Journal of Rural Social Sciences

Volume 34 | Issue 1 Article 5

8-9-2019

Nebraska Residents' Perceptions of Drought Risk and Adaptive Capacity to Drought

Michelle L. Edwards
Texas State University, michelle_edwards@txstate.edu

Please address all correspondence to Dr. Michelle L. Edwards (michelle_edwards@txstate.edu).

Nebraska Residents’ Perceptions of Drought Risk and Adaptive Capacity to Drought

Michelle L. Edwards

Texas State University

ABSTRACT

Climate change is expected to increase the frequency and intensity of drought in certain regions, including Nebraska. While differences in ecological and social vulnerability impact drought response, scholars argue that *perceptions* of risk and adaptive capacity also play a role in predicting adaptation responses. Drawing on Grothmann and Patt’s model of private proactive adaptation to climate change, based on protection motivation theory, I examine Nebraska residents’ perceptions of drought risk and adaptive capacity to drought at two spatial levels, the community and the region, as well as the predictors of these perceptions. Multivariate analyses demonstrate that rural residence positively predicts perceived drought risk, but negatively predicts perceived adaptive capacity to drought. In addition, perceived drought risk and at least one measure of perceived adaptive capacity both tend to be positively predicted by one’s level of belief in scientific information and one’s level of belief in local experience-based information.

KEYWORDS

Adaptive capacity; local knowledge; risk; scientific knowledge; trust

INTRODUCTION

Many individuals see climate change as one of most severe environmental issues we currently face, with impacts that will likely vary by region (King 2004). One projected effect of changing climatic conditions is an increase in the frequency, intensity, and duration of drought (Muller 2014), which, combined with growing water resource demands, provides a significant challenge to communities across the globe (Lazrus 2016). Governmental responses to drought have historically been largely reactive and ineffective. However, scholars have proposed that drought management can be improved by focusing on reducing drought risk, a "product of both the region's exposure to the event… and the vulnerability of society to the event" and improving adaptive capacity, or the ability of a socio-ecological system to respond to and cope with disturbances (Wilhite, Sivakumar, and Pulwarty 2014:5).

Measuring a socio-ecological region's risk potential and adaptive capacity is a complex process and it connects to broader resilience theory, which has been used to understand individual responses to ecological change through "cop[ing] with and adapt[ing] to changes in environmental conditions" (Smith, Anderson, and Moore 2012:381). Research demonstrates that, in addition to objective indicators of risk and adaptive capacity, subjective factors like people's *perceptions* of risk and adaptive capacity play important roles in understanding adaptation behaviors (Grothmann and Patt 2005). Measurements of risk and adaptive capacity to drought are further complicated by the slow-onset nature of drought as an environmental hazard, which makes it difficult for residents and scientists to know when drought has begun and ended.

While geographic location and environmental conditions matter for understanding risk perceptions and water management preferences, social factors also can strongly influence these views (Lazrus 2016). This study uses a general public household survey of Nebraska residents to explore how residents perceive drought risk and adaptive capacity to drought, and to examine how risk perceptions, past risk experience, belief in scientific information, belief in local experience-based information, and rural/urban residence predict perceived risk and adaptive capacity. This study contributes in an incremental way to our understanding of each of these relationships. Its major contributions are in identifying rural residence as a positive predictor of perceived drought risk, but a negative predictor of perceived adaptive capacity to drought, and in identifying both belief in scientific information and belief in local experience-based information as positive predictors of perceived drought risk and at least one perceived adaptive capacity measure.

BACKGROUND

Measuring Risk and Adaptive Capacity

Climate change-related "risk" and "adaptive capacity" have been operationalized and assessed in a variety of ways (examples include Engle 2011; Hultman, Hassenzahl, and Rayner 2010). Risk is typically defined as a "situation or event where something of human value (including humans themselves) has been put at stake and where the outcome is uncertain" (Rosa 1998:28). Adaptive capacity, in contrast, describes the ability or potential for a system to respond to these risks, through increasing its "ability to absorb and recover from losses" and to "exploit new opportunities that arise in the stressed environment" (Hultman et al. 2010:292). Engle (2011) suggests that researchers can either *measure* or *characterize* the concepts of risk and adaptive capacity. Measuring involves the direct assessment of an amount of adaptive capacity or risk at a particular time period. In contrast, characterizing involves examining the "predetermined system attributes, mechanisms, or indicators" suspected in the literature to be determinants of these concepts (Engle 2011:653). This study focuses on *characterizing* perceived risk and perceived adaptive capacity to drought by examining their theorized relationships with other variables.

Objective and subjective (perceived) measures of risk and adaptive capacity are both important for understanding adaptation behaviors. For example, Grothmann and Patt argue:

> The objective ability or capacity of a human actor (what an individual, a group, or a culture *could* do, indicated by the availability and the access to resources) only partly determines if an adaptive response is taken. Even as important as this objective ability is the subjective or perceived ability (2005:202).

Public perceptions of risk typically differ from scientific risk assessments (Slovic 1987) but often play an even more an important role in the priorities and agendas of regulatory bodies (Slovic 2000). Grothmann and Patt (2005) created a socio-cognitive model of private proactive adaptation to climate change (MPPACC) based on protection motivation theory (Rogers 1983) to better understand these subjective perceptions. This study uses this theoretical model to examine drought risk perceptions and perceived adaptive capacity to drought.

Grothmann and Patt's (2005) model identifies two major determinants of adaptation, risk perception and perceived adaptive capacity, which are formed through the cognitive processes of risk appraisal and adaptation appraisal. Risk perception consists of two subcomponents: 1) *perceived probability*, or a person's assessment of a threat's probability of occurring; and 2) *perceived severity*, or a person's assessment of how harmful the consequences of the threat would be to valued items if it were to occur (Grothman and Patt 2005:203). Perceived adaptive capacity consists of three subcomponents: 1) *perceived adaptation efficacy*, or a person's belief that adaptive actions and responses would effectively protect a person from a threat's harmful consequences; 2) *perceived self-efficacy*, or a person's belief in their ability to perform or carry out adaptive responses; and 3) *perceived adaptation costs*, or a person's assessment of the financial costs of choosing the adaptive response (Grothmann and Patt 2005:203).

Drought as a Climate Change-Related Problem in Nebraska

While past research has tended to focus on adaptation to climate change, in general, the Intergovernmental Panel on Climate Change (IPCC) has distinguished between generic indicators of adaptive capacity, which reflect factors seen as useful in responding to climate change in general (e.g., education, income, or health), and specific indicators, which reflect the ability of a system to respond to a specific climate change impact, such as drought (Adger et al. 2007).

Drought is generally seen as a "natural hazard that results from a deficiency of precipitation from expected or 'normal' that, when extended over a season or longer, is insufficient to meet the demands of human activities and the environment" (Wilhite and Buchanan-Smith 2005:4). Drought impacts tend to accumulate over time and geographic space, which make detection and institutional response more challenging than other hazards (Wilhite and Buchanan-Smith 2005). In the United States, the financial toll resulting from drought has been larger than that caused by any other natural hazard (Polsky and Cash 2005). Impacts of drought include "reduced crop, rangeland, and forest productivity; reduced water levels; increased fire hazard; reduced energy production; reduced opportunities and income for recreation and tourism; increased livestock and wildlife death rates; and damage to wildlife and fish habitat" (Sivakumar et al. 2014:126).

