

Colorado Residents Trusted Sources of Agricultural, Biotechnology, and Food Information

Michael J. Martin, Rebecca L. Hill, Anders Van Sandt, and Dawn D. Thilmany

Colorado State University

This research examines the trusted sources for information related to agriculture, biotechnology, and food quality, nutrition, and safety. We use correlation analysis and differences in means tests to explore trust levels using a survey of Coloradans' public attitudes toward agriculture, food, and the environment. Results indicate that individuals trust information they receive about agriculture and food quality, nutrition, and safety from a variety of sources, though not all sources are trusted equally. In addition, individuals' average trust differed for information related to agriculture and information related to food quality nutrition and safety. Demographics also played a significant role on the sources individuals trusted, particularly in regards to age and income. Additionally, individuals who were skeptical of controversial issues related to biotechnology trusted all sources of information less, except for the universities and research organizations, which remained neutral. The implications of the results to agricultural literacy work are discussed.

Key words: agricultural literacy, agriculture information, biotechnology, information consumers, food information, trusted sources of information.

Introduction and Background of Study

The level of trust people have in a source of information can impact their decision to believe the messages emanating from that source. This relationship between trust and information source can be furthered strained when the information is viewed as complicated and divisive, which could easily describe the topics of agriculture, biotechnology, and food (House et al., 2004; James & Marks, 2008; Lusk, 2012; Lusk & Briggeman, 2009; Verbeke, 2005). This complicated relationship can be viewed from a variety of perspectives, including studying the phenomena as an economic decision (e.g., Li, Curtis, McCluskey, & Wahl, 2002), or as journalists who want to influence the credibility of their work by the sources they cite (e.g., Wiggenbach & Rutherford, 2005). For example, an agriculture economist would use data on consumers' trust in genetically modified organisms (GMOs) to develop marketing strategies. The ramifications of trust in sources of agricultural, food, and biotechnological data can also be informative for teachers and instructors in agricultural education.

Agricultural literacy has emerged in the past few decades as a form of agricultural education, which educates the public on complicated and divisive topics related to agriculture and food (National Research Council, 1988). The mantra of many working in the field of agricultural literacy is 'farm-to-table,' or in other words, focusing on how farmers and ranchers serve people (e.g., Agricultural Council of America,

n.d.; American Farm Bureau Foundation for Agriculture, n.d.). There are a variety of people who work in this field, including school teachers, extension agents, community-based educators, corporately funded advocates, and others. They understand that the impact of their work will be influenced by the trust that people have in them as sources of information. Work within agricultural literacy comes in many forms. For example, a vegetable trade association may seek ways to bolster their health education programming. An extension agent may partner with ranchers to broaden their base of expertise for an outreach program. This article explores Colorado residents' level and relationships of trust to various agriculture, food, and biotechnology sources of information and how this impacts the work of those in agricultural literacy.

The efforts of many specialists working in agricultural literacy have centered on educating people about agriculture systems (Frick, Kahler, & Wade, 1991; National Research Council, 1988). Specifically, Meischen and Trexler (2003) identified the ability of a person to evaluate the validity of the media as a criterion for determining if someone is agriculturally literate. Yet, determining the validity of messages can be challenging. Americans are bombarded with messages about agriculture, food, and biotechnology issues. These messages can come from a variety of sources and the messages can be conflicting about the same issue (e.g., Huffman, Rousu, Shogren, & Tegene, 2004). Thus, a

significant challenge for people includes finding trusted sources of information (Kalaitzandonakes, Marks, & Vickner, 2004; Lusk et al., 2004; Piggott & Marsh, 2004). Understanding how the source of information relates to the trust of that information can inform the work of people in agricultural literacy as they play an integral role in crafting and delivering messages about agriculture to a wide array of people.

Agricultural literacy efforts in agricultural education have primarily focused on youth education (Kovar & Henry, 2013). This work has included conceptual and theoretical studies on agricultural literacy work in K-12 schools (Brewster, 2012; Frick et al., 1991; Powell, Agnew, & Trexler, 2008). While researchers have sparsely examined agricultural literacy efforts with adults, research councils have expressed the need to study agriculture from the context of consumers (National Research Council, 1988, 2009). Still, the most recent white papers on agricultural literacy focus primarily on how to improve youth and undergraduate education in agriculture. The void of agricultural education research on adults in agricultural literacy contexts has been filled primarily by agricultural economists and advocates who examined this issue from the perspective of consumers' choices and policy (e.g., Brunson & Steel, 1994; Han & Harrison, 2007; Huffman et al., 2004).

