



Agricultural trade publications and the 2012 Midwestern U.S. drought: A missed opportunity for climate risk communication



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ABSTRACT

The Midwestern United States experienced a devastating drought in 2012, leading to reduced corn and soybean yields and increased instances of pests and disease. Climate change induced weather variability and extremes are expected to increase in the future, and have and will continue to impact the agricultural sector. This study investigated how agricultural trade publications portrayed the 2012 U.S. Midwestern drought, whether climate change was associated with drought, and whether these publications laid out transformative adaptation measures farmers could undertake in order to increase their adaptive capacity for future climate uncertainty. We performed a content analysis of 1000 media reports between April 1, 2012 and March 31, 2014, sampled from ten agricultural trade publications. The results lead us to suggest that trade publications' 2012 U.S. Midwestern drought discussion lacked information that would allow farmers and agricultural advisors to assess climate change risk and subsequent potential adaptive management strategies. Agricultural risk from climate change is very real, and farmers will need to adapt. The agricultural trade publications studied missed an opportunity to convey risk from climate change and the transformative adaptation practices necessary for a sustainable and resilient agricultural system.

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1. Introduction

The Midwestern United States experienced extreme drought in 2012 that adversely impacted Corn Belt farmers. Although this event itself was not found to be connected to climate change¹ (Peterson et al., 2013), climate variability and extremes due

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¹ Reported in a July 2013 AgriNews article, Kevin Trenberth of the National Center for Atmospheric Research took issue with aspects of the Peterson report. For example, Trenberth noted that the report did not account for snowfall deficits in the Rockies during the 2011 winter or the climate change exacerbated high pressure system that staved off rainfall. He stated, "This was a natural variability exacerbated by global warming..." (AgriNews, 2013).

to climate change have been observed across the country and will continue to occur in the future (Melillo et al., 2014). It is helpful to examine how the farm media portrayed this event, as farmers use farm media sources for farming information (Batte et al., 1990; Ford and Babb, 1989; Gloy et al., 2000; Schnitkey et al., 1992) and the media plays a role in interpreting risks (Kasperson and Kasperson, 1996; Wachinger et al., 2013) such as those that stem from drought and climate change. The frequency and intensity of extreme precipitation events are projected to increase for all U.S. regions, and increased summer dryness across most areas of the contiguous U.S. are projected (Walsh et al., 2014). It is predicted that climate change induced weather extremes – extreme heat, severe drought, and heavy precipitation – will have significant impacts on agriculture. For example, by 2050, yields of most major U.S. crops are expected to be in decline (Hatfield et al., 2014). Across the U.S. Midwestern Corn Belt, the frequency of extreme daily precipitation events (a daily amount that now occurs once in 20 years) is projected to increase by the years 2081 – 2100 as compared with 1981 – 2000 (Hatfield et al., 2014). More rain and heavy precipitation events will exacerbate soil erosion and nutrient runoff issues. At the same time, less overall rainfall is expected in the summer when the Corn Belt's predominantly rain-fed agriculture is in most need of moisture. Increased rainfall in the winter, spring and autumn could, in turn, have an adverse effect on planting and harvest activities (Hatfield et al., 2014). Examining how the farm media portrayed the 2012 U.S. Midwestern drought can provide insights into the messaging farmers received in relation to such an extreme event and whether advice toward the advancement of climate adaptive farming was promoted.

Common agricultural adaptation strategies such as irrigation installation, shifting crop selections, pesticide and fertilizer management, changes in tillage practices, and changes in the timing of key field practices are already used by many farmers to cope with variable climate conditions (Hatfield et al., 2014). These practices will provide some capacity to address the immediate projected impacts of climate change on U.S. agriculture. However, long-term adaptation must include more transformative measures that focus on redesigning agricultural systems for ecological resilience and sustainability. Such measures will include strategies such as diversifying crop rotations, improving soil health, reducing external inputs (especially fossil fuel based inputs), and reintegrating animals into cropping systems (Lin, 2011; Tomich et al., 2011; Wall and Smit, 2005). Without farmer belief that significant changes in the climate are likely to occur, their perceived risks from climate change will remain low, and they will have little willingness to transform their agricultural systems according to these strategies (Howden et al., 2007). Research supports the hypothesis that higher perceived risk from climate change is associated with higher levels of willingness to adapt to climate change (Agho et al., 2010; O'Connor et al., 1999; O'Connor et al., 2005; Syal et al., 2011; Weber and Stern, 2011). For example, Arbuckle et al. (2013) found that climate change beliefs were a significant influence on several factors such as perception of climate risk, willingness to use climate information, and an inclination to plan for risk or adaptive farming practices.

There are many factors that influence farmers' willingness to adopt adaptive or conservation farming practices, including perceptions of costs, benefits, and risks (Baumgart-Getz et al., 2012; Prokopy et al., 2008; Ryan et al., 2003; Wheeler et al., 2013), as well as social aspects such as farmer attitudes and identity (McGuire et al., 2013; Reimer et al., 2012; Thompson et al., 2015), and what practices trusted sources of information recommend (Floress et al., 2015). Direct personal experience is also seen as one way in which individuals interpret the degree of risk that may lead to risk responsive behavior such as adaptive farming practices (Kasperson et al., 1988; Kasperson and Kasperson, 1996). However, existing research about the impacts of extreme climate events and how they affect action is conflicting (e.g., O'Connor et al., 2005; Whitmarsh, 2008). For example, Carlton et al. (2016) found that direct experience of the 2012 U.S. Midwestern drought did not change agricultural advisors' climate change beliefs and attitudes toward climate adaptation, but they did find advisors were more concerned about specific risks like drought and pests. Individuals' processes of risk interpretation are complex. In one framework, the Social Amplification of Risk, social sources that include indirect communication from news media and social networks, in addition to personal experience of a hazard or risk, is posited to amplify or reduce individuals' perceptions of a particular risk (Kasperson et al., 1988). According to this framework, the news media transmit risk messages such as accounts of drought impacts and subsequent responses. People interpret these messages and then evaluate their risk response (Kasperson and Kasperson, 1996; Wachinger et al., 2013).

Here, we explore the idea of the “news media” as a “channel of amplification,” theorized to either increase or reduce individuals' perceptions of risk that could lead to changes in beliefs and behavioral intent. Specifically, we look at the potential role of agricultural trade publications as a “channel of amplification” for climate change risk that might then translate to changes in climate change risk perceptions. We ask: *How did agricultural trade publications convey messages on drought and climate change during and following the 2012 U.S. Midwestern drought?* We seek to discover how agricultural trade publications portrayed the 2012 U.S. Midwestern drought, whether the publications associated climate change with the drought, and whether the publications laid out transformative adaptation measures farmers could undertake to increase their adaptive capacity for future climate uncertainty. In the following pages we discuss the role of news media as a channel of risk amplification/attenuation and follow with our data collection approach and results.

