

## Farmers' Trust in Sources of Production and Climate Information and Their Use of Technology

### Abstract

A regionally representative survey of 900 Inland Pacific Northwest farmers showed that farmers trust other farmers and agribusiness most for production management decisions but trust university Extension most for climate change information. Additionally, in responding to questions about use of the Internet and mobile applications for making farm management decisions, many farmers indicated that they use the Internet daily but mobile applications much less regularly to access farm-related information. These results suggest that university Extension personnel have an important role to play in informing farmers about climate change and can do so effectively by using certain digital tools alongside other more traditional avenues for information delivery.

**Keywords:** [university Extension](#), [climate change and agriculture](#), [Internet and mobile applications](#), [trusted information sources](#)

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## Introduction

Farmers draw on multiple sources of information to learn about new production options. Understanding the relative importance of these different sources can improve agricultural professionals' programming and information transfer, especially as it relates to farmers' knowledge and management practices (Hamlet, 2011). Access to reliable information will be increasingly important for farmers, given societal pressures to improve agricultural performance and contribute to global food and fuel supplies while conserving land and natural resources (Reganold et al., 2011) and adapting to and mitigating agriculture's impacts related to climate change (Arbuckle, Lasley, & Ferrell, 2012; Haden, Niles, Lubell, Perlman, & Jackson, 2012). Traditionally, the most important sources of information for farmers have been university Extension, private industry crop advisors, the Natural Resources Conservation Service (NRCS), other farmers, family members, and the Farm Service Agency (Arbuckle et al., 2012; Tarnoczi & Berkes, 2010; Tucker & Napier, 2002). Farmers' decisions about which sources to rely on and for what depend on demographic factors (Gloy, Akridge, & Whipker, 2000; Jones, Diekmann, & Batte, 2010) and the types of information they are seeking (Arbuckle et al., 2012).

University Extension is a trusted information source for farmers and their advisors related to soil and water conservation (Mase, Gramig, & Prokopy, 2016) and climate change (Prokopy et al., 2015). However, communicating with farmers about climate change is challenging because of the highly politicized public discourse surrounding the issue (Layman, Doll, & Peters, 2013; McCright & Dunlap, 2011). Additionally, the complexity and long temporal scale of climate change hinders direct observation (Rickard, Yang, & Schuldt, 2016), encouraging farmers to rely on indirect, often biased sources of information. Despite its importance (Fraisse, Breuer, Zierden, & Ingram, 2009; Henning, Steele, Buchholz, & Ramaswamy, 2014), Extension educators often avoid addressing climate change because of their own lack of familiarity with the topic (Morris, Megalos, Vuola, Adams, & Monroe, 2014).

Improvements in information and communication technology have decreased costs and increased the number of public and private sector providers of agricultural information (Diekmann & Batte, 2009; Gloy et al., 2000). The primary challenge for farmers has changed from obtaining information to discriminating among the rapidly changing and diverse information sources available to them (Fountas, Wulfsohn, Blackmore, Jacobsen, & Pedersen, 2006). As emerging concerns such as climate change continue to intensify production demands, the need for trustworthy information increases and agricultural professionals across disciplines can develop more effective outreach programs by understanding the main information sources farmers trust and use. Targeting farmers' preferred information sources can improve the efficiency of Extension outreach and help ensure that reliable information is accessible. To understand how best to present information about climate change in agriculture, we assessed information sources used by Inland Northwest cereal farmers related to agronomy and climate change and the communication platforms these farmers use most often.

## Methodology

In November 2012, the Social Science Research Unit (SSRU) of the University of Idaho administered a mail survey titled "Inland Pacific Northwest Wheat Producers: Past, Present, and Future" to cereal farmers in the Inland Northwest (northern Idaho, north-central Oregon, and eastern Washington). The survey instrument was developed by an interdisciplinary group of social and biophysical scientist partners and was harmonized with other large-scale survey projects to increase validity and enable comparisons among data sets. The survey was approved by the University of Idaho Institutional Review Board, protocol number 10-139. The National