The state of Nebraska has experienced an extensive history of droughts (Wilhelmi and Wilhite 2002), which, along with other extreme weather events, are expected to occur more frequently with climate change (Van Liew, Feng, and Pathak 2012). The University of Nebraska-Lincoln originally established and continues to house the National Drought Mitigation Center, which aids people and institutions with drought management. According to Nebraska's Drought Mitigation and Response Plan, drought management was previously limited to crisis management, mostly responding reactively after the impact (Nebraska Climate Assessment Response Committee 2000). However, following the increasing occurrence of drought and the severity of its impacts, Nebraskans, among others, have shifted their focus from solely post-crisis response to drought mitigation, vulnerability assessment, and preparedness (Wilhelmi and Wilhite 2002).

Historically, nations have responded to drought using what is known as crisis management, or the reactive, post-impact interventions following a drought, which are often found to be "untimely, poorly coordinated and disintegrated" and generally seen as "ineffective" (Sivakumar et al. 2014:127). Due to increasing drought-related concerns, global leaders have sought ways to improve drought response beyond these reactive measures. For example, in 2013, the World Meteorological Organization, the Secretariat of the United Nations Convention to Combat Desertification, the Food and Agriculture Organization of the United Nations, and other partners met to develop science-based strategies to cope with drought (Sivakumar et al. 2014). Proposals included improvements to drought monitoring, drought prediction, drought vulnerability and impact assessment, drought preparedness and mitigation, and drought response and relief (Sivakumar et al. 2014).

Social Determinants of Perceived Risk and Perceived Adaptive Capacity

Few authors have analyzed predictors of perceptions of risk and adaptive capacity specifically related to drought in the United States. Therefore, I draw on examinations of other climate change-related issues to identify potentially important predictors. In this study, I focus on five major indicators: risk perceptions (in predicting adaptive capacity), past risk experience, belief in scientific information, belief in local experience-based information, and rural/urban residence.

Grothmann and Patt's (2005) model suggests that higher perceptions of risk would positively influence adaptation responses. López-Marrero and Yarnal extend this idea by arguing that higher levels of risk perception could also signal higher levels of adaptive capacity, "as those individuals who express concern (i.e. perceived risk) are more likely to be motivated and make efforts to undertake adaptive strategies" (2010:291). Adaptive capacity is generally seen as a "universally positive system property" of socio-ecological systems that influences a person's response to a threat (Engle 2011:652). However, Burch and Robinson argue that it is also possible that socially disadvantaged populations may be more likely to perceive risks than more empowered populations, but may perceive themselves as less likely to "control or recover from a risk" (2007:312). Also, Grothmann and Patt argue that high-risk perception can occur with low perceived adaptive capacity, which could lead to "maladaptation," such as "avoidant reactions (e.g., denial of the threat, wishful thinking, fatalism)" (2005:203-204). In terms of past risk experience, studies of self-protective behavior in response to natural hazards have typically found that "preparedness" increases with the "severity of past damage" (Grothmann and Patt 2005:205). As a result, one would expect that those with past risk experience would typically have higher levels of risk perception regarding the current hazard and higher perceived adaptive capacity (Grothmann and Patt 2005).

Scholars also emphasize the importance of building trust among stakeholders in order to successfully cope with complex environmental problems (Henry and Dietz 2011). For example, research on resilience suggests that the "risk the individual associates with climate change, the individual's willingness to learn and plan, and the individual's interest in changing behavior – may all be influenced by the extent to which that individual trusts others" (Smith et al. 2012:385). In particular, Henry and Dietz (2011) argue that *trust in information* is a key part of effective commons governance. However, how does belief in different sources of information affect perceived risk and perceived adaptive capacity? I examine two separate dimensions of belief based on scholars' recognition of the potential importance of both *scientific knowledge* and *local knowledge* (e.g., Wynne, 1996). Past research on Iowa farmers' views on climate change found that those who trusted environmentally oriented organizations for information on climate change were more likely to perceive climate change as a risk to agriculture and to support adaptive and mitigative action, whereas trust in agricultural-related groups had a negative indirect effect on support for mitigation (Arbuckle, Morton, and Hobbs 2015).

Rural and urban residents also likely face different risks, have different potential for adaptive capacity, and perceive risk and adaptive capacity in different ways. Some scholars have argued that rural communities are more vulnerable to risk, both in terms of socio-economic vulnerability and ecological vulnerability resulting from climate change (Freshwater 2015; Lal, Alavalapati, and Mercer 2011). Rural communities may also have a more difficult time adapting. Some scholars have described the lack of "resources to undertake natural hazard planning measures" in rural areas and the problems rural planners often face in responding to climate change due to a "lack of political will, disbelief in the value of local action, lack of peer communities for learning, lack of resources, and a poor scientific understanding of climate change" (Homsy and Warner 2013:293). However, others have argued that it is "overly simplistic" to assume greater vulnerability exists in rural areas (Prelog and Miller 2013:4). Rural residents may be more resilient due to strong social capital within rural locations (e.g., strong social ties, high levels of trust among residents, and frequent interaction within communities), as well as "closer, more interdependent, relationships with the natural environment" (Prelog and Miller 2013:4). For example, in their study of rural Texas residents, Prelog and Miller (2013) found that rural residents perceived high levels of concern for drought and high levels of confidence in their ability to respond to disasters.

Drawing on the above literature, I propose the following hypotheses, though keeping in mind the conflicting nature of some of the past research:

H1. Those who perceive higher drought risk will have higher perceived adaptive capacity to drought.

H2. Those with past drought experience will have higher perceived drought risk and higher perceived adaptive capacity to drought than those without past drought experience.

H3. Those with greater belief in scientific information and local experience-based information will have higher perceived drought risk and higher perceived adaptive capacity than those with less belief in these sources of information.

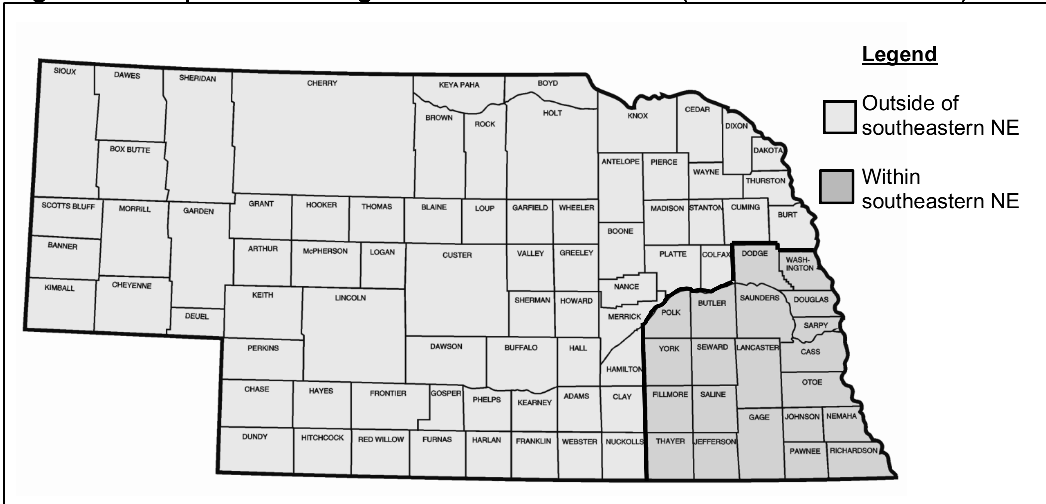
H4. Rural residents will have higher perceived drought risk and lower perceived adaptive capacity than will urban residents.

