Journal of Applied Communications

Volume 109 | Issue 1 Article 7

Debated, Deluged or Disappeared: The Flow of Public Discussion Surrounding Drought in FEMA Region 7

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Recommended Citation

Armstrong, Cory; Baldinelli, Sharon E.; Smith, Kelly; and Medcalf, Sharon J. (2025) "Debated, Deluged or Disappeared: The Flow of Public Discussion Surrounding Drought in FEMA Region 7," *Journal of Applied Communications*: Vol. 109: Iss. 1. https://doi.org/10.4148/1051-0834.2565

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Abstract

Significant drought conditions existed in 2022 in the four-state FEMA Region 7, which includes Nebraska, Kansas, Iowa and Missouri. Geographically, the four states range from 56,000 square miles (Iowa) and 69,000 square miles (Missouri|) to 77,000 (Nebraska) and 82,000 square miles (Kansas). The terrain includes urban areas, including Kansas City, Des Moines and Omaha, along with large swaths of rural and agricultural areas. Those differences suggest that the needs of different segments of the population may be vastly different. Using the two-step flow of communication theory, this study examines how public officials, opinion leaders and the public discussed drought on social media. We collected and coded social media mentions of drought originating within those states then analyzed how drought effects were discussed and any potential resolution. Results indicated that drought effects were discussed by the public, while current conditions were the focus of posts by officials and opinion leaders. More frequent posts were likely when conditions worsened. Authors recommend targeted discussions by officials in response to public needs.

Keywords

Drought, communication strategies, information sharing, social media

Cover Page Footnote/Acknowledgements

This project was developed as part of a grant from the University of Nebraska Medical Center College of Public Health.

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Introduction

"It's hot. It's dry. The drought is worrying northwest Iowa farmers." This August 2022 tweet was one of more than 1,000 tweets originating in FEMA Region 7 discussing the concerns of drought conditions in that area, as much of the Great Plains region suffered from severe drought conditions in 2022-2023 (U.S. Drought Monitor, 2022). Each of the four states in this region—Nebraska, Missouri, Iowa and Kansas—had at least 20 percent of their boundary in severe or extreme drought, including significant exceptional drought conditions in both Kansas and Nebraska during that time period. (U.S. Drought Monitor, N.D.).

As the tweet above references, concern from farmers—and residents, along with local and state leaders—were voiced frequently. However, issues surrounding drought and how to combat it can be challenging for experts, emergency managers and policymakers, as damages from drought can affect wide swaths of economic and agricultural elements (Communicating About Drought, N.D.). Often these damages stem not from an isolated event (such as a hurricane or tornado), but from a buildup over time of water deprivation or excessive heat. Thus, the communication trends surrounding drought conditions likely differ from other natural disaster communications.

This study seeks to understand how drought is being discussed on social media, and how those in varied roles may frame the conversation differently during the region's significant drought conditions in 2022. With its large agricultural industry, this region is ideal for examining how drought communication is employed during times of water scarcity. These areas had major crop loss and significant water restrictions in 2022, based on their drought characteristics (Lookadoo, Bell & Woosley, 2024). Prior nationwide research covering a study period of 2017-18 found that people in the Plains were more likely to tweet about drought than people in other states, and documented Plains agricultural producers' use of the #drought2017 hashtag to call attention to their plight (Smith et al. 2020). The same analysis found that the content of tweets reflected different state and regional experience with drought. Analysis of tweet content can reveal who experiences the effects of drought in different locations and sectors, who has agency, and how water shortage as an issue is framed (Rotz 2017).

The goal of this study is to use FEMA Region 7 (Nebraska, Iowa, Missouri and Kansas) to examine how drought information is being conveyed and discussed by stakeholders, particularly agricultural opinion leaders, as this health and safety crisis is managed. More research is needed to understand the social and behavioral factors that influence how drought-related events can be managed and mitigated. For example, research has found that drought impacts can not only affect individual respiratory conditions and issues of water quality/quantity, it can also have secondary impacts such as changes in mosquito and tick habitats, loss of agriculture and food stability, more frequent wildfires, more frequent and intense heatwaves, and increased dust and dust storms (Lookadoo, Bell, & Woosley, 2024).

