Evaluating Public Perceptions of Agricultural Water Use by Regions to Guide Extension Programming

Alexa J. Lamm
Associate Professor
University of Georgia
alamm@uga.edu

Peyton N. Beattie
Graduate Student
University of Florida
pbeattie@ufl.edu

Melissa R. Taylor
Research Coordinator
University of Florida
Center for Public Issues Education (PIE)

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Agricultural water use accounts for a large portion of water withdrawal in the United States (U.S.). The agricultural industry has recently come under public scrutiny as increased droughts across the nation has led to competition for water. The added pressure has led to an increase in policy aimed at curbing agricultural water use in many parts of the U.S. At the same time, public perception of agricultural water use was at an all-time low with little recognition that agricultural water needs differ depending upon geographic location. The purpose of this study was to evaluate public perceptions of water use across the nation to assist extension educators in the development of programs focused on educating about diverse agricultural water needs. The findings revealed respondents generally trust farmers when it comes to water use and believe farming practices have a positive effect on the natural environment. There were observed differences between regions when it came to farmers' use of resources and how they negatively impact the environment, with respondents from the West having a significantly more negative opinion. Universities and extension educators were found to be the most trusted source of information, therefore regionally specific agricultural water use extension programs could assist in developing an educated public.

Keywords: trust, extension, education, social capital, water, regional differences

Introduction

"Most Americans assume that water supply is both reliable and plentiful" (Attari, 2014, p. 5129). However, over the past 100 years, water has become increasingly limited and low water levels are a constant threat (Araya & Kabakian, 2004). The United States Geological Survey (USGS) reported 355 million gallons per day is withdrawn in the U.S. alone (USGS, 2014). Agricultural water use accounts for a large portion of the water withdrawn in the U.S. According to Schaible and Aillery (2012), "irrigated agriculture accounts for 80-90 percent of consumptive water use in the United States" (p. 5) and has recently come under public scrutiny (Lamm, Taylor, & Lamm, 2016) as competition for water needs have increased. There has also been increased pressure to implement water policy and water management to force the sustainability of irrigated agriculture due to the continued and growing agricultural demand for water resources (Bian, Williams, Benson & Segarra, 2016).

Diverse agricultural water issues have emerged across the U.S. For example, in the Midwest, water used for irrigation is mainly pumped from the High Plains Aquifer, one of the largest aquifers in the United States. The aquifer is a critical source of water for American agriculture and other industries in eight states (Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming) providing water for 27% of the crop production in the U.S. (Drummond, 2003). It is now in jeopardy of depletion within only a few decades (Mann, 2009). Due to a prolonged drought, the current usage of the aquifer is unsustainable as the water is used faster than it is recharged.

In the Northeast, farmers near the Chesapeake Bay area have faced several water issues, most specifically related to water quality. Problems include nutrient, sediment, and toxic contaminant pollution from agriculture, storm water runoff, and nonpoint source runoff (Chesapeake Bay Program, 2012; USGS, 2015).

In the Southeast, Georgia, Florida, and Alabama have been engaged in a decades-long "water war" (Dunkelberger, 2017). The states have been battling over water allocation in two major basins that cross their borders (Southern Environmental Law Center (SELC), 2017). One of which, the Apalachicola-Chattahoochee-Flint Basin, has been named the most endangered river basin in the U.S. (Howard, 2016).

On the opposite side of the country, California has suffered from prolonged drought (Sokolow, Godwin, & Cole, 2016) causing current water supplies to diminish resulting in recurring irrigation issues (University of California, 2015). The Central Valley of California is one of the most agriculturally productive areas in the U.S. (Panda, 2015) accounting for 66-70% of the total irrigated area in the western region (Elias et al., 2016). Aquifers in the Central Valley are so overdrawn that some fields have sunk by over 30 feet (Nijhuis, 2014).

Since 2000, Texas has been subjected to two major droughts in 2006 and again in 2011. These two droughts took the lives of hundreds of people and lost the agricultural industry billions of dollars due to crop failure (Combs, 2012). In 2011, nearly 90% of the state was in exceptional drought status and conditions did not improve until 2013 (Combs, 2012).