Given the recent salience toward biotechnology in agriculture and food systems, exploring trusted sources of information on these issues is particularly timely. For example, Han and Harrison (2007) found that residents in the urban Northeast of the United States had less favorable views toward genetically modified (GM) foods compared to other regions of the United States. The authors imply that their lifestyle and media exposure to negative issues about GM foods may have led to these differences in acceptance. This finding would suggest that agricultural literacy specialists in the urban Northeast have to work with pre-existing negative views on GM foods in their educational programming. Other studies have also linked characteristics of people with their consumer choices. For instance, negative media coverage on specific food products with GMOs led to decreased sales in the United States (Kalaitzandonakes et al., 2004). While the chain of evidence provides some important information for professionals in agricultural literacy, few studies have yet to examine what factors influence the trusted information sources the public may use to form their opinions and attitudes—or if those sources vary by the nature of the agricultural, biotechnology, or food issue in question.

The topic of people's trust in agricultural information has begun to receive attention from professionals in the private sector as well. For instance, the Center for Food Integrity (2013) conducted a survey on consumers' trust in the food system. Their report highlighted that a majority of people felt large food companies are likely to put their company's interests ahead of people's interest. Similarly, research studies have found that trust in products can dictate people's choices. A study by the Center for Rural Studies (2000) examined what sources of agricultural information people of Vermont trust. They found that as people's level of income *increases* the likelihood of them being relatively trusting of the University of Vermont, corporate advertising, and broadcast media *decreases*. These findings highlight an important phenomenon that has been neglected in much of the agricultural literacy research. Trust in agricultural information varies among different groups of people and this level of trust guides their decision-making process. This study explores the commonalities and disparities of trust surrounding agricultural, food, and biotechnology information; some demographics that may define some of those differences; and how greatly credibility between sources of information for agriculture and food issues varies.

Purpose and Research Questions

This study explores the trust for sources of information related to agriculture, food, and biotechnology and how and why this trust differs among people and topics. The following questions were used to guide the research:

1. How does the trust for information about agriculture differ by source of information and demographic characteristics for Colorado consumers?
2. How does the trust for information about food quality, nutrition, and safety differ by source of information and demographic characteristics for Colorado consumers?
3. Does level of trust for a particular source of information for Colorado consumers differ based on the type of information? Specifically, do consumers trust sources for information about agriculture differently than they do for information about food quality, nutrition, and safety?
4. How do stated feelings towards more polarizing topics such as genetically engineered (GE) food and alternative fuel production relate to individuals' trusted sources of information?

Table 1. Summary statistics for demographic variables from Colorado survey and 2010 US census.

Variables	Sample demographics	2010 US census
Average age	52.83 yrs.	--
Female	62.30%	49.8%
Male	37.70%	50.2%
Average household size	2.21 people	2.51 people
Living situation		
Own a home	77.35%	65.9%
Rent	20.44%	31.62%
Live with relatives	1.00%	5.7%
Economic standing		
Household income <\$30k	15.28%	<i>Median income \$58,224</i>
Household income \$30k-\$50k	20.83%	
Household income \$50k-\$75k	24.80%	
Household income >\$75k	39.09%	
Ag background		
Currently work/live on a farm/ranch	3.77%	--
Have worked/lived on a farm/ranch	22.22%	--

Methods and Data

This study emerged from a longstanding, state-wide survey on Colorado public attitudes towards agriculture. The survey has been administered three previous times over the past 17 years. The original study included more than 31 questions asked over many years, but this article focuses on a set of questions representing a new focus of issues in 2011. Specifically, we examined the data on respondents' trusted sources of information for agriculture and food quality, nutrition, and safety with descriptive statistics and then correlated this data with the demographic data of the participants. The demographic data included age, gender, household income, if they have ever worked or lived on a ranch or farm (for context on background), and whether they currently garden or produce their own food. We utilized STATA software to analyze the data.

