from Extension administrators and potential funding partners will be necessary to expand this effort in the future.

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