This study attempts to begin that process of understanding communication patterns about drought, examining how individuals prepare for, respond to, and manage this significant drought event. Specifically, the study will employ the two-step flow of communication (Lazarsfeld et al., 1948) as a theoretical framework and focus on the role of opinion leaders in sharing information related to this content. More specifically, we are interested in comparing how messaging by public officials with those by farmers and other members of the public about drought impacts.

Results and implications can help improve communication during this event and help public health, communication and drought mitigation specialists improve practices in the future.

Literature Review

The seminal two-step flow of communication model, introduced by Lazarsfeld, Berelson, and Gaudet in 1948, aimed to unravel the intricacies of voting behavior by identifying influential individuals and factors shaping public opinion (Lazarsfeld et al., 1948). This paradigm posited that opinion leaders, armed with information from media, policy, and experts, could influence the wider populace by interpreting and disseminating this information (Park, 2019). A significant revision to this model was proposed by Thorson and Wells in 2016, emphasizing the concept of information curation, wherein individuals select and highlight content based on its significance, thereby becoming "influentials" or opinion leaders (Thorson & Wells, 2016; Park, 2019).

In connecting this idea to drought risk communication, our proposition is that opinion leaders and curators, referred to as "influentials," play a crucial role in bridging the gap between technical scientists and the general public. For instance, while the National Drought Mitigation Center may furnish precipitation levels or drought areas, it is often regional media or local emergency management officials who disseminate information directly to influence collective risk management, mitigation, or adaptation among residents in drought-prone areas. Thus, we posit that local first responders and emergency management personnel act as strategic curators for emergency and risk information.

Thorson and Wells (2016), among others, acknowledge the potential for a one-step flow of information through media and public officials, especially via social media. However, in the context of technical risk information, the general public may struggle to comprehend individual risk susceptibility and severity. Recognizing this challenge, Nisbet and Kotcher (2009) highlight the role of local emergency managers and first responders as "issue-specific" or "positional" opinion leaders, possessing superior knowledge and experience in disaster-related topics. Weimann (1991) describes influentials as competent individuals with influential personality traits who, during emergencies, demonstrate their competence by knowing the right people. Recent research about flood-related forecast materials found support for idea of providing context for information, suggesting that the various public needs for emergency preparedness material could be vastly different (Van Dyke et al., 2020). For example, a residential suburban homeowner who might need to consider lawn watering restrictions during drought events is much different from a farmer who contends with providing water options to keep their livestock and crops alive and prospering.

Thus, the potential of interactivity among emergency management/government agencies and the public seems warranted—at a minimum to address more community- and individualistic needs during a disaster (Spence et al., 2015). A recent study by Yudarwati, Putranto, & Delmo (2021) highlighted some of these communication differences. The authors examined social media disaster communication of three events in Indonesia in 2018-19 and found that much of the governmental communication was unidirectional and top down, with little interaction with community members. Specifically, the authors argued that social media was used by these agency stakeholders as a way to share information and not to encourage interactive dialogue. However, the authors noted that in post-disaster analyses, the communities held discussions among stakeholders, built trust and credibility and developed a two-step flow of communication model.

> *"The community and religious leaders act as opinion leaders, who have the advantage of more exposure to media messages and therefore can shape others' opinions and attitudes. This model also addresses the challenges related to digital inequality due to the lack of access to the internet and social media experienced by the disadvantaged*."
> ~Yudarwati, Putranto, & Delmo, 2021, p. 15-16.

The complexity of information dissemination during droughts underscores the necessity for clear, comprehensible risk communication. As noted by Spence et al, (2015), the need for remedial behaviors and mitigation information post disaster is needed. Disaster prevention officials and emergency managers, acting as positional opinion leaders, are tasked with interpreting and disseminating scientific and risk information effectively. Their role is vital in motivating the general public to prepare for disasters beforehand and respond appropriately during crises. Hence, it is imperative that these influentials have access to information presented in formats facilitating a complete understanding of the likelihood and severity of risks, enabling them to make accurate, informed decisions and guide the public accordingly (Weimann et al., 2007).