Over time, the industrialization of agriculture has advanced and consumers have become removed from the farm, creating a disconnect (Rumble & Irani, 2016). The agriculture industry has tried to address the disconnect by communicating with consumers, however, this has proven to be difficult (Rumble & Irani, 2016). A suggested solution to improve communication has been to increase the transparency of the agricultural industry (Garner, 2009; Roybal, 2012). Effective communication methods that develop trust between consumers and the agricultural industry have the potential to make lasting results with policy developed from an educated, informed perspective. Extension programs can play a role in this by educating the public about agricultural water use to ensure an accurate portrayal of agricultural needs and sustainable use of this precious resource are known (Lamm et al., 2016).

Today the general public has an all-time low trust in businesses, government, and news media; with people most likely to trust colleagues, friends, and family (Rawlins, 2008). The internet has created a world where transparency is expected. Access to information is now a need of consumers regardless if the supplier wants to expose itself (Rumble & Irani, 2016). Trust is important for reaching agreement between various stakeholders when solving environmental problems related to watersheds (Leach & Sabatier, 2005).

A study by Mase, Babin, Prokopy, and Genskow (2015) focused on trust between agricultural and non-agricultural respondents on water quality throughout the watersheds in the U.S. They found nonagricultural respondents were more trusting of the quality of water when compared to agricultural respondents. This same study found extension programs, soil and water conservation districts, Natural Resources Conservation Services, and State agencies were the most trusted sources of information (Mase et al., 2015).

As drought, extreme weather events, and wars over water rights continue it is important to understand public trust of agriculture water use in the different regions of the U.S. Stakeholders must work together to develop sustainable solutions that will allow for the water needed for population growth, the sustainability of natural systems and agricultural production. This must be done to benefit consumers and to protect the viability of a strong U.S. agricultural industry. For the public to make informed decisions about agricultural water use it is imperative that educators understand their levels of trust with agricultural producers and perceived transparency of the agricultural industry. Extension educators are influential within their local communities, providing educational programs across the nation (Vörösmarty, Green, Salisbury, & Lammers, 2000) and have the potential to address perceptions of agricultural water use but need to be specific when meeting regional needs.

Theoretical Framework

Social capital theory was used as the framework to guide this study. Social capital is the collective value of all social networks and the inclinations that arise within groups as members strive to help one another (Putnam, 2000). This is particularly important when trying to understand relationships and how relationships are used to share knowledge (Warren, Sulaiman, & Jaafar, 2013). Traditionally, social networks were limited to a geographical location, but with the global society that exists today, social networks have become far more diverse and dynamic (Young, 2011). Social media increases the chance of having a greater network, thus providing access to new information and resources (Warren et al., 2013). Extension educators seek to understand how individuals share resources or knowledge to gain a perspective on how they can be best educated (Putnam, 2000).

Miller and Buys (2008) aimed to understand how social capital would affect human water use behaviors in a drought-stricken area of Australia. This study indicated that close neighborhood connections played a large part in residents practicing environmentally friendly car washing techniques (Miller & Buys, 2008). The study results also indicated that social capital can be a cause of fostering negative norms rather than positive norms (Miller & Buys, 2008). Negative norms in this study occurred when self-reported proactive residents indicated they participate in environmentally unfriendly gardening in the form of applying weed killers, pesticides, and herbicides to their garden (Miller & Buys, 2008).

Jones, Evangelinos, Gaganis, and Polyzou (2010) conducted a study that aimed to understand how social capital was influenced by consumers' perceptions of water conservation policies. When discussing water management with consumers, it was found that institutional trust was the most important factor of social capital as it relates to policy acceptance (Jones et al., 2010). In addition, Jones et al. (2010) found that social trust and adhering to social norms was found to cause citizens to be less compelled to follow water conservation policies. This study also indicated social networks were an influencer of improving domestic water systems (Jones et al., 2010).