2. Influence of news media on risk perception

News media coverage of an issue can affect how people conceive of an issue or story generally (Scheufele, 1999). In order to cover a story, media must distill it into the parts they deem most salient and interesting to their audience, a process referred to as “framing” (Entman, 1993). By choosing what language to use and what perspectives to include, the framing process inherently promotes a specific interpretation of the story at the expense of other potential interpretations (Shah

et al., 2002). People use frames as heuristics to help interpret their perceptions (Elliott, 2003). Thus, media framing can have real-world effects on how people think about the news. Indeed, framing drastically affects how individuals assign blame for public problems (Iyengar, 1991), how people evaluate risk (Kahneman and Tversky, 1984), and the manner in which people understand different aspects of a story, which may influence their attitudes or behaviors (Fiske and Taylor, 1991; Siemer et al., 2007).

There are many inputs that feed into one's perceptions of risk (e.g., political views, social norms, strongly held ideals, etc.) and thus there is not universal agreement on the degree of influence of media on risk perception specifically (Wahlberg and Sjöberg, 2000; Wakefield and Elliott, 2003). Some research has found that media coverage correlates to public perception of climate change or another particular risk. For example, through a study that linked public opinion surveys and media coverage of climate change, Brulle et al. (2012) found that media coverage had a direct effect on level of climate change concern, as did coverage of climate change controversy as conveyed by politicians. In a similar study, Sampei and Aoyagi-Usui (2009) found that public awareness of "global warming" reported through public polling increased during media coverage of the topic, as did the number of people who said global warming was "the most serious issue in the world" (Sampei and Aoyagi-Usui, 2009, p.210). A different study showed that public perceptions of risk associated with genetically modified organisms (GMOs) increased when media attention on the subject also increased (Frewer et al., 2002). Each of these studies found that perceptions of increased risk declined after the height of media coverage, thus media risk coverage may only entail a short-term effect on awareness of and potential amplification of that risk.

Contrary to the idea that media influences risk perception, Gore et al. (2005) found that news media coverage of a black bear-related human fatality increased public awareness of the event but did not increase perceived risk associated with black bears. The authors contend that this deficit of perceived risk was due to the news media repeatedly reporting that black bear encounters are rare, which reinforced the public's existing perceptions that black bear encounters are not a risk about which to worry. Moreover, in a study of local newspaper coverage of the siting of an industrial waste landfill, researchers found that although the newspapers were a valuable source of site-specific information, *people* were a more trusted information source in terms of interpreting risk associated with the landfill (Wakefield and Elliott, 2003).

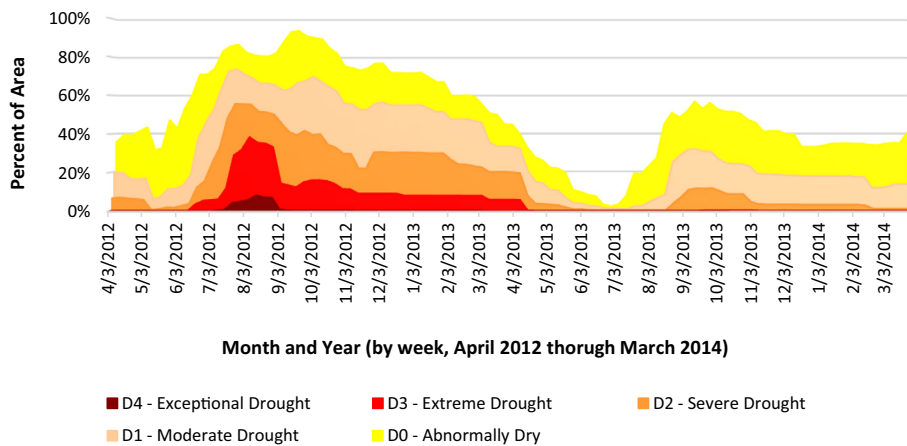
2.1. Agricultural trade publications as an information source

Research that looks at farmer preferences for information shows that farmers prefer and are influenced by agricultural information from personal sources (Davidson et al., 2015; Ford and Babb, 1989; Gloy et al., 2000; Tarnoczi and Berkes, 2010). However, agricultural trade publications are also considered to be useful sources of agricultural information (Batte et al., 1990; Ford and Babb, 1989; Gloy et al., 2000; Schnitkey et al., 1992), including agronomic, environmental (Bruening et al., 1992) and conservation information (Tucker and Napier, 2002). As a utilized source for agricultural information, agricultural trade publications have a role in conveying messages about drought and climate change information that could help farmers as they evaluate risk and their subsequent risk response. Although there are many studies on farmers' perceptions of various risks and the relationship of these perceptions to changes in attitudes or behaviors (e.g., Carlton et al., 2016; Greiner et al., 2009; Mase and Prokopy, 2014; Tucker and Napier, 2001), we found only two studies that looked specifically at how agricultural trade publications report agricultural risk. These studies showed a tendency for agricultural trade publications to attenuate risk. For example, Abrams and Meyers (2010) found that editors of agricultural publications choose to publish on topics they feel have considerable impact on agriculture (e.g. financial risk, weather risk). Moreover, they tend to provide steps that farmers can take to alleviate the reported risk, thus reducing rather than amplifying risk perceptions. A study on Swedish agricultural trade publications found similar risk attenuation. Climate change was reported as fact and articles included actionable responses to climate change risks (Asplund et al., 2013). If agricultural trade publications are an important agricultural information source, then more research should be conducted about how these publications report on risk. Here, we attempt to fill this research gap.

3. Context – Midwest climate conditions 2012

The study context centers upon the 2012 U.S. Midwestern drought (and the weather conditions immediately before, during, and immediately after) that impacted the twelve states that make up what is considered to be the Midwestern United States: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Throughout the Midwest, the dominant weather features in 2012 were extreme heat and drought (see Fig. 1). Record-breaking, persistent heat in March 2012 jumpstarted plant emergence and contributed to drying soils throughout the region (Fuchs et al., 2012). All twelve Midwestern states, along with the majority of the U.S., experienced their warmest March – May on record (NOAA, 2012). Dry conditions that began showing up in March – May, rapidly intensified into a devastating drought characterized by record-breaking high temperatures and widespread rainfall deficits. These conditions were in stark contrast to the record flooding and saturated soil conditions that plagued the Missouri River and Ohio River Basins within the Corn Belt in 2011 (Fuchs et al., 2012).

Nationally, 2012 was marked by the 6th most spatially expansive drought on record (since 1895) with 37.6% of the continental U.S. listed in severe-extreme drought by July according to the Palmer Drought Severity Index (NCDC, 2012). Within the Midwest specifically, ten of twelve states experienced one of their top five warmest Julys on record (NCDC, 2012).



Source: National Drought Mitigation Center

Fig. 1. Midwestern U.S. Drought Severity, by week of the study time frame.

Nebraska and Kansas experienced their driest May – July, while rainfall totals in Illinois and Missouri ranked third driest and Iowa, and Indiana ranked fourth driest according to observations dating back to 1895 (NCDC, 2012).