Agricultural Statistics Services (NASS) drew a sample of 1,988 farmers who grew 50 ac or more of wheat in 2009, 2010, or 2011 in counties throughout the Inland Northwest having significant acreages of small-grain cereals as the main crop. The full Dillman survey method (Dillman, Smyth, & Christian, 2008) was employed and included four mailings and distribution of a postcard. The survey contained questions about farmers' uses and trust of information sources, perceptions of climate change, farm management practices, and demographics. The 900 completed, valid surveys represented a response rate of 46.2%, and the adjusted response rate had a low sampling margin of error of  $\pm 3\%$  at the 95% confidence interval (American Association for Public Opinion Research, 2011), indicating that the survey was representative of the region's farmers. The sampling frame information was proprietary; therefore, the SSRU team contacted NASS to collect summary information on the frame and the number of responses within each county. The SSRU researchers explored weighting the data based on probability of selection and probability of nonresponse for each county, which confirmed that NASS had identified a representative sample.

The analysis presented in this article is based on farmers' responses to a subset of questions from the larger SSRU-conducted survey regarding information sources. Farmers were asked how trustworthy (on a scale having the response options *very trustworthy*, *somewhat trustworthy*, *neither trustworthy nor untrustworthy*, *somewhat untrustworthy*, and *very untrustworthy*) various information sources were for both production management strategies and climate change information. The designated information sources were other producers in the respondent's county, crop advisors from agribusiness, university Extension, independent crop advisors, Soil and Water Conservation District personnel, and state-level NRCS representatives. Additionally, farmers were asked questions about their use of the Internet and mobile applications. The first of these questions examined different uses of the Internet. The second question examined frequency of Internet use and use of mobile applications. Data presented here are descriptive statistics based on percentage frequencies and standard errors.

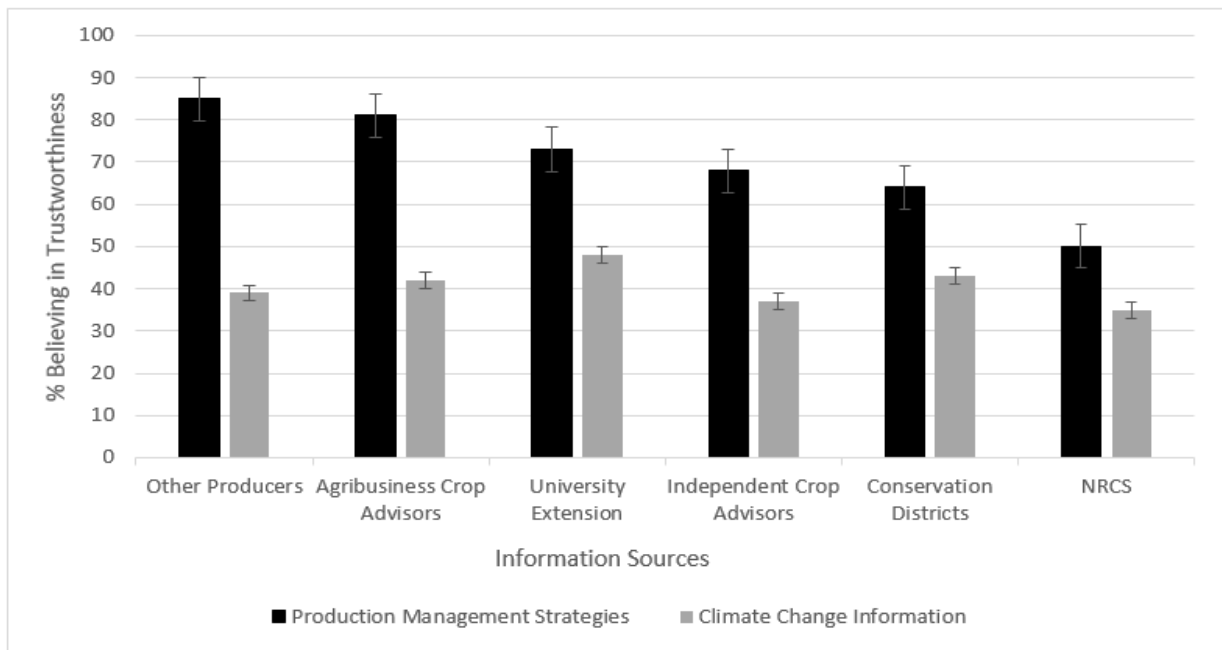
## Results and Discussion

### Trust in Information Sources

Inland Northwest cereal farmers' responses to survey questions about their level of trust in different sources for production management strategies and climate change information are presented in Figure 1. Overall, farmers tended to trust information about production management strategies more than they trusted information about climate change, but their preferences in sources for each type of information varied.