The original study was conducted via an internet survey and with the coordination of a professional third-party research firm. The National Family Opinion (now TNS) research group ensured that the original state-wide study went to a representative sample with respect to race/ethnicity, age, gender, and income. Of the 2,500 potential participants solicited to participate in the study, 629 respondents attempted the study and 504 respondents qualified and completed the study. The response rate was 80.1% of those who engaged with the survey link. The sample techniques and numbered respondents who completed the survey resulted in a 95% confidence interval and error of +/-5%. The demographics between

non-respondents and respondents were compared and found to be statistically similar. Demographic data as well as a comparison of the 2010 census data for the demographic variables is displayed in Table 1.

The respondents varied across numerous demographic factors. For the full sample, the average age of the participants was 53 years. Of the participants who completed the survey, 62.3% were female and 37.7% were male; 35% of the respondents owned a home while 20.44% rented and 1.00% lived with relatives. The household income range of participants included 15.3% making under \$30,000, 20.8% making between \$30,000 and \$49,999, 24.8% making between \$50,000 and \$74,999, and 39.1% making above \$75,000. Only 3.8% of the participants currently worked or lived on a farm and ranch while 22.2% had worked or lived on a farm or ranch at any point during their lives.

The two specific survey questions this study focused on asked participants how likely they were to trust information sources of agriculture as well as food quality, nutrition, and safety. The participant's responses were based on a four-point Likert scale (1 = very likely and 4 = not at all likely). For Research Questions 1 and 2, we examine trusted sources of information and how different demographic characteristics correlate with trusted sources. To examine the differences in participants' trusted sources of information related to agriculture and food quality, nutrition, and safety, we compared the average reported value between information sources. Using STATA we then correlated the sources of trust

Table 2. Trusted sources of information about agriculture.

Information source about agriculture	<i>M</i>
University and research organizations	1.54 ^a
Farmers and ranchers themselves	1.64 ^a
Colorado Department of Agriculture	1.68 ^a
Farm and ranch organizations	1.74 ^b
US Department of Agriculture	1.90 ^c
Other federal government agencies	1.98 ^d
Environmental organizations	2.23 ^e
News reports in the media	2.45 ^f
Food industry	2.47 ^f
Social media	2.86 ^g

Note. Superscripts represent sources with statistically similar trust (if same letter) or statistically different (if different letter).

The scale was 1=very likely; 2=somewhat likely; 3=not very likely; 4=not at all likely

with demographic variables and used *t*-tests to determine the statistical significance of differences across means.

To address Research Question 3, we then compared the average trust for each source related to agriculture to the average trust for each source related to food quality, nutrition, and safety. A *t*-test evaluating the differences in means across the two categories was used to determine the statistical significance of the differences. To explore Research Question 4, we correlated the trust of a given source of information to reported opinions related to two different polarizing issues: GE food and bioenergy production.

RQ #1: How Does the Trust for Information about Agriculture Differ by Source of Information and Demographic Characteristics for Colorado Consumers?

The participants were asked the following question: “Here is a list of sources where you might receive information about agriculture. How likely are you to trust information from the following sources?” The list included the following sources: Colorado Department of Agriculture, US Department of Agriculture, other federal government agencies, food industry, news reports in the media, farmers and ranchers themselves, university research organizations, environmental organizations, farm and ranch organizations, and social media. Respondents were asked to rate each information source from very likely to trust (given a score of 1) to not at all likely to trust (given a score of 4). Average reported trust based on the four-point scale is presented in Table

Table 3. Correlations between trusted sources of agriculture information and participant demographics.

Trusted sources of information about agriculture	Age	Income
University and research organizations	-0.16	-0.31
Colorado Department of Agriculture	0.10	-0.18
Farmers and ranchers themselves	0.15	0.03
Farm and ranch organizations	0.03	-0.12
US Department of Agriculture	0.30	-0.07
Other federal government agencies	0.31	-0.09
Environmental organizations	0.35	0.32
Food industry	0.33	0.19
News reports in the media	0.24	0.17
Social media	0.04	0.34

2; given the scale, the greater the number, the lower the reported trust associated with that source.

Overall, we find significant differences in the stated likelihood of trusting information about agriculture based on the source of the information. The most trusted sources of information are university and research organizations, farmers and ranchers, and the Colorado Department of Agriculture. These three sources are significantly more trusted than all other sources but not significantly different from one another. The least trusted source of information, which is trusted significantly less than all other sources, was social media. The food industry, news in the media, and environmental organizations are also significantly less trusted than other sources, but were still trusted significantly more than social media.