These extreme temperature and precipitation conditions led to significant crop losses and other impacts throughout the agricultural sector. Total losses due to drought and heat were estimated at \$31.2 billion, which is the second costliest drought/heatwave event on record (NOAA, n.d.). The Federal Crop Insurance Program paid out a record-breaking \$17.3 billion in crop losses in 2012, with about 80% of those losses attributed to drought, heat, and hot wind (NRDC, 2013). The National Agricultural Statistics Service (NASS) reported that corn yields averaged 123.4 bushels per acre in 2012, down from 147.2 bushels per acre in 2011 (USDA NASS, 2013). USDA Secretarial Disaster declarations were issued for over 2300 counties nationally, including nearly every county in the Midwest due to drought-related conditions (USDA FSA, 2014).

4. Methods

4.1. Sampling strategy

Through a conjunction of expert advice and focus groups with farmers and agricultural advisors, we generated a list of 17 trusted agricultural information sources. This list was subsequently included in a survey distributed to agricultural advisors in 2013 (Carlton et al., 2016), where respondents were asked to rank the level of importance of each information source (from very important to very unimportant). Ten of these information sources were agricultural trade publications, which we subsequently targeted for this study. Four were national in scope, while six were specific to states in which advisor interviews took place:

- National – Farm Journal, The Progressive Farmer, Ag Professional, Corn and Soybean Digest.
- Indiana – Indiana Prairie Farmer, Indiana AgriNews.
- Iowa – Wallaces Farmer, Farm News, Iowa Farmer Today.
- Nebraska – Nebraska Farmer.

Table 1 shows the results of the 2013 survey of the ten agricultural trade publications we included in this content analysis. Nationally distributed publications, The Progressive Farmer and Farm Journal, had a fairly high percentage of agricultural advisors who thought they were “important” or “very important” sources of information. However, the survey results indicate that state-specific agricultural trade publications are generally seen as more important than nationally distributed publications, perhaps because the information is tailored to each region and thus considered more applicable to that area’s agricultural issues.

We selected the population of articles from these publications by searching for those that contained the keyword “drought” within a 24-month timeframe – April 1, 2012 through March 31, 2014 – in order to capture pre- and post-drought discussions. We retrieved 2846 articles and sampled 1000 of these for coding (35.1% of the article population). As the articles were downloaded, we included only those in which the word “drought” was listed in the body of the article.

Table 1

Sources of agricultural information: Percent of Ag advisors in Iowa, Indiana, and Nebraska who selected “Important” or “Very Important” in 2013 survey.

	Iowa	Indiana	Nebraska
Ag Professional	16.5%	27.8%	14.2%
Agrinews	n/a	51.4%	n/a
Corn and Soybean Digest	25.2%	35.1%	16.4%
Farm Journal	48.6%	41.2%	24.6%
Farm News	19.2%	18.8%	19.4%
Indiana Prairie Farmer	n/a	59.6%	n/a
Iowa Farmer Today	53.5%	7.5%	n/a
Nebraska Farmer	n/a	5.9%	41.0%
The Progressive Farmer	45.7%	44.5%	30.6%
Wallace's Farmer	41.6%	11.1%	9.0%

Legend:	State specific for that state	National scope	Top three reported “important” or “very important” publications per state
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For example, advertisements with the keyword “drought” were not included; neither were articles in which “drought” was only included within the title of an article recommended as relevant reading. This procedure led to our sampling frame of 2846 articles.

In previous qualitative media content analysis studies, article populations tend to be small and thus researchers are able to code entire article populations (for example Billett (2010) coded 248 articles and Doulton and Brown (2009) coded 158 articles). In our case, 2846 was too large a number to code in its entirety. We therefore determined that qualitative review of approximately 35% percent (1000) of the total population would be representative of the entire article population (this is consistent with previous studies, e.g. Hurlimann and Dolnicar (2012) and Liu et al. (2008)). To determine the coding sample, we carried out a proportional stratified random sample by month and agricultural trade publication. Thus, the number of articles in the sample ($n = 1000$), sorted by month and magazine, was proportionate to the total number of articles in the whole population ($n = 2846$). We considered it important to include an article for every month if at all possible. Therefore, in the case that a publication had only one article published in a particular month, we kept that article as part of the sample. Subsequently, in order to maintain the sample size, the number of articles to be selected was reduced in a different month. After calculating the number of articles to be selected for each agricultural trade publication in each month, we used R software to randomly select the coding sample articles. Between 32.3% and 38.6% of articles were sampled each month in order to account for a proportionate number of articles sampled per agricultural trade publication. Fig. 2 illustrates our article population and sample by agricultural trade publication. Overall, we sampled an average of 35% of the total article population for each trade publication.

4.2. Coding and analysis

One researcher developed an initial coding framework by reading 150 articles. We conducted two team meetings to ensure the framework captured research questions and article content. To further refine the coding framework, to reduce researcher bias in code development, and to ensure the consistent application of the codebook to text, we then progressed through five stages of inter-coder reliability. In the first round of coding, three coders coded 10 articles independently. After coder training, five additional coders (eight coders total) coded the same 10 articles. This was followed by three iterations of inter-coder reliability tests with the same eight people coding 20 articles independently. We used Cohen's kappa coefficient, which measures level of agreement (where 1 is perfect agreement), to assess the reliability of each coder's interpretation of article content and code meaning as well as to ensure consistent application of the codes to each article. After each round of coding, we held a group meeting to discuss coding discrepancies and differences in code interpretation. In addition, we analyzed individual articles with lower agreement together during team meetings to improve overall coder understanding (Hak and Bernts, 1996). Each codebook revision included clarifications and code usage examples for explicit coding guidance (Guest and MacQueen, 2007). After five rounds of inter-coder reliability coding, we achieved an average team kappa score for all codes and sub codes of 0.71. Table 2 shows final average team kappa scores for each broad code. Following the final round of inter-coder reliability, each team member coded their own assigned articles in order to analyze the entire 1000 article sample.

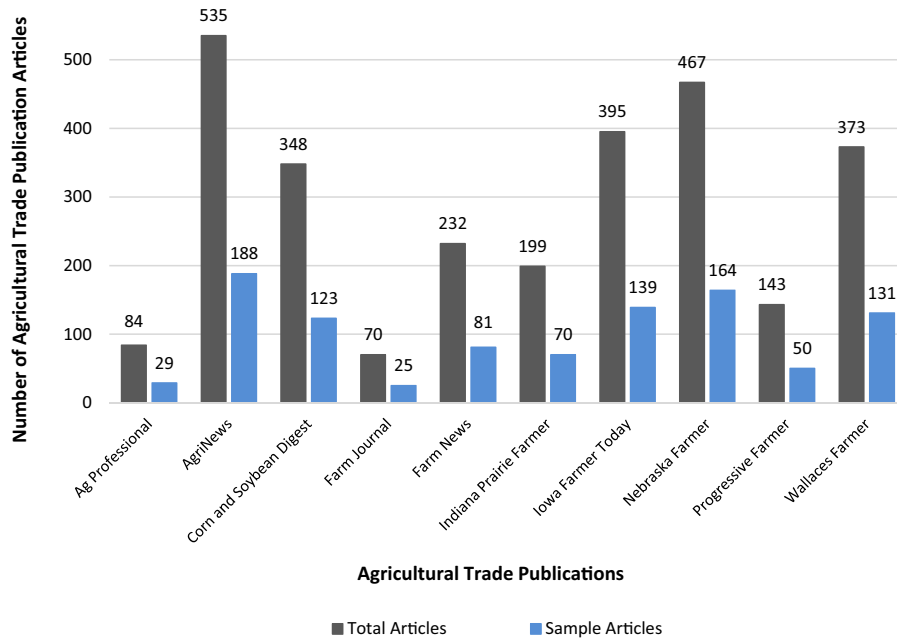


Fig. 2. Number of total population and sampled articles, by agricultural trade publication.

