

Assessing perceptions of climate risk and adaptation among small farmers in Oregon's Willamette Valley

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From the Field

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Abstract

Farmers, particularly small farmers, are on the frontlines of climate change. In Oregon's Southern Willamette Valley, a needs assessment was conducted of small farmers in 2017, where questions related to climate change risks, attitudes toward adaptation and climate beliefs were assessed. Out of all the respondents ($n = 123$), the majority (70%) believe that climate change is occurring, and is caused mostly by human activities. The majority (58%) also strongly agree with the statement that they will have to change practices to cope with increasing climate variability in order to ensure the long-term success of their operation. Another 52% of these respondents indicated that they have already taken action to respond to climate change on their farms. However, only 32% of respondents agreed with the statement that they have the knowledge and skills to deal with weather-related threats to their operation. While this work is preliminary and not comprehensive, our findings suggest that these small farmers are concerned about climate change, readily accept the science as compared to other farmer groups in the USA, and are looking for additional tools and resource to increase their confidence in responding to the challenges they will face as a consequence of climate change.

Introduction

'Farmers are probably the most adaptable group of people who work with the weather all year long, often time having more weather experience than the experts.'

—Farmer respondent

Farmers are on the frontlines of climate change. Climate change exacerbates complex interactions between economic and management challenges that threaten the productivity and viability of farms. Small farmers, many of whom are also beginning farmers (defined by [U.S. Department of Agriculture](#) as those who have been farming for less than 10 yr), are particularly vulnerable to the impacts of climate change because many of them lack the access to land and capital ([U.S. Department of Agriculture](#)), water for irrigation because many are junior water rights' holders (Li *et al.*, 2018) and to farm support programs designed for larger commodity producers (e.g., crop insurance) (Belasco *et al.*, 2013). In the Southern Willamette Valley, in western Oregon, small farmers produce a variety of fruits, vegetables, tree fruit, livestock and poultry for direct to consumer markets. The scale of these farms varies from less than an acre to more than a hundred acres. Willamette Valley small farmers grow and sell food locally and directly to consumers via farmers' markets, CSAs, farm stands and other channels (Fery and Garrett, 2017).

The Northwest region is expected to experience higher temperatures, more variable precipitation and changes to the productivity of specific crops. It is expected that there will be earlier peak flows and less snowpack, limiting the water available for irrigation in the summer growing season (May *et al.*, 2018). Further, it is expected that the region will experience more extremes in precipitation from atmospheric rivers (heavy rainfall events) to drought conditions. To better serve the needs of small farmers, it is necessary to understand how they are thinking about climate risks and whether they intend on making changes in response (May *et al.*, 2018).

Unfortunately, very little data are available regarding farmers' perspectives on these topics in the Northwest (Chatrchyan *et al.*, 2017; Borelli *et al.*, 2018; Roesch-McNally, 2018). To this end, the USDA Northwest Climate Hub partnered with the Oregon State University (OSU) Extension Small Farms Program to include questions related to climate change beliefs and attitudes toward adaptation in a larger study in the Southern Willamette Valley. The lessons learned from this short survey highlights climate risk perceptions, attitudes toward climate adaptation, climate change beliefs and use of climate-related tools and resources.

These findings will be of interest to those working to ensure the economic viability and ecological sustainability of small farms in the era of global climate disruption.

Methods

An online Small Farms Needs Assessment survey (Fery and Garrett, 2017) was developed, piloted and disseminated to farmers, ranchers and landowners in the Southern Willamette Valley, with a focus on farmers from Linn, Benton and Lane counties, during the spring of 2017. During this time, notices about the survey were distributed via social media, electronic and printed newsletters, direct emails, press releases, flyers and handouts. The primary focus of the survey was to ask participants what they wanted the OSU Small Farms Program to work on over the coming years.

The overall survey garnered 249 responses. All survey respondents were asked if they were interested in providing their opinions regarding a series of climate change questions. Of the total number of respondents, 48% ($n=123$) said yes and responded to the rest of the survey. Therefore, only those farmers who had at least some interest in climate change issues would have responded to this portion of the survey. For the purposes of this paper, we focus our analysis on those climate-related questions adapted from well-tested surveys conducted with farmers from other regions in the USA (Loy *et al.*, 2013; Seamon *et al.*, 2017). Specifically, we included a subset of questions that addressed farmers' attitudes toward adaptation, including their perspectives on the need for taking action, assessment of actions already taken, their beliefs about climate change and their use of tools and resources to aid in climate decision-making (see survey questions in Supplementary Materials).