Robinson and Meikle-Yaw (2007) conducted a case study to understand how social capital was fostered through Extension projects in the community. In two Mississippi Delta communities, organizations were created through Extension to develop a public playground in one community and a Martin Luther King, Jr. memorial park was established in the other (Robinson & Meikle-Yaw, 2007). The community projects were assembled by the members of the community given their agreement with ten values and principles provided (Robinson & Meikle-Yaw, 2007). The results of the study discussed that because the members of the community came together to complete these community restoration projects for the community in which they belonged, allowed for the members to be further invested in their community and more civically engaged because of the social capital built during the process (Robinson & Meikle-Yaw, 2007).

Purpose and Objectives

The purpose of this study was to examine public perception of agricultural water use across the U.S. to inform the development of regionally appropriate extension programs. The study was guided by the following objectives:

1. Describe respondents' perceptions of agricultural water use by regions which were broken into four key concepts: trust in water use and protection, use of resources, agriculture's positive impact on the environment, and agriculture's negative impact on the environment.

2. Determine if perceptions of agricultural water use differed between regions.

Methods

This research was part of a larger study of public perceptions of agricultural water use, with four sections relevant to the research objectives. The researchers used a third party public opinion polling company, Qualtrics, to distribute an online survey to capture public perceptions of agricultural water use. The population of interest was U.S. residents aged 18 and older. A non-probability, opt-in sampling technique was used (Baker et al., 2013). The instrument included demographic screening questions to ensure respondents accurately reflected the U.S. adult population. After criteria-based selection and quality assurances, a sample of the population was obtained (N = 1,050). Prior to analyzing the data, post-stratification weighting methods were used based on the 2010 U.S. Census for age, gender, and race/ethnicity to ensure the respondents were representative of the population of interest and geographically represented the nation (Kalton & Flores-Cervantes, 2003). This is standard practice to overcome the limitations of non-probability sampling (Baker et al., 2013; Kalton & Flores-Cervantes, 2003).

Prior to sending the survey, an expert panel that included faculty and staff from The University of Florida reviewed the survey instrument. Additionally, The University of Florida Internal Review Board approved the study. The results were exported and analyzed using SPSS version 23. Descriptive statistics were used to calculate the perception of agriculture water use. ANOVAs were used to determine if statistically significant differences in perceptions of agricultural water use existed between U.S. regions with an $\alpha < .05$ set *a priori*.

The respondents were split based on the home state they reported being from. The regions included the Northeast, the South, the Midwest, and the West. The following states made up each region:

- Northeast: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont
- South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia, and West Virginia
- Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, and Wisconsin
- West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming

To understand perceptions of agricultural water use, respondents were presented with a list of 24 statements and asked to indicate their level of agreement or disagreement towards farmers and farming practices on a 5-point Likert-type scale with responses including 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, or 5 = *strongly agree*. The 24 statements were broken down into four key concepts: trust in water use and protection, use of resources, positive-framed relationship with the natural environment, and negative-framed relationship with the natural environment.

An example of one of the four statements that made up the trust in water use and protection concept included *farmers can be relied upon to keep their promises when it comes to water use*. Responses to the four items were averaged to create an overall index score. The index was found to be reliable with a Cronbach's α of .74.

To understand the use of resources concept, three statements were used to create the resources concept scale. *Farmers should save as much water as possible when irrigating crops even if it means I have to pay more for food I purchase* is an example of a statement from this concept area. Responses to the three items were averaged to create an overall index score. The index was found to be reliable with a Cronbach's α of .84.

Questions to understand the positive relationship with the natural environment included five statements. An example of one of the five statements included *farming protects our natural environment*. Responses to the five items were averaged to create an index score. The index was found to be reliable with a Cronbach's α of .84.

Finally, to determine if agriculture had a negative impact on the environment, five statement were offered to respondents. An example of a statement from this concept area was *fertilizers used on farms pollute natural water sources*. The negative-framed statements used the following scale: 1 = *strongly agree*, 2 = *agree*, 3 = *neither agree nor disagree*, 4 = *agree*, and 5 = *strongly agree*. Responses to the five items were averaged to create an index score. The index was found to be reliable with a Cronbach's α of .86.