METHODS

Survey Sample

This study used a general public household survey of adult Nebraska residents on water supplies and how they should be managed. Data for these analyses were collected between April and June 2012 using random samples selected from the address-based sampling frame, the U.S. Postal Service Delivery Sequence File provided by GENESYS Inc. The initial sample included 2400 Nebraska residents. Due to a separate methodological experiment, stratified random sampling was used to oversample residents living outside of the southeastern region of the state, which allows for greater consideration of the views of rural residents. This division is depicted in Figure 1 and was included in the questionnaire to clarify for respondents their "area of the state." I obtained 50 percent of sampled addresses from southeastern Nebraska counties and 50 percent from the rest of the counties in the state. Similar to Messer and Dillman (2011), I calculated regional sampling weights based on the proportion of households in each region, using 2010 Census data, divided by the proportion of respondents in each region (0.25). I used the *svy:* command in Stata to apply weights to the sample data. After adjusting for undeliverable surveys, I obtained an overall response rate of 49% (1109 respondents).

Figure 1. Map of Two Regions within Nebraska (Based on Counties)



Survey Administration

Sample members each received a twelve-page questionnaire (about a 20-25 minute survey) with 47 numbered questions and up to 126 items related to water governance. I utilized a tailored design method (Dillman, Smyth, and Christian 2009) with a maximum of four contacts per sample member. In the first contact, I included a $4 cash incentive for all sample households, and in the third contact, I included a $2 cash incentive for all non-responding households. This survey was part of a series of experiments conducted by Washington State University testing the effects of survey mode and sponsorship on response (discussed in detail in Edwards 2014).

Each contact was addressed to the "Resident" of the city or town associated with each postal address in the sample. Also, since Nebraska's age of adulthood is 19, I requested that the adult age 19 and over with the most recent birthday fill out the survey, which I included in the contact letters and on the questionnaire. This method has been effectively used in past studies to randomly select a single participant within households (Messer and Dillman 2011).

This survey was designed to improve our understanding of Nebraska residents' perceptions of regional water issues and their governance. It began with a section on drinking water and the governance of tap water, followed by: a series of questions on the potential impacts of the Keystone XL pipeline on the Ogallala Aquifer; a series of questions on the governance of the Ogallala Aquifer and the resolution of water conflicts; a series of questions measuring community and regional past drought experience, drought risk perceptions, and perceived adaptive capacity to drought; questions on how much one trusts different information sources for preparing for and coping with possible rain/snow pattern changes; some general interactional capacity and trust questions; and a series of demographic questions. Due to the research design, the Washington State University Office of Research Assurances determined that the study satisfied criteria for Exempt Research at 45 CFR 46.101(b)(2) (IRB Number 12414).

Variables and Analyses

In this study, I use Ordinary Least Squares (OLS) regression analyses to examine three dependent variables: perceived drought risk and two measures of perceived adaptive capacity. To predict these variables, I use the following independent variables: past drought experience, belief in scientific information, belief in local experience-based information, urban-rural county residence, location outside city or town limits, and the socio-demographic controls of sex, education, and political party affiliation.

The operationalization of risk and adaptive capacity is complicated by the issue of spatial context. Across the United States, political and institutional restructuring has tended to shift water governance responsibilities and costs toward lower spatial levels (Ivey et al. 2004). In addition, the regional nature of the potential impacts of climate change suggests that regional approaches, which “allow targeted measures for specific climate change impacts,” might be “more efficient and appropriate” (Juhola, Peltonen, and Niemi 2012:717). While regional and community levels have been identified as playing significant roles in potential adaptations to climate change, researchers have also noted the interconnectedness of various spatial governance levels (O’Brien, Sygna, and Haugen 2004; Smit and Wandel 2006). In this study, I measure perceived risk, perceived adaptive capacity, and belief in different sources of information at the community and regional levels.

The community- and regional-level measures of *perceived drought risk index* were operationalized in identical ways, each using two items: 1) “It seems likely that my [community/area of the state] will actually face a severe drought in the future” (*perceived probability*), and 2) “I think a drought would be very harmful to my [community/area of the state]” (*perceived severity*). For each item, responses were coded “1” for strongly agree to “5” for strongly disagree. Both items were reverse coded for easier interpretation. Two composite dependent variables were created by summing responses to the two separate community- or region-related items. Thus, higher scores represent higher drought risk perception. The composite measures of perceived drought risk have low to moderate internal consistency (alpha reliability coefficient for the community-level variable = 0.45 and for the regional-level variable = 0.47) and low inter-item correlation (r=0.32 for both spatial levels). However, based on the theoretical model, they seem to address two distinct but important aspects of risk perceptions and, as a result, I have kept them as part of a single index.

The second set of dependent variables measured community- and regional-level perceived adaptive capacity to drought. These measures were also operationalized in identical ways, using four items, which I used to create two indices. The first community- and regional-level measures of *perceived adaptation efficacy index* were created by summing responses to the questions: 1) “If my [community/area of the state] takes steps ahead of time to prepare for a drought, the future costs of a drought will be lower” and 2) "If my [community/area of the state] takes steps ahead of time to prepare for a drought, our future responses will be more effective." For each item, responses were coded "1" for strongly agree to "5" for strongly disagree. These items were reverse coded prior to summing responses (alpha reliability coefficient for the community-level variable = 0.81 and for the regional-level variable = 0.87). The second set of measures of *perceived adaptation ability index* were created by summing responses to the questions: 3) "Leaders in my [community/area of the state] do not have enough training or knowledge to adequately prepare for or respond to a drought" (conceptualized more broadly than perceived self-efficacy, this represents *perceived community/regional efficacy*), and 4) "My [community/area of the state] does not have enough funds to adequately prepare for or respond to a drought" (*perceived adaptation costs*). For each item, responses were coded "1" for strongly agree to "5" for strongly disagree. Given the wording of the questions, higher scores represent higher perceived adaptive capacity to drought. Responses were summed for the composite measure (alpha reliability coefficient for the community-level variable = 0.67 and for the regional-level variable = 0.80).

Past drought experience was a self-reported measure, with respondents asked if their [community/area of the state] had experienced a severe drought since they lived there (coded "1" for yes and "0" for no).