We also explore how demographic variables correlated with the level of trust respondents had with respect to agricultural information sources, and these correlations are reported in Table 3. Positive correlations indicate that an increase in trust for information from that source is negatively correlated with a demographic variable; the opposite is true with a negative correlation value. This may at first glance seem counterintuitive, but you will recall that a higher value for the trust variable indicates a lower reported trust for that information source. Typically, a correlation relationship is considered to be substantial if it is +/- 0.30 (Davis, 1971), and thus we will primarily discuss correlations greater than or equal to this value.

The data analysis reveals some substantial correlations between several variables. There are positive and moderate correlations between age of participant and trusting environmental organizations (0.35), the food industry (0.33), other federal agencies (0.31), and the

Table 4. Trusted sources of information about food quality, nutrition, and safety.

Information source about food quality, nutrition, and safety	M
University and research organizations	1.66 ^a
Colorado Department of Agriculture	1.69 ^b
Farmers and ranchers themselves	1.74 ^b
Farm and ranch organizations	1.82 ^c
US Department of Agriculture	1.93 ^d
Other federal government agencies	2.07 ^e
Environmental organizations	2.36 ^f
Food industry	2.38 ^f
News reports in the media	2.44 ^f
Social media	2.96 ^g

Note. Superscripts represent sources with statistically similar trust (if same letter) or statistically different (if different letter). The scale was 1=very likely; 2=somewhat likely; 3=not very likely; 4=not at all likely

US Department of Agriculture (0.30) for sources of agriculture information. This suggests that as individuals get older they tend to report less trust for the latter sources of information than do their younger counterparts.

Income is positive and moderately correlated to social media (0.34) and environmental organizations (0.32); thus, as income increases, individuals tend to report less trust for these sources of information than do their lower income counterparts. Finally, income is moderately and negatively correlated to universities and research organizations (-0.31), indicating that as income rises, trust of universities for information about agriculture also rises. This result is interesting as it is opposite of what was found in the Center for Rural Studies (2000) research on Vermont residents, which found that as an individual's income increases their trust for the University decreases.

RQ #2: How Does the Trust for Information about Food Quality, Nutrition, and Safety Differ by Source of Information and Demographic Characteristics for Colorado Consumers?

Similar to the question about trusted sources for agricultural information, participants were asked about how they received information about food quality, nutrition, and safety. Respondents were asked to rate each information source on the same scale as they did with agricultural information from very likely to trust the source (given a score of 1) to not at all likely to trust the source

Table 5. Correlations between trusted sources of food quality, nutrition, and safety information and participant demographics.

Trusted sources of information about food quality, nutrition, and safety	Age	Income
University and research organizations	-0.04	0.27
Colorado Department of Agriculture	0.13	0.28
Farmers and ranchers themselves	0.58	0.15
Farm and ranch organizations	0.22	0.37
US Department of Agriculture	0.25	0.04
Other federal government agencies	0.21	0.12
Environmental organizations	0.34	0.50
Food industry	0.21	0.13
News reports in the media	0.48	0.18
Social media	0.55	0.28

(given a score of 4), in terms of their trustworthiness of information sources. The organizations/institutions were the same as those for agriculture. Average values are reported in Table 4, with higher values indicating lower reported trust.

For information on food quality, nutrition, and safety, the most trusted sources of information emanate from universities, the Colorado Department of Agriculture, and farmers and ranchers themselves. These three are also the top three for sources of information about agriculture. However, in this case, trust given to the university sector is significantly greater than all other sources of information, including the Colorado Department of Agriculture or farmers and ranchers themselves. Again, just as was the case for agricultural information, trust of social media is significantly less than trust for all other information sources, followed by news reports in the media and the food industry.

We also explore how demographic variables correlated with the level of trust of information on food quality, nutrition, and safety. Correlations are reported in Table 5. A positive correlation indicates that as a demographic factor increases the level of trust in that source of information decreased, which the opposite is true for a negative correlation. Typically a correlation relationship is considered to be substantial if it is +/- 0.30 (Davis, 1971), and thus we will primarily discuss correlations greater than or equal to this value.

The data analysis reveals some relatively strong correlations between several variables. There is a positive and moderate correlation between age of participant and trusting environmental organizations (0.34), farmers and ranchers themselves (0.58), and social media (0.55). This suggests that as individuals get older they tend to report less trust for these sources of information than do

Table 6. Correlation coefficients for relationship between trusted source of agriculture information and trusted source of food quality, nutrition, and safety information.