The demographic characteristics of the respondents are presented in Table 1. Most of the respondents were White with the Northeast region having the largest percentage. Between the Northeast and the South, the gender representation was fairly even, however in the Midwest the majority of respondents were female whereas in the West the majority of respondents were male. The West had the largest group of respondents identifying as Hispanic or Latino and the highest number of respondents with a 4-year college degree or above followed closely by the Northeast. Overall the largest political affiliation was Democrat. Lastly, about a quarter of all the respondent groups had an annual household income of $50,000 to $74,000 a year (see Table 1).

Table 1
Demographic Characteristics by Region

	Northeast (*n* = 236) %	South (*n* = 364) %	Midwest (*n* = 240) %	West (*n* = 210) %
Sex				
Female	54.4	56.1	59.4	29.6
Male	45.5	43.9	40.6	70.4
Race				
African American	6.8	14.9	11.9	10.9
Asian	3.4	4.9	1.3	11.3
Caucasian/White	75.0	64.9	73.0	54.4
Native American	.7	.6	1.0	0.4
Ethnicity				
Hispanic/ Latino	12.3	13.2	10.3	22.5
Age				
20 - 29	22.5	17.4	11.4	22.5
30 - 39	14.8	21.3	16.8	12.7
40 - 49	19.7	19.7	19.3	14.5
50 - 59	18.2	18.4	20.3	13.9
60 - 69	14.0	12.2	13.4	10.1
70 - 79	5.4	7.7	8.5	6.2
80 years and older	5.2	3.3	10.3	20.1
Education				
Less than 12th grade	1.8	1.0	0.5	4.0
High school graduate	27.8	20.7	28.8	8.1
Some college education	20.8	29.7	24.7	21.3
2 year college degree	9.9	15.1	14.2	12.9
4 year college degree	24.7	25.2	23.4	32.7
Graduate degree	15.1	8.3	8.4	21.0
Annual Household Income				
$24,999 or less	20.9	23.6	23.7	17.0
$25,000 to $49,999	23.2	29.4	36.0	24.5
$50,000 to $74,999	24.6	21.9	27.0	24.5
$75,000 to $149,999	26.1	20.2	11.7	28.6
$150,000 to $249,999	2.4	3.9	1.0	3.8
$250,000 to or more	2.8	1.0	0.6	1.5

Political Affiliation				
Democrat	42.8	36.1	34.1	41.0
Independent	24.9	24.7	26.0	26.4
Non-affiliated	9.0	10.2	13.4	6.7
Republican	23.2	28.4	26.0	25.5

Results

Perceptions of Agricultural Water Use

Regarding *trust in water use and protection,* respondents across the nation equally agreed *farmers used sound principles to guide their behavior when it comes to water*. Additionally, respondents equally had the highest agreement that farmers are concerned about water resources when making decisions about farming (see Table 2). Respondents neither agreed nor disagreed that farmers used sound principles to guide their behavior when it comes to water or that they can be relied upon to keep their promises when it came to water use. Respondents in the Midwest and South were more likely than other regions to think it was important to watch farmers closely to ensure they are not taking advantage of water resources. Those in the West also had a lower level of agreement when it came to trusting farmers will keep their promises about water use.

Regarding *use of resources,* respondents felt farmers should use as little pesticides as necessary, use as little fertilizer as necessary, and as little water as possible even if it means having to pay more for food purchases (see Table 2). The South was slightly more likely to disagree with the statements compared to the other regions.

Most respondents neither agreed nor disagreed agriculture had a *positive relationship with the environment* (see Table 3). The exception was respondents from the West who expressed a slightly higher level of agreement when it came to farm lands or privately owned agricultural lands allow water to return and recharge groundwater resources. Respondents from the Northeast expressed the lowest level of agreement that farmers only use as much pesticides or fertilizer as necessary on their fields and crops.