Table 2

Inter-Coder Reliability: Average kappa scores by broad coding category.

Broad Coding Category	Average Kappa Score
Adaptation and risk reduction strategies	0.65
Climate Change Portrayal	1.00
Drought Causes	1.00
Drought Impacts	0.74
Experts Cited	0.75
GHG Mitigation	1.00
No Codes	0.87
Tools and Information	0.52
Weather and/or Climate	0.62
Average of All Codes and Sub codes	0.71

There is some debate as to what constitutes a “good” kappa score. Landis and Koch’s (1997) interpretation of the magnitude of the kappa score is often cited (e.g., Viera and Garrett, 2005; Sun, 2011; Sim and Wright, 2005): 0.41 to 0.60 = “moderate agreement”; 0.61 to 0.80 = “substantial agreement”; and 0.81 to 0.99 = “almost perfect agreement”. Bakeman and Gottman (1986) state that values above 0.70 are considered satisfactory or even good. Similarly, Gardner (1995) recommends that the kappa coefficient should exceed 0.70 before the researcher should proceed with additional data analyses. There are also some who argue that because of the nature of interpreting qualitative data, quantitative measures such as the kappa score should not be used. Rather, it is preferable to rely on team meetings and discussions to develop a shared understanding of code meanings and the application of the codes to text (see Saldaña, 2013; Guest and MacQueen, 2007; Campbell et al., 2011 for examples of “discussion” approaches to inter-coder reliability and agreement).

We combined these approaches, using the kappa score as a coding reliability guide, while utilizing team discussions to develop a shared understanding of the codebook. Due to the extensive coding meetings we had throughout the inter-coder reliability process, as well as our final meeting where we talked through remaining discrepancies until the coding team was in agreement about code interpretation, we are confident in the consistent application of the codebook to the sampled articles. Moreover, as part of our coding procedure, if a coder found a particular article difficult to interpret, that person escalated the article to the team leader for discussion. The overarching coding framework used in our data analysis included the following themes: 1) Adaptation and risk reduction strategies; 2) Climate change portrayal; 3) Drought causes; 4) Drought impacts; 5) Experts cited; 6) GHG mitigation strategies; 7) No codes; 8) Tools and information; 9) Weather and/or climate. The article excerpts that follow are representative of the coded themes. The codebook is included as a supplement to this article.

5. Results

5.1. Overall article population and sample

Through the coding process, we found seven irrelevant articles that were missed during the initial construction of the sampling frame. Therefore, the number of sampled articles was reduced from 1000 to 993, or from 35.1% to 34.9% of the total article population (Fig. 3). Articles were not re-sampled from the total population because we felt that the reduction of the sample size by seven would not adversely impact our findings.

The percentage of articles in our study, looking by year and month, coincides with drought conditions seen in the Mid-western states. As shown in Fig. 1, drought conditions intensified dramatically between June and August of 2012, tapering off by May of 2013. The increased number of articles that contained the keyword “drought” appear to directly correspond to the increased drought conditions.

Looking geographically (see Fig. 4), drought was particularly intense in the specific states in which the sampled trade publications were distributed (Indiana, Iowa, Nebraska). As the months progressed into 2013, drought conditions all but disappeared in Indiana, but lingered in much of the middle of the U.S., including Iowa and Nebraska. The number of articles in our study also declined, but remained high as compared to the beginning and end of the study timeframe. By July 2013, the number of articles in our population and sample reached the lowest number since July 2012, remaining fairly steady from the remainder of the study timeframe. Drought conditions persisted in much of the West, including Nebraska, while conditions returned to normal in the other Midwestern states.

5.2. “Drought” article themes

Looking at overarching coded themes that emerged from the sampled articles, the majority discussed specific drought impacts (66%), followed by adaptation and risk reduction strategies for future uncertainty (37.7%), weather and/or climate (32.1%), and tools and information given as specific suggestions for current drought recovery (13.8%). Fig. 5 shows how these themes were distributed, proportionally by month, over the study timeframe. Articles that discussed drought impacts were dominant and the proportion of articles coded for adaptation strategies fluctuated over the 24-month timeframe. It is notable that the discussions surrounding adaptation strategies declined during peak drought months and had an apparent increase in the months after Peterson et al.'s (2013) report on relationships between extreme events and climate change (report timing illustrated by dotted line in Fig. 5). Articles coded for tools and information increased during the peak of the drought, most likely to help farmers mitigate crop loss. Articles that discussed climate change and drought causes appear to follow a reverse path as compared with the overall sample and majority of the coded themes, with a steady increase from July 2013 until January 2014. This “reversal” makes sense, as the agricultural community was emerging from the impacts of the drought, perhaps stepping back to evaluate what had happened and reflecting on the causes of drought as conditions improved.

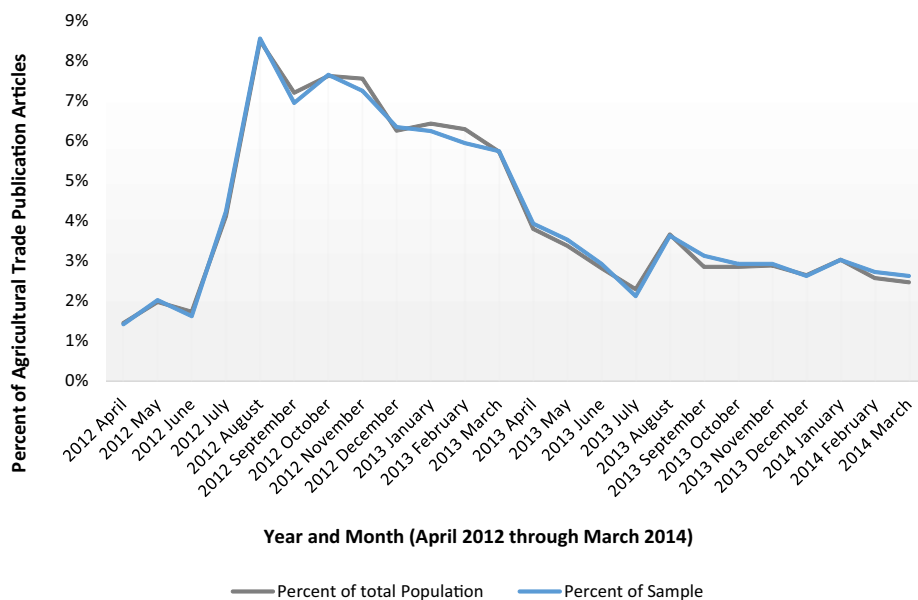


Fig. 3. Percent of total population and sampled agricultural trade publication articles over time.