I used two variables to operationalize belief in different sources of information: *belief in scientific information* and *belief in local experience-based information*. These measures were based on the question: "How much do you <u>believe</u> that each of these sources [scientific information/local experience-based information] would help decision-makers prepare for and cope with possible rain/snow pattern changes in your [community/area of the state]?" Responses ranged on a five-point Likert scale from "strongly believe" to "do not believe at all." In general, higher scores indicate greater belief in the usefulness of scientific or local information.[1 1]

I included two measures to assess the rurality of one's location. Many authors have noted the difficulty of demarcating urban and rural areas, which can vary based on factors including administrative boundaries, population densities, and land-use patterns (Lal et al. 2011). The first measure, *urban to rural county continuum*, designated respondents based on their counties of residence using the United States Department of Agriculture (USDA) 2013 Rural-Urban Continuum Codes. Higher numbers on this variable typically indicate more rural counties, though specific designations are described in Table 1. I also included a second measure of rurality, *outside city limits*, based on a question asking if one's home is outside city or town limits.

Demographic controls included *sex* (female coded "1," male as "0") and *education* (4-year college degree or higher as "1," less than a 4-year degree as "0"). *Political party affiliation* was measured using three categories: Republican, Democrat, and Independent.

For all Likert-scale items, respondents were presented with a "not sure" option, which were excluded from analyses (similar to Boudet et al. 2014). While most "not sure" responses numbered less than 10 percent of responses, for items measuring community- and regional-level perceived drought risk likelihood, perceived community/regional efficacy, and perceived adaptation costs, "not sure" responses ranged from 25 to 36 percent of responses. Since the "not sure" response option was displayed outside of the continuum between strongly agree and strongly disagree within the questionnaire, I excluded these responses from this article's analyses. As discussed by Willits, Theodori, and Luloff, the "undecided," or in this case "not sure", response is "qualitatively different" than the other variables in a typical Likert scale and represents an ambiguous response that is better examined as a separate dichotomous variable (2016b:131).

While risk perception and adaptive capacity are multi-dimensional concepts not easily measured by single items, I was limited by the number of items included in the survey. Due to space limitations, this survey did not include all potential items that could be part of drought risk perceptions and perceived adaptive capacity to drought, such as whether one's community or area of the state would actually take steps ahead of time to reduce the impact of drought, rather than would these steps potentially be effective. The survey also did not include all potential items that could predict perceived drought risk or perceived adaptive capacity to drought, such as the amount of information to which people are exposed, the outcomes of responses to previous drought episodes, or other experiences of community action. Cognitive interviews conducted in the pre-testing phase indicated that the length of each of the sections of the survey were burdensome and, as a result, I shortened each section and combined certain questions to improve respondents' experience. However, this does complicate interpretation of some of the variables.

FINDINGS

Descriptive Statistics

Table 1 provides descriptive statistics for the variables in the study. Nebraska residents had high levels of perceived drought risk regarding both their community and region of the state (average of 8 out of a 10-point scale for each spatial level) and high levels of perceived adaptation efficacy (average of 8 out of a 10-point scale for each spatial level), but lower levels of perceived adaptation ability (average of 5 out of a 10-point scale for each spatial level). In terms of the independent variables, about 35-36 percent of respondents reported having experienced a severe widespread drought in both their community and region of the state. In both samples, over half of respondents lived in counties in metro areas of 250,000 to 1 million population (the highest code for this state), while the other 44-46 percent of respondents were distributed across less populated counties. A small proportion of respondents reported that they lived outside city or town limits for both the community- and regional-level samples (22-23 percent). About 40-41 percent of respondents reported that they strongly believe scientific information would help decision-makers prepare for and cope with possible rain/snow pattern changes at the community and regional levels, whereas only about 28-29 percent said they strongly believed that local experience-based information would help decision-makers at the community and regional levels. About 44 percent of respondents in each sample identified as women and about 44 percent of respondents in each sample had at least a 4-year college degree. Republicans made up about 43-44 percent of each sample, followed by Democrats (30 percent) and Independents (26 percent).

Prior to running the multivariate analyses, I examined the interrelationships among the independent variables for evidence of multicollinearity, as demonstrated in Table 2. Most correlations were smaller than 0.20. For community-level measures, the perceived drought risk index was positively correlated with past drought experience (r=0.27), belief in scientific information (r=0.24), and belief in local experience-based information (r=0.21). Past drought experience was positively correlated with one's location in an urban-rural county (r=0.26). One's location in a more rural county was positively associated with living outside city or town limits (r=0.21) and negatively associated with having at least a 4-year college degree (r=-0.21). One's level of belief in scientific information was positively associated with one's level of belief in local information (r=0.33). One's level of belief in scientific information was also negatively associated with identifying as a Republican (r=-0.25) and positively associated with identifying as a Democrat (r=0.28).

Table 1. Demographic Characteristics of Respondents

Variable	Percent or Mean (St. Deviation) Community-level	Regional-level	Variable	Percent or Mean (St. Deviation) Community-level	Regional-level
Dependent Variables			Outside city or town limits	23.07	22.46
Perceived drought risk index (range 2-10)	7.82 (.077)	7.98 (.080)	Belief in scientific information		
Perceived adaptation efficacy index (range 2-10)	8.38 (.076)	8.14 (.083)	Do not believe at all	2.89	3.23
Perceived adaptation ability index (range 2-10)	5.25 (.102)	5.46 (.108)	Believe a little	5.62	5.49
			Somewhat believe	21.71	20.36
Independent Variables			Mostly believe	30.20	30.05
Past drought experience in one's area of the state			Strongly believe	39.59	40.86
Yes	35.22	35.88	Belief in local information		
No	64.78	64.12	Do not believe at all	1.67	2.91
Urban to rural county continuum			Believe a little	10.16	8.56
1 – Metro areas of 1 million +	0.00	0.00	Somewhat believe	24.29	26.18
2 – Metro areas of 250,000 to 1 million	54.26	56.16	Mostly believe	35.81	33.44
3 – Metro areas of fewer than 250,000	5.47	5.18	Strongly believe	28.07	28.91
4 – Urban pop. of 20,000 +, adj. metro area	6.08	5.66	Female	46.28	43.94
5 – Urban pop. of 20,000 +, not adj. metro area	7.91	7.28	4-year college degree or higher	43.99	44.09
6 – Urban pop. of 2,500 to 19,999, adj. metro area	5.46	5.17	Political party affiliation		
7 – Urban pop. of 2,500 to 19,999, not adj. metro	9.12	9.06	Republican	43.42	44.28
8 – Rural or less than 2,500 urban pop., adj. metro	3.80	3.72	Democrat	30.49	29.72
9 – Rural or less than 2,500 urban pop., not adj. metro	7.90	7.77	Independent	26.10	26.00

Note: Community level N=448; Regional level N=420.