#### Figure 1.

Inland Northwest Cereal Farmers' Responses to Questions About Trusted Sources of Information



Note: NRCS = Natural Resources Conservation Service

## ***Production Management Information***

With regard to production management information, the first and second most trusted sources (those that more than 80% of respondents found to be trustworthy) were other local farmers and crop advisors from agribusiness companies. Farmers' reliance on other local individuals and agribusiness companies, including affiliated crop advisors, for providing information about production decisions is relatively common across cropping systems (Arbuckle et al., 2012; Gloy et al., 2000). In the Inland Northwest, agribusiness crop advisors are well connected and knowledgeable about their clients' particular farm and management needs (Bernacchi & Wulfhorst, 2017). Reliance on other farmers and agribusiness crop advisors may also reflect the relevance the information has for making specific production decisions (Bernacchi & Wulfhorst, 2017). For example, seed, fertilizer, or agricultural chemical dealers from agribusiness companies were preferred information sources for farmers seeking information about crop production, fertilizer application rates, and pest control issues (Arbuckle et al., 2012; Prokopy et al., 2015). Agribusiness sources are often cited as primary sources of information; however, the information they provide tends to be targeted, production oriented, and not necessarily suitable for all needs, such as those related to climate, soil, and water conservation decisions (Prokopy et al., 2015). Because agribusinesses are less equipped to address conservation and climate change concerns, farmers who rely on them as information sources may also be more likely to feel that too much uncertainty surrounds the causes and consequences of climate change to justify changing current practices or strategies (Morton, Roesch-McNally, & Wilke, 2017).

The third most trusted source for information about production strategies was university Extension (73.0%). Although Extension is not always cited as a primary source for information about production systems, it is often an important source used to guide decisions (Prokopy et al., 2015). Research in other regions has shown that Extension is an important source of information about production practices, but not as important as agribusiness crop advisors (Arbuckle et al., 2012). Other research has indicated that experienced farmers tend to use university Extension resources more than other sources for making decisions about production practices,

suggesting that experienced farmers have a better appreciation of the level of knowledge shared between university Extension and rural communities (Jones et al., 2010).

The fourth and fifth most trusted sources of information for making production management decisions were independent crop advisors (67.7%) and soil and water conservation districts (64.3%). Finally, only about half of the respondents (49.8%) considered information about management strategies provided by state-level NRCS advisors to be trustworthy. Soil and water conservation district and state-level NRCS representatives may not be the most trusted sources for all farmers for information about production practices, but they often serve as useful sources for specific conservation options (Arbuckle et al., 2012; Tarnoczi & Berkes, 2010). Reluctance to trust information provided by NRCS representatives may result, in part, from their dual mandate to enforce regulations (at the federal level) and to provide information (at the local scale). The NRCS and the Farm Service Agency have been cited as trusted information sources widely used by farmers in the midwestern United States (Tucker & Napier, 2002), suggesting that substantive differences across regions could exist in relation to effectiveness of programming, local versus nonlocal relations with different government and auxiliary agencies, and willingness of farmers to accept support from government programs that also invoke regulatory dimensions.

## ***Climate Change Information***

The Inland Northwest cereal farmers had only low to moderate levels of trust in climate change information provided to them by other farmers (38.8%), agribusiness crop advisors (41.6%), independent crop advisors (37.2%), soil and water conservation districts (42.7%), and state-level NRCS representatives (35.3%). Low levels of trust in climate information were expected considering the wide array of perspectives about this topic among citizens and agricultural producers in the United States (Arbuckle et al., 2013; Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2014). Altogether, the responses suggest that lack of confidence concerning climate change information is substantial among Inland Northwest cereal farmers, with about 60% indicating that they did not trust information about climate change from sources that they rely on with confidence for other types of information.