Sharing Relevant Drought Information

Typically, there are four types of drought: meteorological, which implies a dry weather pattern; hydrological, which suggests issues with the water supply; agricultural droughts, where soil moisture is depleted, and water supply or ecological droughts, where the supply doesn't meet demands at one point in time (Communicating about Drought, n.d.; Kallis, 2008). Hydrological drought will require a longer recovery period. However, communication and education requirements could be quite different, depending upon which one is present. Weitkamp et al. (2020) found that most discussion about droughts in the United Kingdom, which is often perceived has having a "wet" climate, is reactive. The authors propose that a proactive communication approach may work better, focusing on sustainability rather than water scarcity.

Information dissemination is important; however, determining the relevancy of that information for stakeholders and audiences may prove more challenging. For example, a 2015 study of Twitter discussion during a Nebraska drought found that tweets about drought increased as conditions developed, and the dominant conversations on the platform included themes of agricultural issues, environmental impact, extreme weather, effects and proposed solutions (Wagler & Cannon, 2015). However, other work by Tang et al. (2015) noted that the majority of tweets related to a 2014 California drought focused on messages from governmental agencies—with little interaction with individual members of the public. Further, the study concluded that emergency managers were not employing or engaging in significant drought communication on social media. Similar to the present work, Jin (2020) examined tweets about Hurricane Irma and found that many of the government accounts were not active in sharing information on the events and aftermath. Further, research after Hurricane Michael in 2018 determined that emergency managers providing social media information about mosquito control did not link that information to the natural disaster, suggesting that the pest issue was not connected to the significant amounts of rain that fell in the hurricane (Ruth et al., 2020)

When looking broadly at risk communication strategies, research by Liao et al. (2018) indicates that motivations for sharing communal risk information encompass individual-level concerns (e.g., economic costs), relational concerns (e.g., fostering trustworthiness), and

community-level concerns (i.e., a sense of shared community responsibility). Additional studies suggest that an individual's perceived information needs serve as a predictor for their tendencies in sharing and seeking risk information (Yang et al., 2014; Yang & Zhuang, 2019). However, social norms, perceived efficacy, and trust also emerge as significant predictors of risk information sharing (Yang & Zhuang, 2019).

Exploring the presentation format of shared risk information and its impact on perceived usefulness for disaster risk management, Lin et al. (2017) found that quantitative scale and semi-quantitative ranking scale formats were perceived as most useful. Moreover, research by Sutton et al. (2019) delved into message features that influence information sharing on social media by NWS WFOs. In a different context, social network analysis within fire risk management demonstrated meteorologists' pivotal role in disseminating regional fire risk management information (Owen et al., 2012). This study also underscored the importance of dialogue between fire risk managers in planning for the fire season to support decision-making.

What these studies suggest is that communication by qualified experts—or positional opinion leaders—plays a pivotal role in shaping public engagement with innovations and their diffusion (Huntington & Anderson, 2015; Nisbet & Kotcher, 2009). Despite this, there is a notable gap in research concerning how drought information is shared by key stakeholders (one example is Tang et al., 2015). These individuals possess the capacity to make decisions and disseminate pertinent risk information to a broader audience (Nisbet & Kotcher, 2009). Cash (2001) explored the critical role of agricultural extension services as boundary organizations, communicating scientific information to agricultural decision makers and communicating across scales. Therefore, this study examines the dominant conversations surrounding drought in 2022 in the four-state region of FEMA Region 7 connecting the conversation themes to the authors of those tweets. That is, who is doing the major information sharing, and what are they saying?