Respondents had mixed feelings on whether *agriculture had a negative impact on the environment.* Over half of all respondents felt animal waste, pesticides, and fertilizers used on farms pollute natural water sources, with pesticides having the highest negative response. In terms of farming causing water runoff, responses were a more varied: the West and the Midwest had a higher response rate in agreement, whereas the northeast and the South neither agreed nor disagreed. When it came to farming causes soil erosion, responses were even more varied between strongly agree, agree, and neither agree nor disagree. The highest response was from the West with 42.7% of respondents agreeing that it does cause soil erosion.

Differences in Perceptions of Agricultural Water Use by Region

A series of one-way ANOVAs were conducted to compare the effect of region on perceptions of agriculture water use. There was a significant difference at the $p < .05$ and $p < .01$ level in two areas, *agricultural use of resources* and *agricultural having negative impact on the* *environment* (see Table 4). Post-hoc comparisons using an LSD test indicated overall mean score differences. Responses differed significantly between respondents from the South and all other regions. The Northeast, Midwest, and West all had a higher perception compared to the South that farmers should use as little resources as possible. In addition, there was also a significant difference between the South and the West regarding *agriculture's negative impact on the environment.* The South had a higher perception of agriculture's negative impact on the environment compared to the lower perception of the West (see Table 5). As it relates to agriculture's negative relationship with the natural environment there were significant differences between the South and the west at the $^{**}p < .01$ value, with the West having a more negative perception of the agriculture industry compared to the South.

Table 2

Trust and Resources Results and Comparison between Groups

	Strongly Disagree/Disagree %				Neither Agree nor Disagree %				Strongly Agree/Agree %			
Regions	NE	S	MW	W	NE	S	MW	W	NE	S	MW	W
Trust in Water Use and Protection												
I think it is important to watch farmers closely so they do not take advantage of water resources	14.7	17.5	22.6	18.7	30.6	33.0	32.6	16.9	54.7	49.5	34.8	64.3
Sound principles seem to guide farmer's behavior when it comes to water	9.5	7.5	7.3	10.7	35.9	31.2	23.8	24.2	54.6	61.3	68.9	65.2
Farmers can be relied upon to keep their promises when it comes to water use	10.1	13.4	12.7	17.5	43.0	35.5	31.2	33.8	46.9	51.2	56.2	48.7
I know farmers will be concerned about water resources when they make important decisions about farming	4.2	3.6	2.4	4.2	11.8	10.0	9.5	10.3	84.0	86.4	88.2	85.4
Agricultural Use of Resources												
Farmers should use as little pesticides as absolutely necessary even if it means I have to pay more for food I purchase	6.1	13.4	6.5	7.9	23.8	25.6	17.8	18.4	70.1	61.0	75.6	73.7
Farmers should use as little fertilizer as absolutely necessary even if it means I have to pay more for food I purchase	7.2	17.1	9.4	7.7	29.0	30.8	24.5	26.2	63.8	52.2	66.1	66.0
Farmers should save as much water as possible when irrigating crops even if it means I have to pay more for food I purchase	10.6	12.1	8.9	8.3	30.3	32.4	29.2	29.4	59.0	55.4	61.9	62.3

Note: Northeast (NE; *n* = 236), South (S; *n* = 364), Midwest (MW; *n* = 240), and West (W; *n* = 210).