Information source	Correlation coefficient
University and research organizations	0.02
Colorado Department of Agriculture	0.31
Farmers and ranchers themselves	0.85
Farm and ranch organizations	-0.14
US Department of Agriculture	0.46
Other federal government agencies	0.76
Environmental organizations	0.92
Food industry	0.80
News reports in the media	0.82
Social media	0.64

their younger counterparts. Income is positive and moderately correlated to farm and ranch organizations (0.37) and environmental organizations (0.50), indicating that as income increases, individuals tend to report less trust for these sources of information than do their lower income counterparts.

RQ #3: Does Level of Trust for a Particular Source of Information for Colorado Consumers Differ Based on the Type of Information? Specifically, do Consumers Trust Sources of Information about Agriculture Differently than They Do for Information about Food Quality, Nutrition, and Safety?

To explore this research question we asked if there were differences in the level of trust for information from the sources of information based on the type of information. In short, we want to know if individuals trust different sources for information about agriculture more than they do for information about food quality, nutrition, and safety. We first look at the correlation between the two variables and then tested for significant differences in means across the two variables.

Correlations for trust on information regarding agriculture compared to information related to food quality, nutrition, and safety are reported in Table 6. If we consider just the correlation relationships that were +/- 0.30 or greater, the data revealed that the trust for sources of information about agriculture and the sources of information about food quality, nutrition, and safety are positively correlated. This indicates that greater trust for a source of information about agriculture correlates with greater trust for food quality, nutrition, and safety as

well. This may seem straightforward, so we will focus primarily on exceptions to this common finding or those with stronger correlations. Farm and ranch organizations were the only negative correlation, which might be expected since they represent agricultural interests, not those issues closer to the consumers' food choices and nutritional education. Some of the strongest correlations are for environmental organizations, news reports, other federal government agencies, farmers and ranchers themselves, and the food industry. There were notable—but weaker—correlations for social media, the Colorado Department of Agriculture, and the US Department of Agriculture. It is important to remember this does not reflect relative level of trust, but instead, how consistent that trust is across sources. So, the practically zero correlation for universities and research organizations is not negative, but instead, respondents consider this source independent for agricultural information relative to food, nutrition, and safety information. In contrast, there are very similar trust levels across these issues for most sources listed.

In addition to interest in the correlation between trusted sources of information about agriculture and food quality, nutrition, and safety, we can further explore the differences in the magnitude of trust by source across these two different types of information. To examine this, we test the difference in means for each source across the two types of information. As can be seen in Table 7, the average trust for information about food quality, nutrition, and safety was significantly greater than average trust for information about agriculture for the following sources of information: Colorado Department of Agriculture, other federal government agencies, farmers and ranchers themselves, university and research organizations, environmental organizations, farm and ranch organizations, and social media. There was no significant difference across means for the US Department of Agriculture and news reports in the media. Finally, only one source of information was significantly more trusted for agricultural information than information about food quality, nutrition, and safety—the food industry. These results indicate that, in general, the average trust for information about food quality, nutrition, and safety is greater than information about agriculture, across many different sources of this information. It may also indicate there is more conflicting information presented to the public in the realm of agriculture.

Table 7. Difference in means by information source for information regarding agricultural information and information about food quality, nutrition, and safety.

Information source	Difference in means significant	Direction of significance
Colorado Department of Agriculture	Yes*	Food quality
US Department of Agriculture	No	N/A
Other federal government agencies	Yes**	Food quality
Food industry	Yes*	Ag
News reports in the media	No	N/A
Farmers and ranchers themselves	Yes*	Food quality
University and research organizations	Yes	Food quality
Environmental organizations	Yes*	Food quality
Farm and ranch organizations	Yes*	Food quality
Social media	Yes*	Food quality

Note. If direction of significance states "food quality," individual trust is greater for information about food quality, nutrition, and safety from this source. If direction states "ag," individual trust is greater for agriculture from this source.

* Significance at 1% level; ** Significance at 5% level

RQ #4: How do Stated Feelings towards Controversial Topics Such as GE Food and Alternative Fuel Production Relate to an Individual's Trusted Sources of Information?