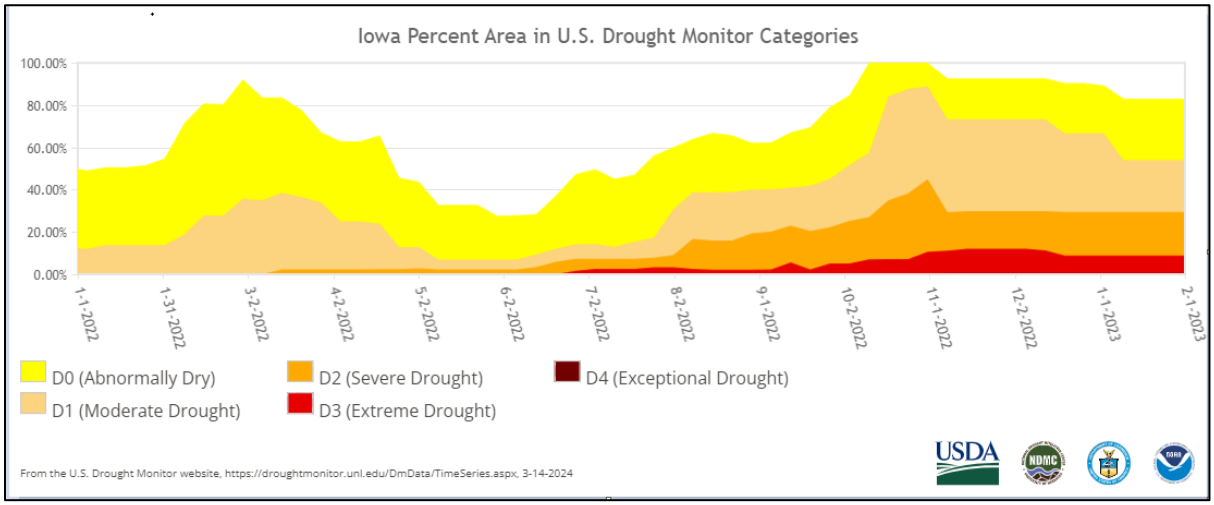
Drought Conditions and Present Work

The present study examines four states within the FEMA-designated Region 7. Each of the four states experienced drought in 2022, with Nebraska experiencing the most drought and Missouri experiencing the least.

Iowa was at least partially in drought for all of 2022. In May, only 7 percent of the state was in moderate drought or worse. Drought peaked in November, when 89 percent of the state was in moderate drought or worse. Iowa’s mean population in drought throughout the year was 1,031,257. Its mean Drought Severity and Coverage Index (DSCI) was 117.The Drought Severity and Coverage Index is a weighted sum of the area in drought that expresses U.S. Drought Monitor values for an area as a single statistic (Figure 1).