In terms of the limitations of the study, the response of 249 is fairly low. According to the USDA 2012 Agricultural Census, for Linn, Benton and Lane counties that there are 5328 small farms (those farms grossing less than \$250,000 yr^{-1}). Further, given that this was a convenience sample of small farmers, some whom are already connected to OSU Extension networks, we expect that there would be some self-selection bias on behalf of respondents. Given that this survey was administered via a convenience sample, and no general demographic information was included, it is not recommended to generalize these results to the broader population of small farmers in the region or make comparisons to Agricultural Census data.

Results and discussion

Of those who agreed to answer the questions about climate change, the majority were from Linn, Benton and Lane counties (86%) (Table 1). Forty-seven per cent of the respondents identified themselves as a farmer/rancher, 34% as a landowner and 14% selected 'other'. The 'other' category was open-ended and the majority self-identified as 'hobby farmers' or those hoping/planning to farm in the future. Respondents were able to select more than one role; therefore, all results from these respondents have been included in our analysis.

A majority of respondents (65%) considered themselves beginning farmers. Nearly 50% farm on less than 10 acres and another 22% operate on more than 50 acres. Fifty-five per cent of respondents farm on land without water rights or with limited water rights, which is a real challenge for specialty crop producers who typically rely on irrigation. Respondent's farming operations

Table 1. Table of key farmer characteristics ($n=123$)

Farmer characteristics	Per cent ^a
Farmers operating in Linn, Benton and Lane Counties	86
Identify as farmer/rancher	47
Landowner	34
'Other'	14
Farming ≤ 10 acres	48
Farming 10–49 acres	40
Farming ≥ 50 acres	22
Identify as a beginning farmer (farming <10 yr)	65
Farming on land without water rights or with limited water rights	55

^aRespondents were able to choose more than one option.

were diversified, with the majority producing a combination of products with the top five being vegetables, tree fruits/nuts, pasture/forage/hay, herbs and poultry production for eggs.

Climate change beliefs and attitudes toward adaptation

In terms of climate change beliefs, the majority of respondents (70%) believe that climate change is occurring, and is caused mostly by human activities. The majority of respondents also agreed that action needs to be taken to minimize climate risk. These reported beliefs in climate change were higher than among similar studies of farmers conducted in other parts of the USA (Prokopy *et al.*, 2015; Chatrchyan *et al.*, 2017). Additionally, previous research makes a connection between these climate beliefs and support for climate action (Howden *et al.*, 2007; Arbuckle *et al.*, 2013; Hyland *et al.*, 2016; Chatrchyan *et al.*, 2017) suggesting that as belief in anthropogenic climate change increases, so does support for adaptive and mitigative action, although this trend is not always supported in the literature (Schattman *et al.*, 2018a, 2018b).

The majority of the respondents (58%) strongly agreed with the statement that they will have to change practices to cope with increasing climate variability in order to ensure the long-term success of their operation. Fifty-two per cent of these respondents indicated that they have already taken action to respond to climate change on their farms. It is clear that farmers from other parts of the country are also beginning to take action in response to climate change (Jemison *et al.*, 2014; White *et al.*, 2018; Schattman *et al.*, 2018b) and many farmers anticipate taking action in response to projected changes (Haden *et al.*, 2012; Niles *et al.*, 2016; Roesch-McNally, 2018; Roesch-McNally *et al.*, 2019).