Consumers are often most vocal about polarizing agricultural topics such as GE foods and alternative energy production. Due to the comprehensive nature of this survey, we have the rare opportunity to explore how some of these controversial issues relate to individuals' trusted sources of information. For this research question, we focused on two survey questions. First we asked, "In your opinion, how safe is GE food to eat?" We will subsequently refer to this question as GenEng Q. The respondents answered this question on the following scale: 1=almost always safe; 2=usually safe; 3=sometimes safe; and 4=almost never safe. Second, we stated, "the United States should increase its production of corn-based ethanol and crop-based bio-diesel as alternatives to petroleum-based fuels." This statement is designated as BioFuel Q. Participants responded to this statement on a five-point scale: 1=strongly agree; 2=moderately agree; 3=slightly agree; 4=moderately disagree; and 5=strongly disagree. The mean and standard deviation for these issues is reported in Table 8.

Table 8. Mean and standard deviation for GenEng Q and BioFuel Q.

Issue	Mean (SD)
GenEng Q	2.59 (0.96)
BioFuel Q	2.97 (1.39)

Table 9. Correlation of issues with stated level of trust by source for agricultural information.

Information source	GenEng Q	BioFuel Q
Colorado Department of Agriculture	0.41	0.36
US Department of Agriculture	0.52	0.49
Other federal government agencies	0.43	0.44
Food industry	0.60	0.39
News reports in the media	0.30	0.36
Farmers and ranchers themselves	0.29	0.17
University and research organizations	-0.02	0.25
Environmental organizations	0.28	0.46
Farm and ranch organizations	0.42	0.31
Social media	0.39	0.32

Table 10. Correlation of issues with stated level of trust by source for information related to food quality, nutrition, and safety.

Information source	GenEng Q	BioFuel Q
Colorado Department of Agriculture	0.17	0.17
US Department of Agriculture	0.17	0.19
Other federal government agencies	0.15	0.24
Food industry	0.27	0.06
News reports in the media	0.15	0.20
Farmers and ranchers themselves	-0.06	0.16
University and research organizations	0.13	0.16
Environmental organizations	-0.05	0.34
Farm and ranch organizations	-0.01	0.19
Social media	0.03	0.16

The stated responses to each of these issues was correlated to the stated level of trust by information source for agriculture (see Table 9), and food quality, nutrition, and safety (see Table 10). We focus on correlations that are +/- 0.30 or greater. In general, for both issues we see a positive correlation between the trust variables and the issue variable.

The GenEng Q variable indicates that the less safe you feel GE food is to eat, the less likely you are to trust information from most sources (although university and

research organizations seem to be neutral in this case). This finding is intuitive, as it suggests there is some share of the public that is generally mistrusting of innovations and information related to innovations. It is an important finding that universities are “neutral” and may be one source of information people (trusting and not) turn to for agricultural information on the genetic engineering issue. In terms of trust on food, nutrition, and safety, there is a broader set of information sources that may be trusted for information on genetic engineering in that domain; there is a weaker correlation between mistrust of genetic engineering and information sources in that area.

The BioFuel Q variable indicates that the more you disagree with the production of biofuels as alternatives to petroleum based fuels, the less likely you are to trust information from most sources. Overall, the correlations are weaker in terms of sources of agricultural information and very small for food, nutrition, and safety (as one might expect given the distant relationship between these issues). However, there does seem to be some relationship with respect to mistrust in governmental, environmental, and food industry sources and lack of support for biofuels. This is an important finding since a large share of the messages in support of such efforts emanates from these sources, and it appears that these institutions may be poor platforms to promote efforts in alternative energy.

Discussion and Implications

In this research, we examined the trusted sources for information related to agriculture and information related to food quality, nutrition, and safety. Overall, survey results indicated that individuals report that they do trust information they receive about agriculture and food quality, nutrition, and safety from a variety of sources. While overall individuals do trust the information they receive, Research Questions 1 and 2 revealed that not all sources of information are equally trusted.

For information about agriculture, as income increases, reported trust for information from social media and environmental organizations decreases. The opposite is true for information from the university and research organizations, as income increases the reported trust of information from the university and research organizations increases. This result is interesting as it is opposite of what was found in the Center for Rural Studies (2000) research on Vermont residents, which found an individual’s income and trust for the University were negatively correlated. Income was also correlated to

trust for information related to food quality, nutrition, and safety. Specifically, as income increases, trust of information from farmers and ranchers and from environmental organizations decreases.