Table 2. Interrelationships among the Independent Variables for Community-level and Regional-level Models

Community-level Variables	Perceived drought risk index	Past drought experience	Urban-rural county cont.	Outside city/ town limits	Belief in scientific info.	Belief in local info.	Female	4-year college +	Republican	Democrat
Past drought experience	0.27***									
Urban-rural county cont.	0.16***	0.26***								
Outside city/ town limits	0.15**	0.16***	0.21***							
Belief in scientific info	0.24***	-0.12**	-0.17***	-0.13**						
Belief in local info	0.21***	0.03	0.00	0.03	0.33***					
Female	0.10*	-0.11*	-0.05	0.04	0.09	0.05				
4-year college +	0.09	0.01	-0.21***	0.03	0.17***	-0.04	0.00			
Republican	-0.02	0.16**	0.16***	0.15**	-0.25***	-0.07	-0.06	0.11*		
Democrat	0.11*	-0.09	-0.11*	-0.07	0.28***	0.10*	0.13**	-0.07	-0.58***	
Independent	-0.10*	-0.08	-0.07	-0.10*	-0.01	-0.03	-0.06	-0.05	-0.52***	-0.39***

Regional-level Variables	Perceived drought risk index	Past drought experience	Urban-rural county cont.	Outside city/ town limits	Belief in scientific info.	Belief in local info.	Female	4-year college +	Republican	Democrat
Past drought experience	0.29***									
Urban-rural county cont.	0.19***	0.28***								
Outside city/ town limits	0.17***	0.20***	0.15**							
Belief in scientific info	0.30***	-0.06	-0.15**	-0.11*						
Belief in local info	0.20***	0.09	0.05	0.10*	0.31***					
Female	0.08	-0.03	-0.01	0.04	0.16**	0.10*				
4-year college +	0.06	-0.07	-0.23***	-0.00	0.17***	-0.02	0.02			
Republican	0.02	0.09	0.16***	0.15**	-0.26***	-0.02	-0.10	0.11*		
Democrat	0.06	-0.04	-0.12**	-0.10*	0.29***	0.07	0.15**	-0.07	-0.59***	
Independent	-0.09	-0.05	-0.06	-0.06	-0.01	-0.05	-0.05	-0.04	-0.52***	-0.39***

Note: Community level N=448; Regional level N=420; *p<.05; **p<.01; ***p<.001 (two-tailed).

Correlations between regional-level measures were nearly identical to the correlations between community-level measures with one addition: past drought experience at the regional-level was also negatively correlated with residence outside city or town limits (r=0.20). These correlation coefficients suggest that multicollinearity is likely not a problem (similar to Willits, Theodori, and Luloff 2016a). I also examined the variance inflation factor (VIF) scores. None of the VIF scores exceeded 1.4, which suggests again that multicollinearity is likely not an issue (O'Brien 2007).

Multivariate Analyses

Table 3 demonstrates results from two OLS regression analyses predicting the dependent variable of perceived drought risk at the community level and the regional level. Providing support for my second hypothesis (H2), in both models, past drought experience positively predicted perceived drought risk, holding other variables constant (p<0.001). Thus, compared to those without past drought experience, those with past drought experience, on average, scored 0.83 points higher on the perceived drought risk index at the community level and 0.76 points higher at the regional level. I also found some support for my third hypothesis (H3). One's level of belief in scientific information also increased one's score on the perceived drought risk index at both the community and regional levels (p<0.001). One's level of belief in local experience-based information positively predicted their level of perceived drought risk at the community level (p<0.01) but not at the regional level. In terms of the rural/urban variables, those located in more rural counties typically reported higher perceived drought risk at the community and regional level than those in more urban counties (p<0.001), and those located outside the city or town limits reported higher perceived drought risk at the community level (p<0.05) and at the regional level (p<0.01). This supports my fourth hypothesis (H4). Women typically had higher perceived drought risk regarding their community (p<0.05), but not their region. Overall, the community-level model with all predictors included produced an adjusted R^2 value of 21.47 (p<0.001), and the regional-level model produced an adjusted R^2 value of 24.13 (p<0.001).

Table 4 demonstrates results from two OLS regression analyses predicting the dependent variable of perceived adaptation efficacy at the community level and the regional level. In both models, one's level of perceived drought risk positively predicted their perceived adaptation

Table 3. OLS Regression Analyses Predicting Perceived Drought Risk Index for Community-level and Regional-level Models

	Community-level Model			Regional-level Model		
Independent Variables	*B*	*St. Error*	*95% Confidence Interval*	*B*	*St. Error*	*95% Confidence Interval*
Past drought experience	0.83***	0.135	0.56 to 1.09	0.76***	0.155	0.45 to 1.06
Belief in scientific info.	0.33***	0.077	0.18 to 0.49	0.47***	0.079	0.32 to 0.63
Belief in local experience-based info.	0.18**	0.070	0.04 to 0.32	0.08	0.077	-0.07 to 0.23
Urban-rural county continuum	0.09***	0.029	0.04 to 0.15	0.10***	0.027	0.05 to 0.15
Outside city or town limits	0.36*	0.162	0.04 to 0.68	0.47**	0.169	0.14 to 0.80
Female	0.29*	0.139	0.02 to 0.56	0.07	0.143	-0.21 to 0.36
4-year college degree +	0.25	0.143	-0.03 to 0.53	0.17	0.148	-0.12 to 0.46
Political party affiliation						
Republican [reference]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Democrat	0.25	0.165	-0.08 to 0.57	-0.04	0.179	-0.39 to 0.31
Independent	-0.03	0.179	-0.38 to 0.32	-0.21	0.166	-0.54 to 0.12
Constant	5.11***	0.411	4.04 to 5.47	5.46***	0.454	4.17 to 5.80
R^2	21.47***			24.13***		
N	448			420		

Note: *p<.05; **p<.01; ***p<.001 (two-tailed).

efficacy, holding other variables constant ($p<0.01$ for the community model and $p<0.001$ for the regional model). This provides support for my first hypothesis (H1). In contrast with perceived drought risk, past drought experience negatively predicted one's score on the perceived adaptation efficacy index, but only at the regional level ($p<0.05$). This provides some evidence against my second hypothesis (H2), which expected that past drought experience would positively predict perceived adaptive capacity. Compared to those without past drought experience, those with past drought experience at the regional-level had significantly lower perceptions of their region's adaptation efficacy. One's level of belief in scientific information positively predicted one's perceived adaptation efficacy at the community level ($p<0.01$) and at the regional level ($p<0.001$). Similarly, one's level of belief in local experience-based information positively predicted one's perceived adaptation efficacy at the community level ($p<0.001$) and at the regional level ($p<0.05$). This provides support for my third hypothesis (H3). Living in a more rural county lowered one's perception of adaptation efficacy at the community level ($p<0.001$), but not at the regional level. Neither of the urban/rural variables were significant predictors of one's perception of the adaptation efficacy of their region. These findings demonstrate very limited support for my fourth hypothesis (H4), which suggested that rural residents would have lower perceived adaptive capacity. Overall, the community-level model with all predictors included produced an adjusted R^2 value of 17.54 ($p<0.001$), and the regional-level model produced an adjusted R^2 value of 23.68 ($p<0.001$).