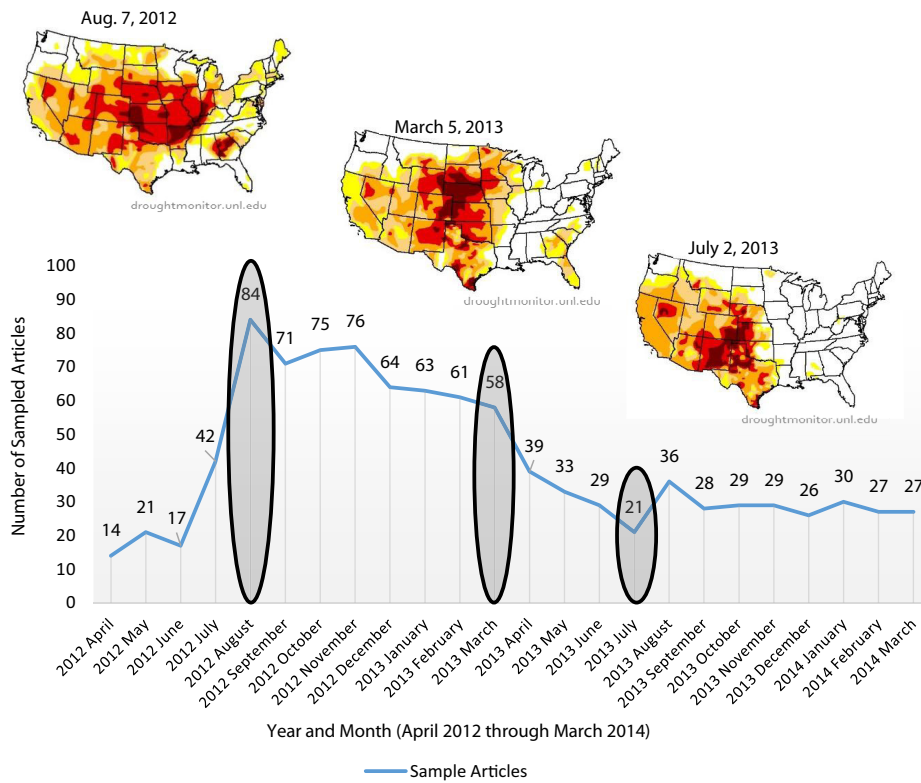


Fig. 4. Article distribution and drought conditions: August 2012, March 2013, and July 2013. (See above-mentioned reference for further information.)

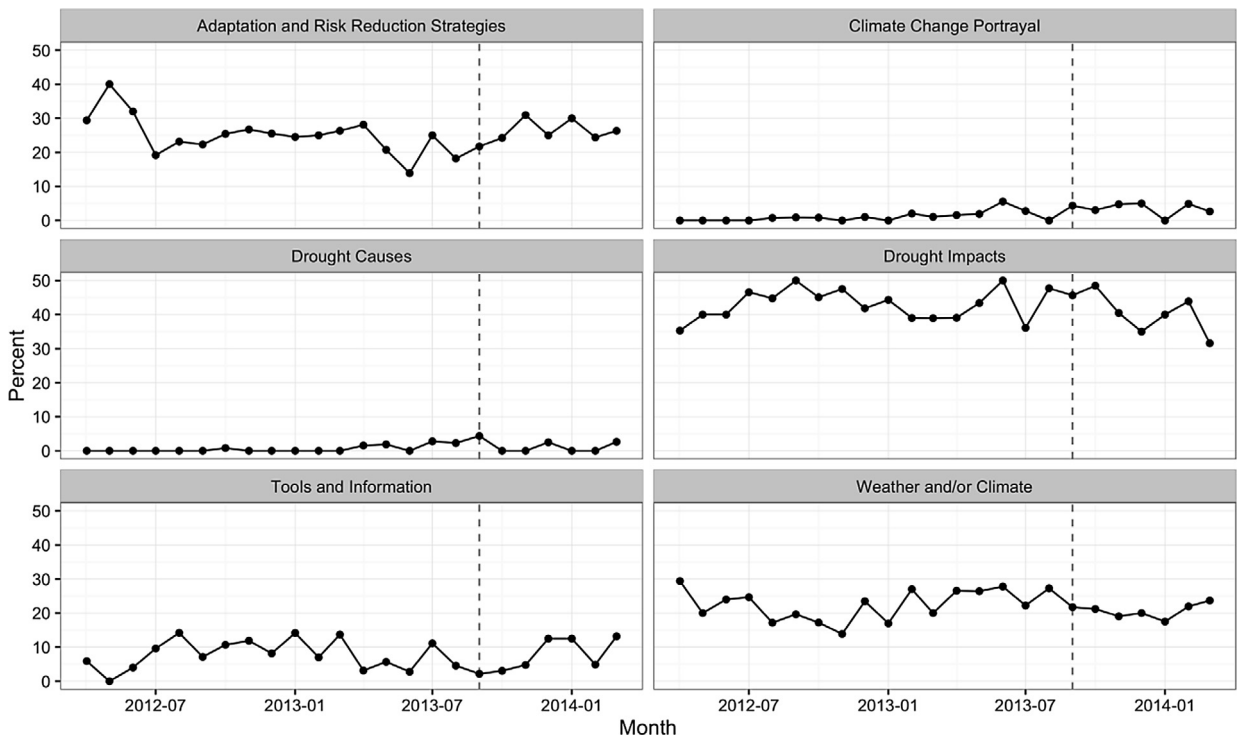


Fig. 5. Monthly comparison of article distribution: Proportion of sample articles coded within overarching themes.

Table 3

Ten most frequent sub codes (excludes experts cited).

Coding Category	Sub Code	# of Articles Coded	% of Sampled Articles	Example Text
Drought Impact	Crop yield	248	25.0%	"USDA recognized the seriousness of the drought impact on crops by making substantive reductions in the crop yields to 146 bushels per acre for corn and 40.5 bpa for soybeans"
Drought Impact	Livestock	211	21.2%	"This year will see another dip in beef production, thanks to an ever-shrinking cow herd, caused in part by severe drought across the Southern Plains states"
Weather and/or Climate	Present weather	162	16.3%	"The very warm weather pattern across the region in late August and early July has reduced the crop maturity concerns for most of the Upper Midwest"
Drought Impact	Commodity prices	142	14.3%	"The disaster means short crops, tall commodity prices and certain-to-rise food prices"
Weather and/or Climate	Past weather	140	14.1%	"What a difference a year makes! March 2012 statewide averaged 54.4 degrees F, 17.7 degrees above normal, the warmest March in Indiana since records started in 1895"
Drought Impact	Crop damage	121	12.2%	"Both corn and soybean growth is being stunted by lack of decent moisture in much of the Midwest. . .The rootless corn has mostly disappeared. A portion of the affected plants finally fell over and got torn lose from its one root"
Drought Impact	Increased costs	93	9.4%	"There are fantastic fed cattle prices out there, and we're going to need them because our input costs are growing,' Ellis said. Profitability will continue to be affected by high feed prices. . ."
Weather and/or Climate	Extreme events	88	8.9%	"Ask most current farmers over 40 years old in the Upper Midwest about the worst drought that they remember, and 1988 would be a common response. However, that could potentially change after this year, as the drought in many areas of the Midwest in 2012 is setting up to be quite severe"
Drought Impact	Other	74	7.5%	"Depression and stress during tough times, like drought, often result in conflicts with spouses and poor parenting that may cause problems for youths in school achievement, peer relations, antisocial behavior, self-confidence, depression and substance misuse"
Drought Impact	Soil moisture	71	7.2%	"Fall tillage has been a little slow to occur in many areas, due the extremely dry topsoil conditions. . .If the dry soil conditions persist through October, it will make for very poor soil conditions for fall applications of anhydrous ammonia fertilizer. . ."