Figure 1

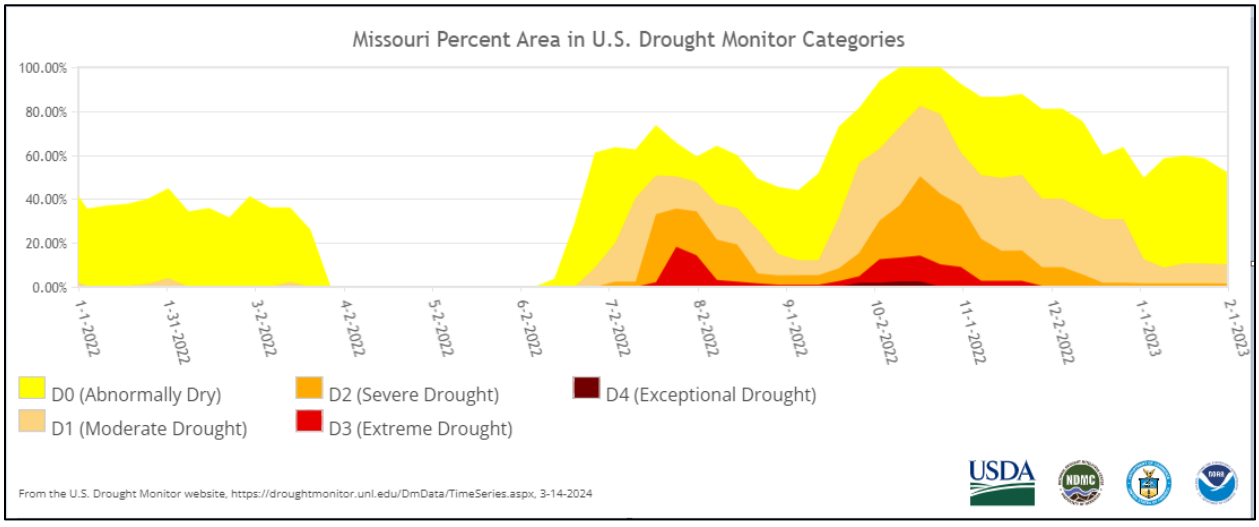
Iowa Drought Severity in 2022



Missouri was completely free of drought and abnormally dry conditions in April and May of 2022. Drought later peaked twice in the state, with 51% of the state in moderate drought or worse on July 19, and 82% in moderate drought or worse on Oct. 18. Missouri's mean population in drought throughout the year was 1,101,156. Its mean Drought Severity and Coverage Index (DSCI) was 80 (Figure 2).

Figure 2

Missouri Drought Severity in 2022

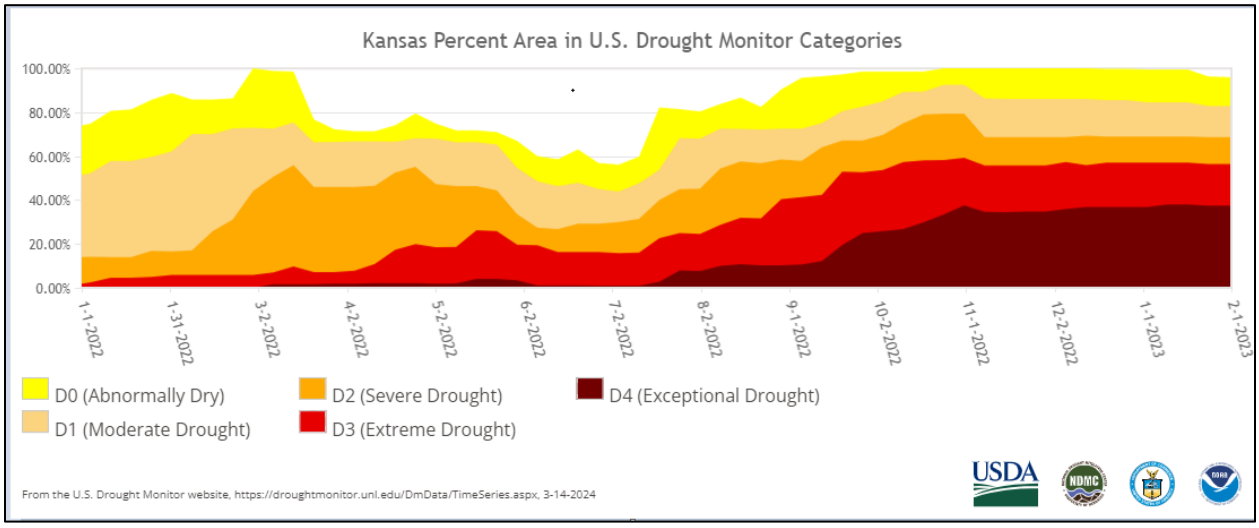


Most of Kansas was in moderate drought or worse throughout 2022. The least proportion of the state in moderate drought or worse was 44 percent on July 5. The highest proportion was 93 percent in late October and early November. Kansas' mean population in drought throughout

the year was 1,290,004. Its mean Drought Severity and Coverage Index (DSCI) was 241 (Figure 3).