Table 5 demonstrates results from two OLS regression analyses predicting the dependent variable of perceived adaptation ability index at the community level and at the regional level. In predicting community and regional adaptation ability, perceived drought risk had a negative effect ($p<0.001$) and past drought experience had a positive effect ($p<0.001$ for the community level and $p<0.01$ for the regional level). In contrast with the prior models shown in Table 4, these models provide evidence against my first hypothesis (H1) which predicted a positive relationship between perceived drought risk and perceived adaptive capacity, and support for my second hypothesis (H2), which predicted a positive relationship between past drought experience and perceived adaptive capacity. Higher levels of belief in local experience-based information resulted in higher perceptions of adaptation ability at the regional level, but not at the community level ($p<0.01$). This demonstrates less support for my third

Table 4. OLS Regression Analyses Predicting Perceived Adaptation Efficacy Index for Community-level and Regional-level Models

	Community-level Model			Regional-level Model		
Independent Variables	*B*	*St. Error*	*95% Confidence Interval*	*B*	*St. Error*	*95% Confidence Interval*
Perceived drought risk index	0.20**	0.064	0.07 to 0.32	0.34***	0.080	0.19 to 0.50
Past drought experience	-0.16	0.160	-0.48 to 0.15	-0.48*	0.193	-0.86 to -0.10
Belief in scientific info.	0.22**	0.086	0.05 to 0.39	0.30***	0.092	0.12 to 0.48
Belief in local experience-based info.	0.28***	0.084	0.12 to 0.45	0.19*	0.082	0.03 to 0.35
Urban-rural county continuum	-0.09**	0.032	-0.15 to -0.03	-0.02	0.033	-0.08 to 0.04
Outside city or town limits	-0.24	0.170	-0.57 to 0.10	-0.22	0.181	-0.58 to 0.13
Female	0.15	0.140	-0.13 to 0.42	-0.02	0.148	-0.31 to 0.27
4-year college degree +	0.06	0.148	-0.23 to 0.35	0.22	0.157	-0.08 to 0.53
Political party affiliation						
Republican [reference]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Democrat	-0.07	0.179	-0.42 to 0.28	-0.06	0.177	-0.41 to 0.29
Independent	-0.21	0.174	-0.56 to 0.13	-0.12	0.180	-0.47 to 0.23
Constant	5.09***	0.560	4.28 to 6.37	3.49***	0.569	2.63 to 4.80
R^2	17.54***			23.68***		
N	448			420		

Note: *p<.05; **p<.01; ***p<.001 (two-tailed).

hypothesis (H3) than I had with the prior adaptive capacity models. At both spatial levels, those who resided in more rural counties and those living in homes outside city or town limits had significantly lower perceptions of regional adaptation ability ($p<0.01$ and $p<0.05$ respectively). In contrast with the Table 4 models, these results strongly support my fourth hypothesis (H4). Overall, the community-level model with all predictors included produced an adjusted R^2 value of 21.25 ($p<0.001$), and the regional-level model produced an adjusted R^2 value of 19.95 ($p<0.001$).

CONCLUSION

Due to social and environmental factors, certain communities and regions are potentially more vulnerable to the impacts of climate-change-induced drought than other communities and regions. This study contributes to research on adaptation to climate-change-induced drought by examining predictors of perceived drought risk and two measures of perceived adaptive capacity to drought in Nebraska. Overall, I found that those with higher perceived drought risk tended to be those with past drought experience, those with higher levels of belief in scientific information, those who live in more rural counties, and those who live outside of city or town limits. These findings mostly supported my hypotheses.

However, my two measures of adaptive capacity produced somewhat conflicting results. Those with higher perceived adaptation efficacy tended to be those reporting higher perceived drought risk, those with higher levels of belief in scientific information, those with higher levels of belief in local information, and those who live in less rural counties (only in the community-level model). These findings suggest that three of my four hypotheses were mostly supported. Past drought experience was a negative predictor of perceived regional adaptation efficacy, which provided evidence against one of my hypotheses.

In looking at my second measure of adaptive capacity, those with lower perceived adaptation ability tended to be those reporting higher perceived drought risk, those who live in more rural counties, and those who live outside of city or town limits. This provides evidence against my hypothesis on the relationship between perceived drought risk and perceived adaptive capacity and support for my hypotheses on the relationship between rurality and perceived adaptive capacity and on the relationship between past drought experience and perceived adaptive capacity.

Table 5. OLS Regression Analyses Predicting Perceived Adaptation Ability Index for Community-level and Regional-level Models

	Community-level Model			Regional-level Model		
Independent Variables	*B*	*St. Error*	*95% Confidence Interval*	*B*	*St. Error*	*95% Confidence Interval*
Perceived drought risk index	-0.57***	0.071	-0.71 to -0.43	-0.50***	0.080	-0.66 to -0.34
Past drought experience	0.84***	0.210	0.43 to 1.26	0.61**	0.219	0.18 to 1.04
Belief in scientific info.	0.07	0.126	-0.18 to 0.31	-0.20	0.114	-0.42 to 0.03
Belief in local experience-based info.	0.13	0.111	-0.09 to 0.35	0.26**	0.100	0.07 to 0.46
Urban-rural county continuum	-0.11**	0.038	-0.19 to -0.03	-0.11**	0.039	-0.18 to -0.03
Outside city or town limits	-0.48*	0.203	-0.88 to -0.08	-0.54*	0.225	-0.98 to -0.10
Female	0.11	0.188	-0.26 to 0.48	-0.20	0.199	-0.59 to 0.19
4-year college degree +	0.15	0.193	-0.23 to 0.53	0.10	0.201	-0.29 to 0.50
Political party affiliation						
Republican [reference]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Democrat	-0.26	0.235	-0.72 to 0.20	-0.18	0.252	-0.67 to 0.32
Independent	-0.18	0.228	-0.63 to 0.27	-0.11	0.242	-0.58 to 0.37
Constant	8.72***	0.681	7.88 to 10.51	9.16***	0.741	8.36 to 11.05
R^2	21.25***			19.95***		
N	448			420		

Note: *p<.05; **p<.01; ***p<.001 (two-tailed).

This study's findings suggest the importance of distinguishing risk perceptions from adaptation perceptions, and perceived adaptation efficacy from other forms of adaptive capacity. These results suggest that perceived risk, perceived adaptation efficacy, and perceived adaptation ability are not always impacted in the same ways by the same variables. For example, in this study of Nebraska residents, past drought experience positively predicted perceived drought risk and regional perceived adaptation ability, but negatively predicted regional perceived adaptation efficacy. Similarly, perceived drought risk positively predicted community and regional-level perceived adaptation efficacy, but negatively predicted perceived adaptation ability at both spatial levels. Of particular concern to readers of this journal is the relationship between rurality and perceived drought risk and between rurality and both measures of perceived adaptive capacity. Rural residents, defined as both those living in more rural communities and those living outside of city or town limits, tended to have higher perceptions of drought risk for their communities and region, but lower perceptions of adaptation efficacy at the community level and lower perceptions of adaptation ability at the community and regional levels. According to Grothmann and Patt (2005), high levels of risk perception and low levels of perceived adaptive capacity can result in avoidant maladaptation, including fatalism, denial, and wishful thinking.

These findings are limited in several ways that can be potentially improved upon in future research. Because of concerns about respondents' burden, the broader survey from which these data were drawn only included a few items related to each measure of perceived risk and adaptive capacity. Similarly, my measures of belief in different sources of information and past drought experience relied on single item measures. All of my key variables – perceptions of drought risk, adaptive capacity, past drought experience, trust in different sources of information, and rurality – represent complex concepts that could potentially be improved by the inclusion of more items in their measurement. In particular, for my perceived risk indices, my low alpha levels measuring index reliability may have been improved by the inclusion of more items (Willits et al. 2016). However, researchers often have to balance the researchers' desire to ask more questions against the potential impacts of more questions on respondents.