While results from Research Questions 1 and 2 show that the most and least trusted sources of information are the same whether information is related to agriculture or food quality, nutrition, and safety we found in Research Question 3 that the magnitude of trust differs across the two different types of information. The average trust for information about food quality, nutrition, and safety was significantly greater than the average trust for information about agriculture across several of the sources of information. Perhaps the standardization of food and nutrition information—such as nutrition labels and labeled health claims—has relatively increased the confidence in information on those issues. Whatever the root of this trust, people trust sources of information about food issues more than sources of information about agricultural topics.

For that reason, an agricultural literacy campaign focused on Table-to-Farm literacy campaign may provide better traction for agricultural interests than the Farm-to-Table approach commonly utilized. The Table-to-Farm perspective is new in the agriculture literacy literature, though some research can be seen as heading that direction (Meischen & Trexler, 2003; Powell, Agnew, & Trexler, 2008); however, there is a Table-to-Farm movement which is growing. With this focus, agricultural literacy specialists would first focus on food topics and then work backwards toward agriculture topics. The general population connects more confidently with information provided in that realm. The success of modern food movements also point to this (e.g., Let’s Move, n.d.). Agricultural literacy specialists may have to reorganize their anchor organizations and talking points to be more impactful. Our findings on age—specifically that younger respondents were more likely to trust social media, environmental organizations, and the farmers/ranchers—is one indicator of how literacy strategies may want to align with key informants with a Table-to-Farm approach.

Lastly, in Research Question 4 we explored how opinions towards two polarizing topics—GE foods and biofuel production—relates to an individual’s reported trust for information across the two categories. Those who found agricultural system innovations (genetically engineering foods and biofuel) had more negative implications were generally less trusting of information sources, particularly in the agriculture domain. This finding is intuitive, as it suggests there is some share of

the public that is generally mistrusting of innovations and information related to that information. It is an important finding that universities and research organizations are “neutral,” as these groups may be one source of information that people would generally trust for agricultural information on the genetic engineering issue, which is echoed in other studies (Huffman et al., 2004). Food information sources were less scrutinized, so perhaps approaching the GE foods issues with university and research organizations personnel from the food and nutrition sciences might be an effective approach, which also emerged from other studies (Han & Harrison, 2007). However, it is important to realize that not every person trusts in university and research organizations (Bleich, Blendon, & Adams, 2007; Malka, Krosnick, & Langer, 2009). An implication from this could be that people have become in-tune to who is producing the message and are less trusting of messengers who seem to have a profit motive. This may be an important consideration for those working on agricultural literacy projects within public institutions.

The results from this study represent residents of Colorado, and care must be taken before generalizing these results to other states and regions. While the questions on trusted sources of information were new to the 2011 Colorado public attitudes survey, the questions about safety of consuming GE foods and support for biofuels were replicated from past surveys. In future work it would be valuable to explore a broader set of agricultural innovations, such as impacts of genetic engineering on the environment, cloning, fortified foods, and pink slime (yield enhancing meat technologies). Reflecting on how to respond to these findings, we realize that information on the frequency of use and accessibility for these information sources would have provided valuable insights and should be included in future surveys. Clearly, a broader sample of the United States would also make future research more generalizable. But, also retaining the long time series of the Colorado sample is of value to explore changing perceptions across time.