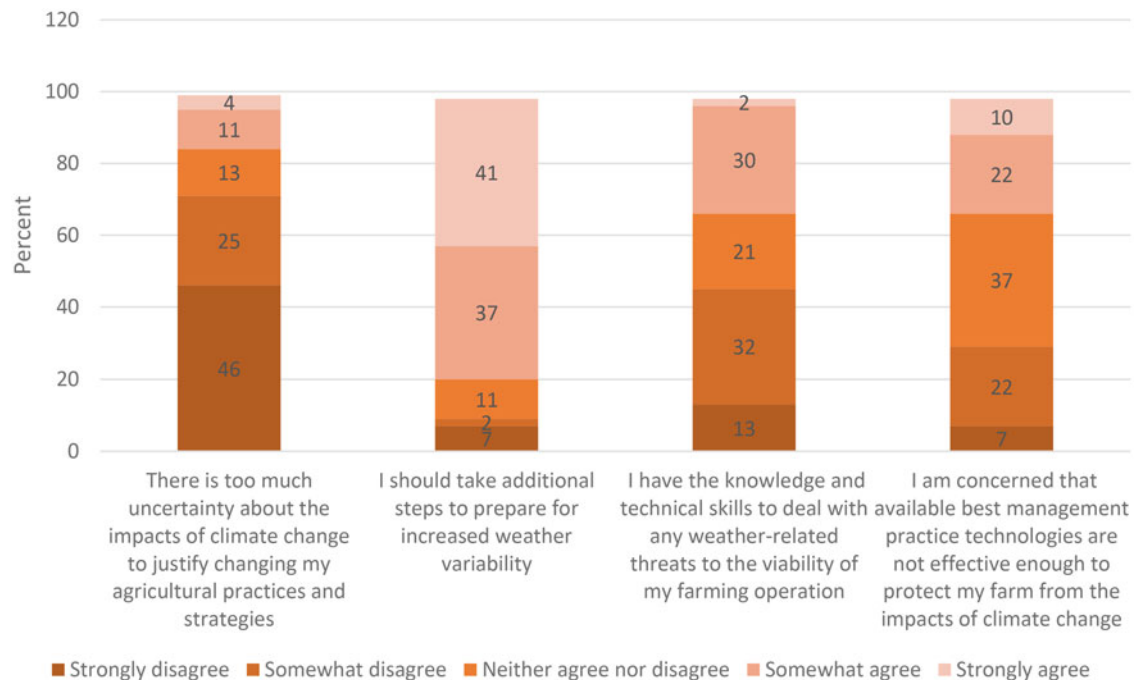
Among the farmers surveyed as part of this analysis, a subset of them responded to an open-ended question about the kinds of changes they had made as a result of climate change. These responses were then organized into thematic categories that best reflect the broad ideas representative in farmer's responses. The top five themes among farmer responses were changes to water management, improvement to soil management, diversifying crop/farm system, crop/variety selection and livestock management (Table 2).

In terms of attitudes toward adaptation, most respondents suggested that action is necessary to respond to climate risks, with

Table 2. Responses ($n = 51$) to an open-ended question about what changes farmers made as a result of changes in the climate

Practice	Example	Farmer quote	Number of times mentioned
Water management	Use of drip irrigation, water tanks	'Have developed water storage to counteract the lower production of groundwater from wells at the height of the dry/hot season.'	26
Improved soil management/health	Reduction of erosion, improvement to soil health	'Soil management for carbon sequestering.'	12
Diversifying systems	Diversify cropping systems, crop rotation or field/farm management	'Diversifying to hedge my bets.'	10
Crop selection/ varietal	Drought resistant varieties	'Growing less water intense crops.'	9
Livestock management	Climate-controlled barns, changes to pasture management	'Fenced off new pastures. Made access to barn safe.'	9
Season extension	Shorten and/or lengthen the growing season	'I've also built cold frames, and used those, getting my veggies sprouting in December, when the cold frame is covered in snow and ice (yay mel).'	4
Forest/woodland management	Agroforestry	'Moving away from hay to native woodland products.'	4
Dry Farming	Relying on seasonal soil moisture instead of irrigation for crops	'Dry farming experiments, non-irrigated tree crops.'	3
Hugelkultur	Raised beds with composting woody material	'Used Hugelkultur techniques.'	3
Cover crops	Use of cover crops in the fallow season	'Trying to keep cover crops on soil to reduce damages caused by heavy rain.'	3

Multiple responses recorded for each respondent.

**Fig. 1.** Respondents ($n = 123$) were asked a series of agreement scale questions regarding their attitudes toward adaptation.