Figure 3

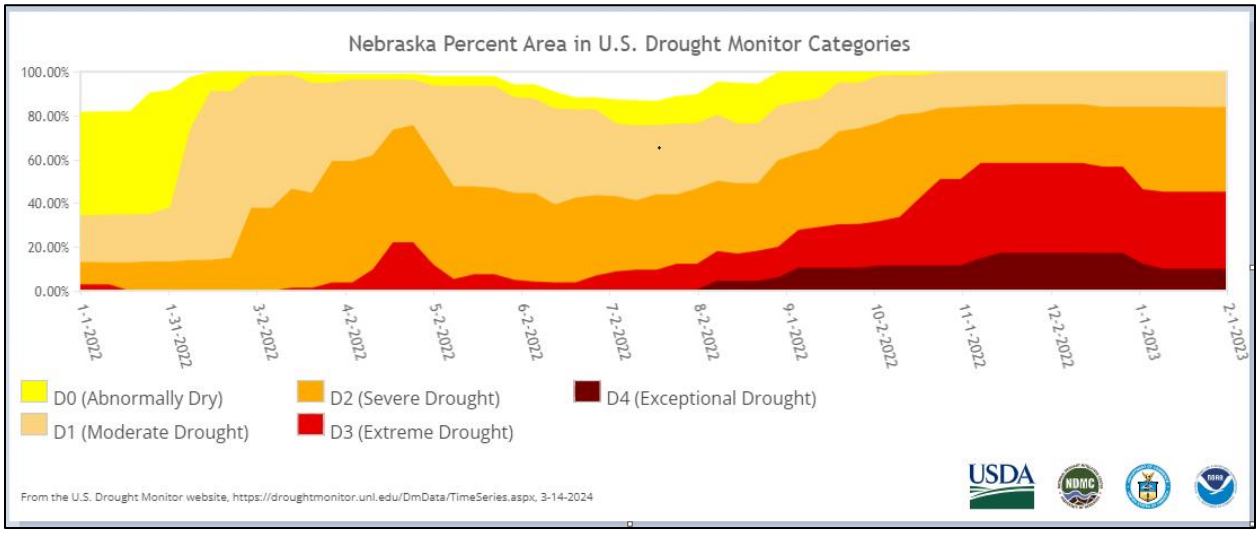
Kansas Drought Severity in 2022



Most of Nebraska was in moderate drought or worse throughout 2022. The least amount of drought was in January, when moderate drought or worse covered about 35% of the state. For the final months of the year, just under 100 percent of the state was in moderate drought or worse. Nebraska's mean population in drought throughout the year was 1,170,795. Its mean Drought Severity and Coverage Index (DSCI) was 258 (Figure 4).

Figure 4

Nebraska Drought Severity in 2022



Given the severity and variety of drought conditions across the region, researchers posited the idea that public discussion may also vary. The present study proposed that positional opinion leaders may have different viewpoints than audiences, based in part on Tang et al. (2015) findings. Prior work examining disaster-related communication proposed that coordinated social media communication among local, state and federal emergency managers is most beneficial during a disaster (Mitcham et al., 2021). The authors noted that when communication is not coordinated, it can confuse audiences and decrease reliance on information sources.

Mitcham and co-authors were focused on acute disasters in their work. As noted, however, drought as a natural hazard is generally a sustained event with a "creeping" effect. Thus, individuals living within these locations may have different viewpoints, needs and impacts from the conditions. It follows then that more interaction among positional opinion leaders and individuals would be needed. The National Integrated Drought Information System proposes the use of personal narratives as a communications strategy for positional opinion leaders and official stakeholders (Communicating about Drought, n.d.). If these groups are not interacting on social media, it seems likely that these communication styles are not being employed. Prior work on social media discourse by Wagler and Cannon (2015) noted that the main themes of a 2012 drought in Nebraska included themes about effects of drought on the environment, particularly livestock and agriculture impacts. The present work focuses on a larger region with varying levels of drought conditions—therefore, perhaps effects will differ based on location, author, and role.

In recent years, social media monitoring has become a recommended practice for public information officers during times of health and safety crises (Houston et al., 2015; Hadi & Fleshler, 2016). A survey of PIOs following the 2016 Zika crisis indicated that those who monitored social media felt more prepared for the crisis (Avery, 2017). The author also found that PIOs in rural communities were less likely to monitor social media than those in larger communities, which she connected to resource allocation. The current work attempts to compare the public discussion of drought conditions to determine commonalities and differences within the conversation. If social media monitoring is occurring, it seems likely that commonalities would exist among the discussion.