Table 3

Positive and Negative Relationship Results and Comparison between groups

	Strongly Disagree/Disagree %				Neither Agree nor Disagree %				Strongly Agree/Agree %			
Regions	NE	S	MW	W	NE	S	MW	W	NE	S	MW	W
Agriculture's Positive Impact on the Natural Environment												
Farmers only use as much pesticides as necessary on their fields and crops	22.6	18.1	16.6	25.1	37.4	36.0	37.1	29.3	39.9	45.9	46.3	45.5
Farmers only use as much fertilizer as necessary on their fields and crops	16.9	16.9	16.6	22.3	39.8	41.2	35.3	34.0	43.3	41.9	48.0	43.7
Farm lands or privately owned agricultural lands allow water to return and recharge groundwater resources (such as aquifers where we get our drinking water)	7.4	6.4	7.2	7.8	37.3	33.7	37.1	21.8	55.3	59.9	55.8	70.6
Farming protects our natural environment	9.3	7.9	12.7	19.0	27.2	31.3	30.8	26.5	63.6	60.8	56.4	54.5
Farmers conserve water	12.3	13.7	13.2	14.0	45.6	37.3	45.9	32.7	42.0	49.0	40.9	53.3
Agriculture's Negative Impact on the Natural Environment												
Animal waste used on farms pollutes natural water sources	12.3	17.6	19.2	12.1	34.8	29.6	28.4	28.6	52.9	52.8	52.4	59.3
Pesticides used on farms pollutes natural water sources	6.1	9.7	7.6	6.8	25.7	25.2	22.8	19.0	68.0	65.1	69.6	74.2
Fertilizers used on farms pollutes natural water sources	7.8	11.7	9.3	8.6	26.7	30.3	27.9	30.8	65.5	58.0	62.8	60.6
Farming causes water runoff	22.0	22.8	18.9	12.1	37.5	41.2	27.2	37.1	40.6	36.0	53.9	50.7
Farming causes soil erosion	26.3	28.2	29.3	30.8	34.0	38.6	32.8	26.5	39.7	33.2	37.9	42.7

Note: Northeast (NE; *n* = 236), South (S; *n* = 364), Midwest (MW; *n* = 240), and West (W; *n* = 210).

Table 4
Differences in Agricultural Water Use by Region and ANOVA Tests

	Northeast (n = 236) *M (SD)*	South (n = 364) *M (SD)*	Midwest (n = 240) *M (SD)*	West (n = 210) *M (SD)*	*F*	*p*
Trust in water use and protection	3.74 (.60)	3.75 (.63)	3.75 (.53)	3.78 (.59)	.31	.82
Agriculture had a positive impact on the environment	3.50 (.76)	3.54 (.75)	3.40 (.75)	3.55 (.83)	.66	.58
Agriculture had a negative impact on the environment	3.51 (.80)	3.38 (.85)	3.51 (.74)	3.59 (.74)	2.	.03*
Agricultural Use of Resources	3.87 (.90)	3.66 (.99)	3.88 (.89)	3.93 (.89)	4.39	.00**

Note. * $p < .05$ and ** $p < .01$.

Table 5
Post-Hoc Test Differences in Regions

	Region	Regions	Mean Dif.	*p*
Trust in water use and protection	South	Northeast	.00	.96
		Midwest	.00	.99
		West	-.04	.50
Agriculture had a positive impact on the environment	South	Northeast	.04	.62
		Midwest	.13	.23
		West	-.02	.47
Agriculture had a negative impact on the environment	South	Northeast	-.13	.08
		Midwest	-.13	.7
		West	-.21	.00**
Agricultural Use of Resources	South	Northeast	-.21	.01**
		Midwest	-.22	.00**
		West	-.27	.00**

Note ** $p < .01$.

Conclusions

The findings revealed respondents across the U.S. trust farmers when it came to their water use and they had a positive perception regarding agriculture's positive impact on the environment. Differences were observed when it came to farmers' use of resources and their negative impact on the environment, with respondents from the West having a significantly more negative perception compared to respondents in other U.S. regions.

Respondents felt farmers should only use the necessary amount of resources (e.g. pesticides, fertilizer, and water) as needed. Additionally, respondents reported being willing to pay more for food if farmers would limit their use of pesticides, fertilizer, and save water. This indicated the public is willing to work with farmers to support their businesses, if in turn the agricultural industry does their part to protect the natural environment.

According to social capital theory, knowledge can be accessed through various networks of social relationships among individuals. The study conducted by Jones et al. (2010) indicated that institutional trust was the most important factor of social capital. Similarly, the results of this study can be used to strengthen social ties and increase transparency between members of the general public and the agricultural industry, disagreements between various stakeholders can be resolved and plans of action can be created. As stated previously, extension educators are influential within local communities and are the most trusted sources of information. Much like the study of Robinson and Meikle-Yaw (2007), Extension supported community projects created social ties within the communities leading community members to be more civically engaged.