71% disagreeing with the statement that there was too much uncertainty about the impacts of climate change to justify changing their practices and 78% agreeing or strongly agreeing that they should take additional steps to deal with increased weather variability (Fig. 1). This is in contrast to the same questions

asked of Midwestern farmers who largely agreed that there was too much uncertainty to justify taking action (Morton *et al.*, 2017). However, only 32% of our respondents agreed with the statement that they have the knowledge and skills to deal with weather-related threats to their operation. This is similar to

Table 3. Respondents were asked the open-ended question, 'What tools or resources would you like to see that might help you make better decisions in the context of more extreme and variable weather?' ($n = 50$)

Desired information/tools	Example	Farmer quote	Number of times mentioned
Alternative farm systems/ diverse crops or varieties	Changing crops grown in the region	'Experimental results on new techniques, systems, crops.'	18
Improved forecasts (count/per): – Long-term (6) – Seasonal (5) – Short-term (5)	– More information on how climate will change – Better seasonal and short-term forecasts	'Information about how climate is projected to change in our area and when.' 'Better predictions, short and long term.'	16
Water management	Irrigation or rainwater catchment	'Case studies on cost-benefit analysis of backup water systems such as water storage, rainwater catchment, ponds, and new shallow wells.'	15
Need for global action	Action to deal with climate change	'Acknowledgement of global climate change/extreme weather & political will to mitigate otherwise what difference does it make on a tiny farm scale?'	7
Caring for soil resources	Soil health improvement	'I want to learn how to remediate the soil to bring back the healthy biology.'	7
Emergency response/ dealing with extremes	How to reduce risks with extreme events	'What to do to battle extremes (flooding, drought, snow/freezes, hot weather, etc.).'	6
Infrastructure (barns, greenhouses)	Changes to barns, greenhouses, etc.	'I am not sure what tools might be out there. I am thinking more about tunnels and greenhouse to have places to protect plants, grow longer season, shade.'	6
Livestock management in extremes	Changes in pasture management	'Livestock management practices for extreme and variable weather—specifically, how to minimize the impact of extreme temperature swings on sheep (selecting adaptable breeds, planting more trees, improving livestock facilities, etc.).'	6
Resources for dealing with drought	Drought tools	'Would like to see more seminars/working groups/discussion about on-farm water storage (and support for such storage from the State of Oregon) as a tool to alleviate some of the effects of multi-year drought or borderline drought conditions in our region in recent years.'	5
Alternative energy systems	Wind, solar, etc.	'Information on converting your house/farm to solar and wind power—like *solid* info, a how to guide, for the do it yourself-er.'	4

Multiple responses accepted.

concerns of New England producers who are also worried that they lack financial capacity, knowledge and technical skills to deal with weather-related threats on their farms (White *et al.*, 2018). In addition, 32% agreed or strongly agreed that they were concerned that available best management practice technologies are not effective enough to protect farms from climate impacts.

The final open-ended survey question inquired as to what tools and resources farmers would like to have to improve decision-making in the context of more extreme and variable weather (Table 3). The majority of respondents did not articulate the need for specific tools, but focused on the informational content they want. The most common request was improved information about alternative farming systems, including new crop varieties and general ways to modify the crop/livestock system to cope with a changing climate. The second most common request was a desire for improved forecasts; however, there was significant diversity in what kinds of weather and climate information that farmers wanted, from short-term to longer-term forecasts.

Small farmer respondents articulated a need for general tools and resources to make better decisions when faced with extreme and variable weather, including the need for improved forecasts, identification of new farming techniques (e.g., alternative crops,

season extension) and improvements to water management systems, as well as strategies and tools for dealing with more extreme and variable weather. Indeed, decision-making tools and resources are increasingly called for as an important part of landowner outreach and education in the context of climate-informed decision-making. Yet it has been argued that creating usable climate science information will require an iterative process that builds strong linkages between scientists and decision makers, facilitated through different forms of engagement (Dilling and Lemos, 2011).

This short survey and needs assessment is a first step for the Southern Willamette Valley small farm community, OSU Extension and regional partners to assess concerns and needs related to projected climate changes. This work highlights the importance of gaining local, place-based information on farmer perspectives on climate change, their attitudes toward climate action and their need for climate-informed resources (Chatrachyan *et al.*, 2017; Lane *et al.*, 2018; White *et al.*, 2018). This work is therefore a critical first step in providing a grounded perspective for county-based Extension, as a community of practice (Roesch-McNally *et al.*, 2019), as they seek to provide services to small farmers who are dealing with challenges associated with climate change.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/S1742170519000267>.

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