In order to isolate how the conversation patterns focus on effects of drought, we created three general control variables: the number followers of a twitter account, the breadth of issue by state and the time of year. On Twitter (and social media in general), the number of followers has generally been connected to level of influence and opinion leadership (Hwang, 2015). To determine breadth of issue, we examined whether the issue was limited to one state or across multiple states, in or out of Region 7. Because drought-related issues can be seasonal, we opted to examine the time of year (spring/summer/fall) in which the tweet occurred. Controlling for these issues would help us examine the conversation patterns in depth.

Guided by this research, this project aimed to understand public discussion about drought-related issues. In particular, what are the main topics, and how do they differ by official vs. nonofficial sources? In addition, does the severity of drought impact what is discussed?

H1: Information about drought effects and impacts will be shared more frequently on social media by non-official communication sources in Region 7 than from official or positional communication sources.

H2: When more drought effects are discussed, they are significantly more negative in sentiment than when fewer drought effects are discussed.

RQ1: How does public discussion of drought compare among opinion leaders and other local stakeholders?

RQ2: Does discussion of drought effects vary with the severity of impact?

Methods

The focus of this study was on public discussion of drought within Region 7. To get a sense of public discussion, data were retrieved from Twitter (now X) through Sprinklr, a proprietary social media archive that enables researchers to extract content from specified media platforms over an allotted period of time through dates and keyword searches (Sprinklr, 2022; Ritchart et al., 2024; Sharma et al., 2024).[1] The search strategy included pulling all data from Jan. 1 to Dec. 31 of 2022 with the following keywords: drought and any of the four states in the region (through postal abbreviation or full name) or the #drought22 or #Statedrought hashtags. Tweets were then culled to focus on tweets that originated in one of the four states of the region. This yielded a sample of 1082 for coding.[2]

After data collection, the tweets were loaded into MAXQDA, a qualitative content analyses software program. All coding was completed by one graduate research assistant and one undergraduate student, under the training of the first author. Both coders were provided a coding guide and initial discussion with the first author. After the first round of coding, discussions and about disagreements were held, followed by a second round of independent coding. Final reliability for all coding—100 tweets (or 10 percent of the sample)—was conducted in MAXQDA, which calculated a Cohen's Kappa of 0.97 for the manifest coding between the two coders (O'Connor & Joffe, 2020).[3] Once intercoder reliability was established, the research assistant completed all coding under the direction of the first author.

Measurement

The main dependent variable for this analysis was the frequency of drought effects discussed in the posts. This variable was created by a summative index (M = .43, SD = .64). The following effects were coded as presence/absence and then combined for analyses: Wildlife health and habitat (14%), Crop health (14%), livestock health (3.8%), human mental/physical health (3.6%), other (5.9%). See Table 1 for complete list of effects. The tweet author's profession was also coded for presence/absence. See Table 2 for full list of professions. Professions were then split into four general categories for analyses: General media (25%), Government (15%), Weather experts (21.6%) and other (38.3%). In this instance, we operationalize government and weather experts as positional opinion leaders.

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[1] Data collection was conducted at the Social and Traditional Media Analytics and Research Tools (SMART) Lab at the University of Nebraska-Lincoln. The core facility was created through funding from the Nebraska Research Initiative.

[2] Full details and copies of the search strategy are available upon request. Our tweet search terms was determined using recommendations from the National Drought Mitigation Center, who monitors those conversations.

[3] Intercoder reliability was based on manifest content and constructed using the MAXQDA program. Most internal intercoder reliability packages are conservative in nature, so we have confidence that the overall reliability score is accurate (O'Connor & Joffe, 2020).

Table 1
Drought Effects Mentioned in Tweets

Drought Effects	*No. of Tweets*	*Percent*
Wildlife health or habitat	162	13.9
Crop Health	159	13.7
Livestock Health	41	3.5
Human Mental Health	32	2.7
Air quality	5	.004
Human Physical Health	6	.005
Recreation	2	.001
Water Use Restrictions	5	.004
Economy	7	.006
Other	50	4.3
None	693	59.6
Total	1162	

Note: Effect Numbers exceed 1082, as some tweets mentioned multiple effects.