In addition to overarching themes, we coded the sampled articles into smaller, more detailed, themes (sub codes). [Table 3](#) shows the ten most frequently coded sub codes. Each sub code corresponds with only two overarching themes (coding category); drought impact and weather and/or climate. As we will discuss, the overwhelming message that emerged from the agricultural trade publications we reviewed was the impact of the drought on farms/farmers and ranches/ranchers and the weather conditions surrounding the ongoing drought. Although over a third (37.7%) of the sample was coded with the overarching theme "adaptation and risk reduction strategies", there were less articles with adaptation/risk sub codes than each of the ten most frequent sub codes.

[Table 4](#) illustrates examples of the predominant types of adaptation and risk reduction strategies the sampled articles covered. Most of the adaptation and risk reduction strategies discussed in the article sample were geared toward short-term recovery and mitigation of future risk. They involved change, but not necessarily a transformative shift in how farming is conceived. Almost 7 percent of the sampled articles recommended "conservation practices" as a means to reduce future risk due to weather extremes (e.g., drought, dry, hot, wet). Such practices included more common adaptation strategies like changes to tillage practices and implementation of cover crops. While "hybrid seeds" (5.2%) might mitigate yield losses in dry years, strategies such as "crop insurance" (5.1%) and "financial/marketing strategies" (4.0%) work within existing systems rather than considering new systems built on long-term resilience in terms of climate, weather, global economics, and viability of land for future generations. Although the low number of instances of "irrigation" (3.12%) discussed as a method of risk reduction may be due to the overall climate variability found throughout the Midwest, increasing water is an obvious adaptation strategy that could have its own maladaptive issues. A relatively small number of articles discussed the value of "soil health" (3.83%) for long-term farm viability, something that is the foundation of resilient, sustainable agriculture systems and environmental quality ([Doran, 2002](#); [Papendick and Parr, 1992](#); [Tomer et al., 2013](#)).

5.3. Reporting on climate change – is climate change a risk to agriculture?

As discussed, farmers' perceived climate change risk influences their willingness to plan for adaptive farming practices ([Arbuckle et al., 2014](#); [Howden et al., 2007](#)). Using the Social Amplification of Risk Framework, we explored the notion of

Table 4

Example “adaptation and risk reduction strategies” sub codes: Number and percent of sample and overarching theme.

Example Adaptation/Risk Sub Codes	# of Articles Coded	% of Sampled Articles	% of Adaptation/Risk Theme	Example Text
Conservation practices	67	6.75%	17.91%	“Using conservation tillage methods such as no-till and planting cover crops... allowed the ground temperatures on his farm to remain in a healthy range of 80–90 degrees F while bare ground temperatures in tilled fields reached as high as 130 degrees... The cover crops also helped retain higher soil moisture levels to help Brandt produce 168 bu. of corn per acre, compared to around 100 bu./acre many growers using conventional tillage produced as a result of drought...”
Hybrid seeds	52	5.24%	13.90%	“The hybrids, made available to growers under the new DroughtGard Hybrids name, are designed to help farmers mitigate the risk of yield loss when experiencing drought stress, says Mark Edge of Monsanto”
Crop insurance	51	5.14%	13.64%	“Resolve to never say, ‘It can’t happen to me.’ — ‘The 2012 drought was a stark reminder that bad outcomes can come to our farms and businesses. Evaluate and use the tools to help reduce the terrible financial consequences that can come from bad outcomes. Start with a reevaluation of crop insurance alternatives”
Farm management/planning	42	4.23%	11.23%	“We do not have control of the weather or the markets or the cost of inputs used in production, but we can plan our operations to reduce the effects of adverse conditions, both financial and ecological”
Fertility/nutrient management	40	4.03%	10.70%	“Grounded, experienced and reasoned advice on what cultural and fertility steps could help the crops withstand moisture stress next year will be valuable. Years of fertility research in states to the west show that deeper placed nitrogen and phosphate has a big advantage over broadcast material”
Financial/marketing strategy	40	4.03%	10.70%	“Today’s products, if properly matched to the borrower’s risk profile, covers price and yield and guarantees ‘X’ dollars per acre. This normally protects the variable cost of planting the crop. If you can cover out-of-pocket costs, you can live to fight another day”
Soil health	38	3.83%	10.16%	“Most of the pioneers developing soil health systems began with erosion concerns, trying to slow topsoil erosion. But they have evolved from keeping the soil they have to dramatically improving it. To them, healthy soil is at the center of their operation, and the key to everything from reducing crop inputs and runoff to mitigating drought concerns and growing healthier crops”
Testing	38	3.83%	10.16%	“One way to reduce the chances of K deficiency is to maintain soil test levels.” At low or moderate levels, we are almost guaranteed to have a deficiency if we have prolonged dry weather,” Ferrie says. ... During the growing season, tissue analysis will reveal deficiencies. ... With the possibility of another dry season looming in many areas, now’s a good time to learn all you can about the vital nutrient K. ...”
Irrigation	31	3.12%	8.29%	“In spite of an extended drought and limited well capacity, Grall has produced profitable corn yields while going as easy as possible on pumping. ... We’re irrigating for profit, as opposed to huge yields with heavy irrigation. We want the best net income per inch of water applied. ...”
Advisors	19	1.91%	5.08%	“... dry weather and poor yields are reminders of how much N can go unused by corn plants in a drought. ... you should test under all conditions as part of a long-term, successful N management plan. ... Most experts agree that farmers should use a commercial company to do the sampling and talk with a local ag retailer for N recommendations”

Note: Each of the 374 articles coded with the overarching “adaptation/risk management” theme, may also have been coded with more than one sub theme.

“news media” (agricultural trade publications) as a channel of amplification of climate change risk. We thus looked at whether and how climate change was framed within the study articles. Very few of the articles in the article population and sample discussed climate change. Within the article sample, we found 22 (2.2%) articles that discussed “climate change” or “global warming.” It must be noted that our study entailed a sample comprised only of articles that included the word “drought”; more research would be needed for a more comprehensive understanding of the “climate change” discussion with all articles in the study timeframe.