Implications and Recommendations

This study provided an opportunity to demonstrate an array of perceptions related to agricultural water issues by U.S. region. Prior to providing recommendations based on the results, it is important to recognize the limitations of this study. A potential limitation was the use of a non-probability sampling. While weighting techniques were applied, the relationship between the sample and the population is unknown. It is unclear how representative it is of the population as whole and should be interpreted with caution.

Since local university extension, soil and water conservation districts, and state agencies were found to be the most trusted sources of information in a study by Mase et al. (2015), it is important for the university to be transparent with the public about agriculture-related information in order to regain trust. It is important for extension programs to consider creating partnerships to transfer knowledge to multiple stakeholders to create a larger network for social capital. Perhaps forums targeted at members of the media could be used to educate those having a large amount of influence about agricultural water use.

Building social ties between extension educators and members of the public can increase the chance of a greater, more informed network. This informed network could address the negative media coverage and explain what the agricultural industry is doing to mitigate high water consumption activities. It could also be used to assist in the development of policy with individuals representing all water stakeholders present to ensure policy and regulation is formed to sustain natural resources without devastating agriculture.

Farmers in local communities could open their farms to the public to build social capital with the local residents. For these open-houses or field days farmers could offer local residents a transparent look at how farmers use pesticides, fertilizers, and water on their operations. This would provide an opportunity for local citizens get a first-hand look at how agriculture is using their resources. This also provides an opportunity for the public to develop educated perceptions of agriculture's positive and negative impacts on the environment.

Extension educators involved in water education should also increase initiatives that would help enhance perceptions of agricultural water use (Lamm et al., 2016) since agricultural water use accounts for a significant amount of water withdrawal (Schaible & Aillery, 2012). For example, producing television clips and YouTube videos that demonstrate practical techniques farmers and producers use to maintain and preserve water could be helpful. Extension programs should be delivered both online and in person; both options would allow participants to increase their knowledge on a broad set of topics and connect interested parties to those living within their communities (Wolfson et al., 2015).

In an effort to educate the public, Extension educators can increase awareness of local farmers' positive agricultural water use in their regional communities. Public visability can come in the forms of signage at the local grocery store next to the produce and meat section indicating where the product was grown and how the farm positively promotes agricultural water use within the region, social media campaigns that highlight local farmers' sustainable agricultural water use practices, and signs visable from the road indicating that a farm is practicing positive and sustainable agricultural water use. For example, extension educators in the South can publicly promote farmers' low use of pesticides, fertilizer, and water. Extension educators in the West and Midwest can publicly promote what farmers are doing to decrease water runoff. Extension eduactors in the West can publicly promote how farmers work to decrease soil erosion. The public in the western U.S. exhibited a more negative perception of agricultural water use perhaps because water shortages have been highlighted repeatedly. Therefore, extension educators have a greater challenge ahead of them in trying to increase public understanding of farmers' agricultural water use.

Perceptions of water issues, and actual water issues, vary depending upon geographic location. It is important that extension educators create programs based on the issues pertaining to their particular area. Increasing communication about agricultural water use can increase stakeholder awareness and improve public perception. Increased awareness will ultimately create more informed policy and regulations benefiting water allocation for all water users.

Additional studies should be conducted to continue adding to the agricultural water use and extension education literature. Studies could be conducted based on additional demographics to determine audience segments' perceptions of agriculture water use. Other demographics that could be used to segment audiences are age, generation, individual state, income level or education attainment, and race. Segmenting audiencing would increase the ability to dive deep into specific issues and discussions because extension educators would be addressing specific concerns related to agriculture water use rather than speaking broadly. In addition, after extension programming specifically addressing agriculture water use was conducted, a study could intentionally measure the longitudinal effect of the program on public perception of agriculture water use.

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