My selection of state and spatial levels may also limit the generalizability of this study. While the use of two ecologically and socially different regions provides credibility to the findings in this study, it is possible that research on other states in the United States or other countries may not produce similar findings. In addition, this research does not provide us with insight as to how perceived drought risk and perceived adaptive capacity to drought relate to objective measures of adaptive capacity to drought or actual adaptation responses to drought. Further exploration of these issues, with both qualitative and quantitative analyses, would be beneficial to policy-makers and scholars.

A high percentage of respondents, particularly women, provided "not sure" responses to a few items within the perceived drought risk and perceived adaptive capacity to drought measures. While a thorough discussion of these nonsubstantive responses is beyond the scope of this article, past research suggesting that women typically have higher climate change risk perceptions (e.g. Leiserowitz 2006), so further consideration of these responses may be useful for improving our understanding of perceptions of drought risk, adaptive capacity, and actual adaptation responses.

In terms of measurement issues, questionnaires in this study allowed respondents to independently define "community" (though over 90 percent of residents selected the city or town where they receive their postal mail), but, using an attached map (Figure 1), I provided specific boundaries for "region" in order to reduce cognitive burden for respondents. An interactional approach suggests that a community or region's boundaries are "continually redefined through the process of interaction and collective action" (Flint, Luloff, and Theodori 2010, p. 29). It is unclear whether the specified boundaries would overlap appropriately with regional boundaries defined independently by residents. In addition, results at the community level and regional level were nearly identical. It is possible that the relationships functioned in similar ways at these two spatial levels; however, as one reviewer noted, it is also possible that the distinction between community-level perceptions and regional-level perceptions was trivial for at least some of the respondents. Further analysis is needed to better explore this issue.

Scientists have recently been called upon to translate their broader findings into adaptation strategies for residents dealing with changing climatic conditions (Molnar 2010). However, a common frustration seems to be that proposed strategies are not necessarily matched with the local ecological and social context within which people live. Though local knowledge is valued in academic work on adaptive management (Berkes, Colding, and Folke 2000), researchers have not sufficiently clarified what "local" expertise means for residents of rural and urban areas. Rural and urban communities not only face potentially different vulnerabilities to climate change, but also different challenges building adaptive capacity to respond to the impacts of climate change. However, strengthening belief in scientific information and local experience-based information seems to suggest at least one opportunity for increasing perceived adaptive capacity, even when controlling for rural/urban residence.

ENDNOTES

[1] As one reviewer noted, this question is potentially problematic in that it does not allow the researcher to disentangle a respondent's belief in this information helping decision makers *prepare for* climate change impacts versus helping them *cope with* climate change impacts.

ACKNOWLEDGMENTS

The authors would like to thank Don A. Dillman, Jolene D. Smyth, the Social and Economic Sciences Research Center at Washington State University, and the Bureau of Sociological Research at the University of Nebraska-Lincoln for their contributions.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

FUNDING

Data for this research was collected at Washington State University under a Cooperative Agreement from the U.S. Department of Agriculture – National Agricultural Statistics Service and the National Science Foundation Division of Science Resources Statistics [#43-3AEU-5-80039 to Don A. Dillman]. Additional support for data collection was provided by the Social and Economic Sciences Research Center.

REFERENCES

Adger, W. Neil, Shardul Agrawala, M. Monirul Qader Mirza, Cecilia Conde, Karen O'Brien, Juan Pulhin, Roger Pulwarty, Barry Smit, and Kiyoshi Takahashi. 2007. "Assessment of Adaptation Practices, Options, Constraints and Capacity." Pp. 717-743 in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by Martin Parry, Osvaldo Canziani, Jean Palutikof, Paul van der Linden, and Clair Hanson. Cambridge, UK: Cambridge University Press.

Arbuckle, Jr., J. Gordon, Lois Wright Morton, and Jon Hobbs. 2015. "Understanding Farmer Perspectives on Climate Change Adaptation and Mitigation: The Roles of Trust in Sources of Climate Information, Climate Change Beliefs, and Perceived Risk." *Environment and Behavior* 47(2):205-234. doi:10.1177/0013916513503832

Berkes, Fikret, Johan Colding, and Carl Folke. 2000. "Rediscovery of Traditional Ecological Knowledge as Adaptive Management." *Ecological Applications* 10(5):1251-1262.

Boudet, Hilary, Christopher Clarke, Dylan Bugden, Edward Maibach, Connie Roser-Renouf, and Anthony Leiserowitz. 2014. "'Fracking' Controversy and Communication: Using National Survey Data to Understand Public Perceptions of Hydraulic Fracturing." *Energy Policy* 65:57-67. doi:10.1016/j.enpol.2013.10.017

Burch, Sarah, and John Robinson. 2007. "A Framework for Explaining the Links between Capacity and Action in Response to Global Climate Change." *Climate Policy* (4):304-316. doi:10.1080/14693062.2007.9685658

Dillman, Don A., Jolene D. Smyth, and Leah M. Christian. 2014. *Internet, Phone, Mail, and Mixed-mode Surveys: The Tailored Design Method.* 4th ed. Hoboken, NJ: John Wiley & Sons, Inc.

Edwards, Michelle L. 2014. "An Experimental Test of the Effects of Survey Sponsorship on Internet and Mail Survey Response." *Public Opinion Quarterly* 78(3):734-750. doi:10.1093/poq/nfu027

Engle, Nathan L. 2011. "Adaptive Capacity and Its Assessment." *Global Environmental Change* 21(2):647-656. doi:10.1016/j.gloenvcha.2011.01.019

Flint, Courtney G., A.E. Luloff, and Gene L. Theodori. 2010. "Extending the Concept of Community Interaction to Explore Regional Community Fields." *Journal of Rural Social Sciences* 25(1):22-36.

Freshwater, David. 2015. "Vulnerability and Resilience: Two Dimensions of Rurality." *Sociologia Ruralis* 55(4):497-515. doi:10.1111/soru.12090

Grothmann, Torsten, and Anthony Patt. 2005. "Adaptive Capacity and Human Cognition: The Process of Individual Adaptation to Climate Change." *Global Environmental Change* 15(3):199-213. doi:10.1016/j.gloenvcha.2005.01.002

Henry, Adam D., and Thomas Dietz. 2011. "Information, Networks, and the Complexity of Trust in Commons Governance." *International Journal of the Commons* 5(2):188-212. doi:10.18352/ijc.312

Homsy, George C., and Mildred E. Warner. 2013. "Climate Change and the Co-production of Knowledge and Policy in Rural USA Communities." *Sociologia Ruralis* 53(3):291-310. doi:10.1111/soru.12013

Hultman, Nathan E., David M. Hassenzahl, and Steve Rayner. 2010. "Climate Risk." *Annual Review of Environment and Resources* 35:283-303. doi:10.1146/annurev.environ.051308.084029

Ivey, Janet L., John Smithers, Rob C. De Loë, and Reid D. Kreutzwiser. 2004. "Community Capacity for Adaptation to Climate-induced Water Shortages: Linking Institutional Complexity and Local Actors." *Environmental Management* 33(1):36-47. doi:10.1007/s00267-003-0014-5