Fig. 6 illustrates the proportion of the sample articles coded for climate change portrayal over the study timeframe. The discussion of these “climate change” coded articles appear to correspond with the overarching coded themes and trajectory of the drought over the study timeframe. Climate change was discussed in very few articles, however the majority of those that included the words climate change referred to it in a way that conveyed the concept as a fact; that climate change is occurring. This presentation was then followed by steps pertinent to farmer or agricultural adaptation strategies under future climate uncertainty (see Table 5 for example statements for climate change sub codes).

Articles that included climate change content began to appear in August and September 2012. These articles contained drought impacts as the primary discussion point. Climate change was a minor if not almost invisible aspect of these articles. In October, the 2012 Midwestern drought was a trigger for a discussion on agriculture resilience:

“...we need to design systems for resilience, instead of designing them only for maximum, efficient production for short-term economic return, which is the singular goal of industrial agriculture. ...We cannot meet the challenges ahead by simply doing more of what we have been doing. The transition we have to anticipate will require some of the most-creative and imaginative thinking and research we have ever done” (Kierschenmann, 2012).

However, a December article negated climate change and told readers to manage for drought (not climate change) “in spite of doomsday sayers who promote climate change” (Nanda, 2012, p.8). By February of 2013, the few articles that reported on climate change used the phenomenon to discuss related adaptation strategies such as multicropping, irrigation, water management systems, and conservation practices like no-till farming and cover crops. These discussions corresponded to declining drought conditions. In September 2013, Peterson et al.’s (2013) report on relationships between 2012 extreme events and climate change was released, thus several articles in the latter part of the study timeframe reported that the 2012 Midwestern drought was not caused by climate change. Moreover, two articles in this time frame seem to downplay climate change risk by stating farmers have always adapted and will continue to be able to adapt to future climate variations and associated risks.

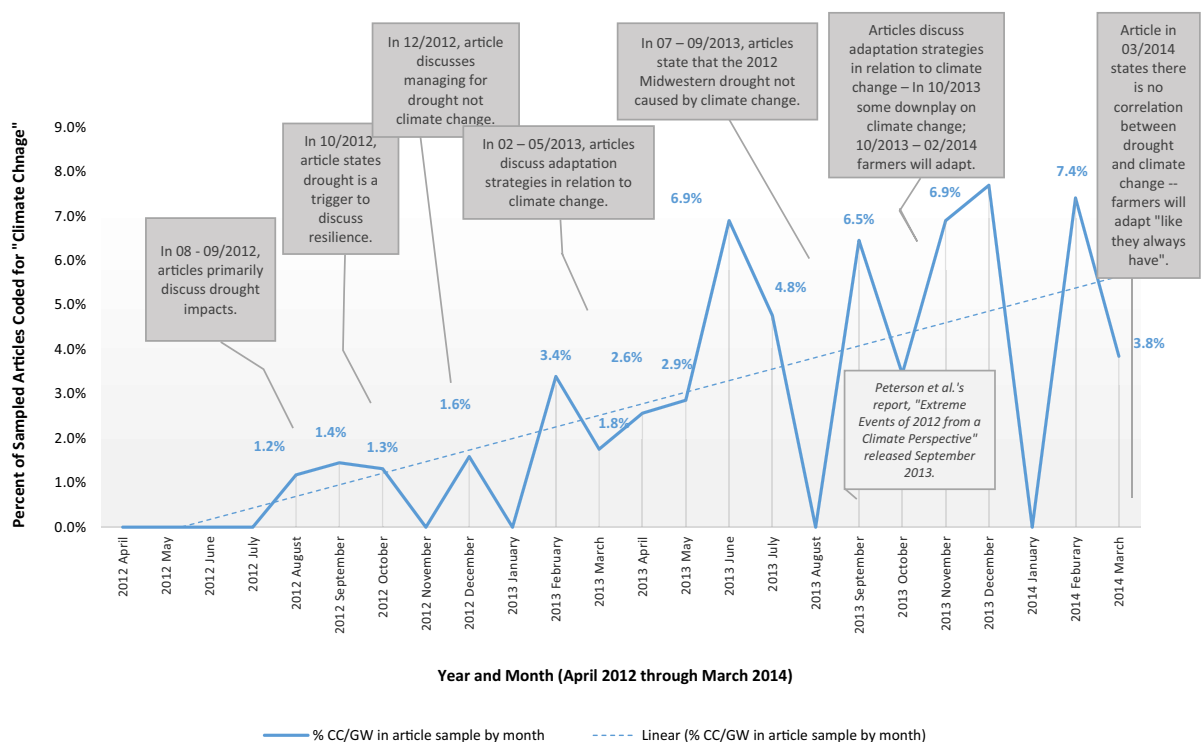


Fig. 6. Proportion of articles that discuss climate change over time.

Table 5

Example “climate change portrayal” sub codes: Number and percent of sample and overarching theme.

Climate Change Portrayal	# of Articles Coded	% of Sampled Articles	% of CC Portrayal Articles	Example Text
No attribution assigned	17	1.71%	77.27%	“Climate change is another issue USDA is tackling. The department recently produced two studies that demonstrate its impact on agriculture. ‘There’s no question that the climate is changing,’ Vilsack said. To help, USDA is expanding its pest forecasting and soil health management tools” “The climate is changing, and agriculture needs to adjust accordingly. . . . the issue has become politicized to the point where some people feel disinclined to listen to scientists. But these are Iowa scientists, people we know we can trust. . . There are things that can be done to mitigate the effects of the upcoming changes,’ said Anderson. One is cover crops. . . .”
Human caused	3	0.30%	13.64%	“A study of a dozen of last year’s wildest weather events found that in about half the cases, manmade global warming increased the likelihood of their occurrence”
Natural and human caused	1	0.10%	4.55%	“Public opinion may finally be warming up to the Lukewarmers’ theory that the current climate reflects a combination of natural and anthropogenic influences”
No climate change	1	0.10%	4.55%	“Don’t overreact to 2012. It was a once-in-50-years growing season. If I were a betting man, I would not bet on a repeat of similar conditions next year in spite of doomsday sayers who promote climate change”
Evidence not sufficient	0	0.00%	0.00%	None
Natural changes only	0	0.00%	0.00%	None

5.4. Reporting on drought causes – climate change and drought?

In addition to discussions surrounding climate change generally, we also analyzed whether climate change was labeled as a cause of drought (Table 6). We did this to discover whether the 2012 U.S. Midwestern drought appeared to be a trigger for agricultural trade publications to discuss longer range climate risks rather than the current drought crisis. Within the article sample, we found nine articles that considered drought causes, which we coded according to two categories:

- 1) Drought is/was caused by climate change; and
- 2) There is no relationship between drought and climate change.

Five articles discussed climate change in a way that indicated that there was no correlation between drought and climate change. These discussions involved the following ideas:

- 1) There is no correlation between drought and climate change;
- 2) Drought in general is a natural occurrence; or
- 3) The 2012 U.S. Midwestern drought was caused by La Niña conditions.

Only six articles reported that future climate scenarios entail climate change induced drought. Two of these also mentioned that the 2012 U.S. Midwestern drought was not caused by climate change.