Nearly half (47.8%) of the farmers found university Extension to be the most trustworthy source of climate change information. Although trust is not overwhelming for any climate change information source, a greater trust in Extension likely reflects the century-long history of university Extension's effectively providing useful, unbiased, science-based information to farmers via land-grant institutions. This information has dramatically improved farming practices and technologies (e.g., fertilizers, crop varieties, pesticides, implements) and strengthened farm operations (Gould, Woodrum, & Steele, 2014; Henning et al., 2014). The long-standing consideration that university Extension provides reliable agricultural expertise likely gives Extension-based information a level of credibility that may be lacking in the information provided by private consultants or conservation-oriented agencies (Prokopy et al., 2015).

Farmers may also particularly trust university Extension because of the complexity of climate-change related issues. Because of their direct relationship with universities, Extension personnel have ready access to the information, ideas, and resources shared across disciplines to address complex phenomena, such as climate change. In contrast, specialized entities, such as crop advisors, are by necessity focused on on-farm profitability from season to season and thereby can take a more short-term approach to addressing farm-related challenges. Agribusinesses, crop consultants, commodity groups, state agencies, and other agricultural information providers also rely heavily on university Extension information to inform their technical recommendations for farmers

(Arbuckle et al., 2012), supporting the importance of Extension, even if indirectly, in guiding management decisions. Research from the Midwest suggests that crop advisors specifically look to Extension for climate change information (Prokopy et al., 2015). Also, university Extension has often successfully created a feedback loop between scientists and end users, which in turn enhances the usefulness of resources and decision support tools for farmers (Breuer, Dinon, Boyles, & Wilkerson, 2011). Together, these points suggest that university Extension is and will remain a vital and effective means for information delivery to serve the public, especially concerning complex and contentious issues such as climate change (Henning et al., 2014).

Studies from other regions have shown that Extension professionals and other agricultural advisors agree that they must assist farmers in adapting to more extreme and variable weather (Prokopy et al., 2013). Although university Extension's ability to communicate about conservation concerns and other related issues such as climate change will remain important, additional training will be necessary to increase the effectiveness of outreach on the topic of climate change (Wojcik, Monroe, Adams, & Plate, 2014). Because farmers and crop advisors address agricultural complexities directly, it likely will be university Extension's responsibility to ensure that relevant, science-based information about climate change is available to farmers, other agricultural advisors, and industries (Prokopy et al., 2015).

## Uses of Internet and Mobile Technology

Effective information delivery depends not only on trust in the information source but also on a delivery mode that meets audience members' needs. As Internet use becomes more prevalent for accessing information, an understanding of Inland Northwest cereal farmers' various uses of the Internet was needed. Associated results are presented in Table 1. Large majorities of farmer respondents had visited websites on the Internet (88.1%) and used the Internet for email (81.9%). In addition, many survey respondents had used the Internet to help manage their finances (56.4%) and share photos (49.6%). Surveyed farmers were less likely to have used the Internet for downloading enterprise budgets (31.3%), watching videos (19.4%), or performing other tasks (5.7%). Internet usage by Inland Northwest cereal farmers for viewing websites (88.1%) and accessing email (81.9%) is comparable to use by the general U.S. population (84%) (Perrin & Duggan, 2015), suggesting high interest in the technology as well as national improvements in Internet connections and availability (Stenberg, 2013).

**Table 1.**

Inland Northwest Cereal Farmers' Primary Uses of the Internet

<b>Use</b>	<b>Percentage</b>	<b>Std. Error</b>
Visiting websites	88.1	0.9
Using email	81.9	1.1
Managing finances	56.4	1.4
Sharing photos	49.6	1.4
Downloading enterprise budgets	31.3	1.3
Watching movies/videos	19.4	1.1
Other	5.7	0.7

Inland Northwest cereal farmers' levels of frequency in obtaining farm-related information using the Internet are presented in Table 2, and most of the survey respondents reported that they used the Internet to access this type of information. Over 63% of farmers indicated that they used the Internet daily to obtain farm-related information, and 16.9% reported using it at least once or twice weekly. Only 7.9% indicated that they did not use the Internet to access farm-related information. In combination, over 85% of surveyed farmers reported that they checked the Internet for agriculture-related information including market, weather, and agronomic information at least a few times a month, if not more frequently.