Juhola, Sirkku, Lasse Peltonen, and Petteri Niemi. 2012. "The Ability of Nordic Countries to Adapt to Climate Change: Assessing Adaptive Capacity at the Regional Level." *Local Environment* 17(6-7):717-734. doi:10.1080/13549839.2012.665861

King, David A. 2004. "Climate Change Science: Adapt, Mitigate, or Ignore?" *Science* 303(5655):176-177. doi:10.1126/science.1094329

Lal, Pankaj, Janaki R. R. Alavalapati, and Evan D. Mercer. 2011. "Socio-economic Impacts of Climate Change on Rural United States." *Mitigation and Adaptation Strategies for Global Change* 16(7):819-844. doi:10.1007/s11027-011-9295-9

Lazrus, Heather. 2016. "'Drought is a Relative Term': Drought Risk Perceptions and Water Management Preferences among Diverse Community Members in Oklahoma, USA." *Human Ecology* 44:595-605. doi:10.1007/s10745-016-9840-y

Leiserowitz, Anthony. 2006. "Climate Change Risk Perception and Policy Preferences: The Role of Affect, Imagery, and Values." *Climatic Change* 77:45-72. doi:10.1007/s10584-006-9059-9

López-Marrero, Tania, and Brent Yarnal. 2010. "Putting Adaptive Capacity into the Context of People's Lives: A Case Study of Two Flood-Prone Communities in Puerto Rico." *Natural Hazards* 52:277-297. doi:10.1007/s11069-009-9370-7

Messer, Benjamin L., and Don A. Dillman. 2011. "Surveying the General Public over the Internet Using Addressed-based Sampling and Mail Contact Procedures." *Public Opinion Quarterly* 75(3):429-457. doi:10.1093/poq/nfr021

Molnar, Joseph J. 2010. "Climate Change and Societal Response: Livelihoods, Communities, and the Environment." *Rural Sociology* 75(1):1-16. doi:10.1111/j.1549-0831.2010.00011.x

Muller, Joy C.-Y. 2014. "Adapting to Climate Change and Addressing Drought – Learning from the Red Cross Red Crescent Experiences in the Horn of Africa." *Weather and Climate Extremes* 3:31-36. doi:10.1016/j.wace.2014.03.009

Nebraska Climate Assessment Response Committee. 2000. "Drought Mitigation and Response Plan." Retrieved January 5, 2017 (http://www.carc.nebraska.gov/docs/NebraskaDrought.pdf).

O'Brien, Karen, Linda Sygna, and Jan Erik Haugen. 2004. "Vulnerable or Resilient? A Multi-scale Assessment of Climate Impacts and Vulnerability in Norway." *Climatic Change* 64(1-2):193-225. doi:10.1023/B:CLIM.0000024668.70143.80

O'Brien, Robert M. 2007. "A Caution Regarding Rules of Thumb for Variance Inflation Factors." *Quality and Quantity* 41(5):673-690. doi:10.1007/s11135-006-9018-6

Polsky, Colin, and David W. Cash. 2005. "Drought, Climate Change, and Vulnerability: The Role of Science and Technology in a Multi-scale, Multi-stressor World." Pp. 215-245 in *Drought and Water Crises: Science, Technology, and Management Issues*, edited by D.A. Wilhite. New York: Taylor & Francis Group.

Prelog, Andrew J., and Lee M. Miller. 2013. "Perceptions of Disaster Risk and Vulnerability in Rural Texas." *Journal of Rural Social Sciences* 28(3):1-31.

Rogers, Ronald W. 1983. "Cognitive and Physiological Processes in Fear Appeals and Attitude Change: A Revised Theory of Protection Motivation." Pp. 153-176 in *Social Psychophysiology: A Sourcebook*, edited by J. T. Cacioppo & R. E. Petty. New York: The Guilford Press.

Rosa, Eugene. 1998. "Metatheoretical Foundations for Post-normal Risk." *Journal of Risk Research* 1(1):15-44. doi:10.1080/136698798377303

Sivakumar, Mannava V. K., Robert Stefanski, Mohamed Bazza, Sergio Zelaya, Donald Wilhite, and Antonio Rocha Magalhaes. 2014. "High Level Meeting on National

Drought Policy: Summary and Major Outcomes." *Weather and Climate Extremes* 3:126-132. doi:10.1016/j.wace.2014.03.007

Slovic, Paul. 1987. "Perception of Risk." *Science* 236(4799):280-285. doi:10.1126/science.3563507

Slovic, Paul. 2000. *The Perception of Risk.* New York: Earthscan.

Smit, Barry, and Johanna Wandel. 2006. "Adaptation, Adaptive Capacity and Vulnerability." *Global Environmental Change* 16(3):282-292. doi:10.1016/j.gloenvcha.2006.03.008

Smith, Jordan W., Dorothy H. Anderson, and Roger L. Moore. 2012. "Social Capital, Place Meanings, and Perceived Resilience to Climate Change." *Rural Sociology* 77(3):380-407. doi:10.1111/j.1549-0831.2012.00082.x

Van Liew, Michael. W., S. Feng, and T. B. Pathak. 2012. "Climate Change Impacts on Streamflow, Water Quality, and Best Management Practices for the Shell and Logan Creek Watersheds in Nebraska, USA." *International Journal of Agricultural & Biological Engineering* 5(1):13-34. doi:10.3965/j.ijabe.20120501.003

Wilhelmi, Olga V., and Donald A. Wilhite. 2002. "Assessing Vulnerability to Agricultural Drought: A Nebraska Case Study." *Drought Mitigation Center Faculty Publications,* Paper 9. Retrieved January 5, 2017 (http://digitalcommons.unl.edu/droughtfacpub/9).

Wilhite, Donald A., and Margie Buchanan-Smith. 2005. "Drought as Hazard: Understanding the Natural and Social Context." Pp. 3-29 in *Drought and Water Crises: Science, Technology, and Management Issues*, edited by D. A. Wilhite. New York: Taylor & Francis Group.

Wilhite, Donald A., Mannava V. K. Sivakumar, and Roger Pulwarty. 2014. "Managing Drought Risk in a Changing Climate: The Role of National Drought Policy." *Weather and Climate Extremes* 3:4-13. doi:10.1016/j.wace.2014.01.002

Willits, Fern K., Gene L. Theodori, and A. E. Luloff. 2016a. "Self-reported Familiarity of Hydraulic Fracturing and Support for Natural Gas Drilling: Substantive and Methodological Considerations." *Journal of Rural Social Sciences* 31(1):83-101.

Willits, Fern K., Gene L. Theodori, and A. E. Luloff. 2016b. "Another Look at Likert Scales." *Journal of Rural Social Sciences* 31(3):126-139.

Wynne, Brian. 1996. "May the Sheep Safely Graze? A Reflexive View of the Expert-lay Knowledge Divide." Pp. 44-83 in *Risk, Environment, and Modernity*, edited by Scott Lash, Bronislaw Szerszynski, and Brian Wynne. Thousand Oaks, CA: Sage Publications Inc.