Table 6

Example “drought and climate change” sub codes: Number and percent of sample and overarching theme.

Drought and Climate Change	# of Articles Coded	% of Sampled Articles	% of Drought Causes Articles	Example Text
Drought: part of future due to CC	6	0.60%	66.67%	“‘We are seeing evidence of the changing climate in the last decade or more. . . .’ Hohenstein said the U.S. will see more droughts, more floods and more erratic weather. . . Farmers can expect more heat and drought stress on crops such as soy- beans and corn. . . .”
Drought and CC: no relationship	5	0.50%	55.56%	“Bringing the topic closer to home, where drought concerns are being raised in farm country, Michaels asserts, ‘There is no correlation between drought and global warming. None whatsoever’”
Midwestern drought and CC: no correlation	2	0.20%	22.22%	“We also think that’s one of the reasons why we had our big drought last year. We were strongly in a La Niña base state in the atmosphere globally”
Drought: natural occurrence	1	0.10%	11.11%	“Drought is a natural occurrence that is going to happen – more frequently in some areas than in others”
Total “Drought causes” articles	9			

Note: Each article could have included more than one “Drought causes” sub code.

Overall, very few articles discussed potential links between drought and climate change. The articles that did were published at a point when reflection on, rather than reaction to, the extreme event could take place; after the most intense drought months and right around the publication of [Peterson et al.'s \(2013\)](#) report on connections between 2012 extreme events and climate change. Due to the very small number of “drought cause” articles, we suggest that this particular relationship was not utilized as an amplification of climate change risk.

6. Discussion and conclusions

Through this study, we have examined the farm media's coverage of the 2012 U.S. Midwestern drought through the analysis of ten agricultural trade publications. Media sources are an important means of conveying information, playing a role in how risk is interpreted ([Kasperson et al., 1988](#)). Drought impacts and weather were the primary topics covered within agricultural trade publication “drought” articles between April 1, 2012 and March 31, 2014. Impact and weather categories as the most prominent themes in the article sample is not surprising, as the 2012 U.S. Midwestern drought was an impactful event to the readership of the agricultural trade publications we analyzed. However, it is just these types of impacts that we posit could be a catalyst for change toward resilient approaches to farming. It was an opportune time for agricultural trade publications to saturate their readership with information about benefits of conservation practices, the value of building soil health, and other transformative practices as long-term risk or adaptation strategies. Instead, agricultural trade publications appear to have focused much of their attention on short-term, more immediate mitigative actions that farmers could implement within the existing agricultural system. These were important considerations to help farmers successfully emerge from the impacts of the drought, but there was a lack of a longer-term view of sustainable farm management. In fact, we found that many “adaptation/risk” strategies discussed were common approaches (e.g., hybrid seeds, crop insurance), not transformative ones (e.g., soil health, multicropping, livestock integration). This apparent reaction to intense drought conditions reflects [Abrams and Meyers' \(2010\)](#) findings that agricultural trade publication editors tend to attenuate risk by reporting on actions farmers can take to mitigate impacts to a particular risk.

Although very few articles discussed climate change (a potentially contentious topic), it is notable that the majority framed climate change as fact. This opens possibilities for discussions surrounding transformative adaptation measures for U.S. agriculture. Indeed, that climate risk and adaptation was discussed at all, and by what we assume are credible and trusted sources, may have contributed to amplification of the risk ([Kasperson et al., 1988](#)). Undoubtedly, what appeared to be intense drought coverage must have brought farmers' attention to the impacts of the drought. Moreover, the pragmatic approach to the reporting described above (primarily drought impacts and weather) could raise awareness of drought as a specific hazard that then might influence attitudes toward adaptation, as is suggested by [Carlton et al. \(2016\)](#) who found that there was a significant association between increased risk perception and more favorable attitudes toward adaptation.

In terms of the Social Amplification of Risk Framework, agricultural trade publications can be considered interpreters of risk. In this study, their messaging entailed the impact of the drought and recovery advice for the current and following growing season. We found a lack of interpretation of climate change risk and the means to adapt to future climate uncertainty. In [Frewer et al.'s \(2002\)](#) study of public perception of GMOs they noted, “A proactive risk communication strategy is likely to provide people with the opportunity to formulate an informed view about the risk, which is less likely to be influenced by risk information presented in a ‘crisis’ context” ([Frewer et al., 2002, p. 710](#)). Coverage of the 2012 U.S. Midwestern drought was, for the most part, presented within the timeframe of the drought crisis, with messaging that clearly articulated the impacts of the crisis as well as short-term recovery measures. Despite this apparently well-intentioned approach to the information needs of the agricultural trade publication readership, we agree with [Frewer et al.'s](#) contention of the value of a proactive risk communication strategy. Although the pragmatic approach to drought recovery was valuable and necessary, we are firm in our contention that this drought was a lost opportunity to extend the conversation to proactive climate risk communication strategies surrounding long-term adaptation within the agricultural system.

We acknowledge that agricultural trade publications must be responsive to readership, and perhaps advertiser, needs ([Abrams and Meyers, 2010](#)). Moreover, risk interpretations are more likely to resonate when the messages match people's individual reference systems ([Renn, 2011](#)). For example, [Prokopy et al. \(2015\)](#) found that farmers are not great believers in human caused climate change. Indeed, farmers are generally considered to be politically conservative (e.g., [Lord, 2015](#)), and conservative Republicans tend to believe that there is not enough evidence to show that global temperatures are rising ([Kiley, 2015](#)). Perhaps these reasons contributed in some part to the low number of “climate change” articles published. That is, climate change may not be part of farmers' reference system and agricultural trade publications did not want to risk alienating their readership by interpreting the drought as a climate change risk. Alternatively, perhaps because experts cited within the articles did not (or could not) make the link between drought and climate change, agricultural trade publication editors were unwilling to make that link themselves – the media is a channel of information not the actual source.

Without further investigation, we cannot know the reasoning behind agricultural trade publication coverage of the 2012 U.S. Midwestern drought. In fact, this points to some limitations of this study. First, we conducted this analysis only on articles that included the word “drought.” We therefore do not know how prevalent “climate change” *without* drought was within articles published in the same time period. This is also true of “adaptation/risk” strategies. This study focuses only on how these concepts were covered in the context of a drought crisis, and thus our results should be considered in that light. Despite these limitations, this study has shown the type of information agricultural trade publications conveyed during a specific drought crisis. Because of

the importance placed on agricultural trade publications as an information source, this study has filled an important research gap in agricultural risk communication, while pointing to the potential of a proactive risk communication strategy to the future viability of a sustainable agricultural system. Despite the fact that the 2012 U.S. Midwestern drought was not linked to climate change, extreme weather will increase, and farmers will need to adapt. Overall, we contend that coverage of the 2012 U.S. Midwestern drought could have served as a more explicit example as to why risk management strategies are important to farm viability, particularly under uncertain conditions. The fact that so few articles were specifically related to climate change does not help bring the message home about climate change risk being a real concern worthy of a risk response.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.crm.2016.10.006>.

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