**Table 2.**

Levels of Frequency of Inland Northwest Cereal Farmers' Use of the Internet for Farm-Related Information

<b>Frequency of Internet use</b>	<b>Percentage</b>	<b>Std. Error</b>
Every day	63.6	1.4
Once or twice a week	16.9	1.1
A few times a month	4.8	0.6
A few times a year	3.3	0.5
Never	7.9	0.8
Missing	3.6	0.5

Data on farmers' use of mobile applications—smartphone or tablet apps—to support farm operations are presented in Table 3. The farmers' use of mobile applications was lower than their Internet use, with only 25.4% of surveyed farmers using mobile applications on their smartphones or tablets. Twelve percent of the responding farmers reported having a mobile device that they did not use for farming activities. Another 54.1% of respondents reported that they did not use mobile applications at all, and 4.1% did not know what mobile applications were. Of those who used mobile applications (229 respondents), many (108 respondents) noted that they used mobile weather applications more than other types (data not shown).

**Table 3.**

Inland Northwest Cereal Farmers' Use of Mobile Applications (Apps for Smartphone or Tablet) to Support Farm Operations

<b>Use of apps to support farm enterprise</b>	<b>Percentage</b>	<b>Std. Error</b>
Does not use	54.1	1.4
Uses	25.4	1.3
Uses mobile device but not for farming enterprise	12.0	0.9
Does not know what apps are	4.1	0.6

Use of mobile applications was very low considering the proportions of the general population of the United States who own smartphones (68%) and tablets (45%) (Anderson, 2015). However, our survey data do not

distinguish between farmers who are using mobile devices to access information directly from websites versus from mobile applications. Also, our survey data cannot indicate what barriers exist with regard to the adoption of this technology. However, in some wheat-producing counties in the region, relatively low mobile wireless availability and restricted access to faster upload speeds may impede technology adoption (Whitacre, Mark, & Griffin, 2014).

Despite their convenience and current popularity, digital resources are unlikely to supplant entirely more traditional outlets for conveying information about agriculture or climate change. A subpopulation of U.S. residents simply remains uninterested in digital means of communication (Stenberg, 2013). A report in 2009 indicated that farmers often prefer print media over interpersonal sources, broadcast media, and electronic media (Diekmann & Batte, 2009). Other research has shown that mobile devices are used less than laptop/desktop computers for precision agriculture work, with only 21% of farmers and consultants studied reporting that they used their mobile devices more than their personal computers for jobs that could be perceived to be too complicated for small, handheld devices (Hopkin, 2013). Additionally, field demonstrations, meetings, face-to-face discussions, farm shows and television programs, and printed farm newspaper and magazine articles have been identified as important communication channels in both earlier research (Tucker & Napier, 2002) and more recent studies (Arbuckle et al., 2012; Jones et al., 2010). Moreover, having access to a greater number of information sources increases farmers' likelihood of being open to new ideas and practices (Tarnoczi & Berkes, 2010), further indicating that multiple approaches for outreach are important.

## Conclusion

Cereal farmers in the Inland Northwest tended to trust other farmers and crop advisors from agribusiness companies more than other sources for information on production management strategies. The farmers' strong relationships with these groups are presumed to exist due to the applied knowledge, experience, and targeted approaches these sources bring to addressing farm-related management decisions and concerns. Overall, trust among cereal farmers in information about climate change was low or uncertain regardless of source, but farmers tended to trust university Extension more than other sources. The direct experience held by other farmers and crop advisors makes it difficult for university Extension to serve as a primary source of production management information. However, Extension's role in providing research-based information on climate change and other complex agricultural concerns to nonproducer agricultural professionals is an important outreach priority. Programs targeted at agricultural professionals who work directly with farmers can arm those individuals with evidence-based information about climate change and other production management issues.

To strengthen the work that Extension professionals and others do in the realm of agricultural advising, particularly in the era of climate change, further effort must be made by Extension to engage with farmers and other agricultural professionals using the Internet and other digital tools and resources. Growing interest in digital methods for obtaining information presents opportunities for innovative outreach and development of resources. Although the use of mobile devices to direct production management decisions has not been widely accepted among cereal farmers in the Inland Northwest, according to the findings we have reported, interest in these outreach channels can be expected to increase as the availability and usefulness of Internet-based mobile applications and wireless access in remote areas continue to improve. Complex issues and advancing technological communication delivery systems offer exciting opportunities for university Extension and other agricultural advisors relative to enhancing their outreach capabilities and connections with farmers.

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