References

- Agricultural Council of America. (n.d.). *National agriculture day* [website]. Available on the World Wide Web: <http://www.agday.org/>.
- American Farm Bureau Foundation for Agriculture. (n.d.). *What is agricultural literacy?* [website]. Available on the World Wide Web: <http://www.agfoundation.org/what-is-ag-literacy>.
- Bleich, S., Blendon, R., & Adams, A. (2007). Trust in scientific experts on obesity: Implications for awareness and behavior change. *Obesity, 15*(8), 2145-2156.
- Brewster, C. (2012). Toward a critical agricultural literacy. In K. Donehower, C. Hogg, & E.E. Schell (Eds.), *Reclaiming the rural: Essays on literacy, rhetoric, and pedagogy* (pp. 34-51). Carbondale, IL: South Illinois University Press.
- Brunson, M.W., & Steel, B.S. (1994). National public attitudes toward federal rangeland management. *Rangelands, 16*(2), 77-81.
- Center for Food Integrity. (2013). *Consumer trust research 2013* [website]. Available on the World Wide Web: <http://www.foodintegrity.org/research>.
- Center for Rural Studies. (2000). *2000 Vermonter poll: Trust in various sources of agriculture information*. Burlington, VT: University of Vermont, Center for Rural Studies. Available on the World Wide Web: http://www.uvm.edu/crs/reports/report_archive/VTPoll_2000_AgInfo.pdf.
- Davis, J. (1971). *Elementary survey analysis*. Englewood Cliffs, NJ: Prentice Hall.
- Frick, M.J., Kahler, A.A., & Miller, W.W. (1991). A definition and the concepts of agricultural literacy. *Journal of Agricultural Education, 32*(2), 49-57.
- Han, J., & Harrison, W. (2007). Factors influencing urban consumers' acceptance of genetically modified foods. *Review of Agricultural Economics, 29*(4), 700-719.
- House, L., Lusk, J., Jaeger, S., Traill, W.B., Moore, M., Valli, C., et al. (2004). Objective and subjective knowledge: Impacts on consumer demand for genetically modified foods in the United States and the European Union. *AgBioForum, 7*(3), 113-123. Available on the World Wide Web: <http://www.agbioforum.org>.
- Huffman, W.E., Rousu, M., Shogren, J.F., & Tegene, A. (2004). Who do consumers trust for information: The case of genetically modified foods? *American Journal of Agricultural Economics, 86*(5), 1222-1229.
- James, H.S., & Marks, L.A. (2008). Trust and distrust in biotechnology risk managers: Insights from the United Kingdom, 1996-2002. *AgBioForum, 11*(2), 93-105. Available on the World Wide Web: <http://www.agbioforum.org>.
- Kalaitzandonakes, N., Marks, L.A., & Vickner, S.S. (2004). Media coverage of biotech foods and influence on consumer choice. *American Journal of Agricultural Economics, 8*(5), 1238-1246.
- Kovar, K.A., & Henry, A.L. (2013). Two decades of agricultural literacy research: A synthesis of the literature. *Journal of Agricultural Education, 54*(1), 167-178.
- Let's Move. (n.d.). *Let's move! America's move to raise a healthier generation of kids* [website]. Available on the World Wide Web: <http://www.letsmove.gov/>.
- Li, Q., Curtiss, K.R., McCluskey, J.J., & Wahl, T.I. (2002). Consumer attitudes toward genetically modified foods in Beijing,

- China. *AgBioForum*, 5(4), 145-152. Available on the World Wide Web: <http://www.agbioforum.org>.
- Lusk, J.L. (2012). The political ideology of food. *Food Policy*, 37, 530-542.
- Lusk, J.L., & Briggeman, B.C. (2009). Food values. *American Journal of Agricultural Economics*, 91(1), 184-196.
- Lusk, J.L., House, L.O., Valli, C., Jaeger, S.R., Moore, M., Morrow, J.L., & Traill, W.B. (2004). Effect of information about benefits of biotechnology on consumer acceptance of genetically modified food: Evidence from experimental auctions in the United States, England, and France. *European Review of Agricultural Economics*, 31(2), 179-204.
- Malka, A., Krosnick, J.A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis*, 29(5), 633-647.
- Meischen, D.L., & Trexler, C.J. (2003). Rural elementary students' understandings of science and agricultural education benchmarks related to meat and livestock. *Journal of Agricultural Education*, 44(1), 43-55.
- National Research Council. (1988). *Understanding agriculture: New directions for education*. Washington, DC: National Academy Press.
- National Research Council. (2009). *Transforming agricultural education for a changing world*. Washington, DC: The National Academies Press.
- Piggott, N.E., & Marsh, T.L. (2004). Does food safety information impact U.S. meat demand? *American Journal of Agricultural Economics*, 86(1), 154-174.
- Powell, D., Agnew, D., & Trexler, C. (2008). Agricultural literacy: Clarifying a vision for practical application. *Journal of Agricultural Education*, 49(1), 85-98.
- Verbeke, W. (2005). Agriculture and the food industry in the information age. *European Review of Agricultural Economics*, 32(2), 347-368.
- Wiggenbach, G.J., & Rutherford, T.A. (2005). Trust, bias, and fairness of information sources for biotechnology issues. *AgBioForum*, 8(4), 213-220. Available on the World Wide Web: <http://www.agbioforum.org>.