Table 2
Tweet Author Descriptions

Tweet Author Description	*No. of Tweets*	*Percent*
General Media	271	25.0
Weather Expert	234	21.6
Individual or Personal	137	12.7
Government (non-weather)	162	15.0
Undetermined/Other	77	7.1
Farmer/Agricultural expert	69	6.4
Academic	47	4.3
Drought monitor	85	7.9
Total	1082	100.0

Codes for official observations were defined as discussion by an author related to their official capacity. For example, “Iowa's drought monitor is basically unchanged from last week…” (57.9%). An individual observation was defined as discussion within the post based on one’s personal experience or not connected to any government or official capacity. For example, “This has been the hottest, driest summer I’ve ever experienced. 🥵” (17.7%).

The number of followers for each tweet author was split at the median (2885 followers). Following a method from Sharma et al. (2024), sentiment (positive/neutral/negative) was a categorical description, coded on a 1 (negative) to 3 (positive), given from Sprinklr rates each tweet (M = 1.92, SD = .36). As each state in Region 7 had different levels of severity from the drought, we examined tweets originating from each state. See Table 3 below for a breakdown by

state. We also examined tweets by time of year by splitting the calendar year into quarters by origination time and date of the tweet—the first quarter (January-March included 130 tweets, April-June included 182 tweets, July-September included 471 tweets and October-December included 298 tweets. Finally, we included a control variable for *breadth of issue*, which we coded as involving one state (70%) or involving multiple locations within the region.

Table 3
Tweets by State

State	*No. of Tweets*	*Percent*
Nebraska	413	38.2
Iowa	272	25.1
Missouri	242	22.4
Kansas	155	14.3
Total	1082	100.0

Results

All data analyses were conducted using SPSS Statistical Package 28.0. To examine H1, the observation variables (official/individual) were examined in independent sample T-Tests on the frequency of drought effects. The results, shown in Table 4, demonstrate that the frequency of drought effects was higher when an original observation was made (M = .58, SD = .74) and lower when an original observation was not made (M = .40, SD = .62) (t(251)=3.07 p=. 02, d=. 64). In examining the official observations, the presence of an official observation (M = .37, SD = .57) resulted in significantly lower mentions of drought effects than those where official observations were absent (M = .51, SD = .69) (t(888)=-3.41 p=. 01, d=. 64). This finding lends support to H1. in that tweets that included official observations were less likely to discuss drought effects when compared to those who tweeted individual observations.

Table 4
T-test of Discussion of Drought Effects Based on Observations

Variable	Effects Mean (SD)				*t*(1082)	*p*	Cohen's *d*
	Absent		Present				
Original obsv.	.402	(.62)	.58	(.74)	-3.068	.002	.64
Official obsv.	.51	(.69)	.37	(.60)	3.41	.001	.64

Further, a paired-sample T-test (not shown) was conducted examining discussion of effects of crops and animal health and effects on human health. The results indicated the mean for discussion of crops and animal health (M = .335) was significantly higher than the human health discussion (M = .10), *t*(1081) = 12.06, *p*. 001.

To study other relationships, a univariate analysis of variance was conducted with the frequency of drought effects discussion as the dependent variable. Three variables were used as general control variables: the level of followers of a twitter account, the breadth of issue and the time of year. While no hypotheses were proposed on those variables, the researchers believe they were important to get a sense of their impact on discussion of effects. Other variables in the analysis included each of the four states in Region 7, observation type, state or origin and the author's profession. The results of the analysis can be seen in Table 5.

Table 5
ANOVA tests examining discussion of drought effects

Variable	*M*	*F(df)*	*p*	η^2
Followers		1.32(1)	.25	.001
Low Followers	.229			
High Followers	.180			
Breath of Discussion		.89(1)	.41	.002
One State	.417			
Multiple State	.449			
Observation		.59(2)	.55	.001
Official	.233			
Original/Individual	.202			
State		2.57(3)	.05	.007
Iowa	.280[a]			
Nebraska	.220[b]			
Missouri	.126[ab]			
Kansas	.191			
Author Type		16.49(3)	.001	.044
Government	.146[a]			
Media	.199[bd]			
Weather Expert	.035[cd]			
Other	.437[abc]			
Sentiment		7.99(2)	.001	.015
Negative	.380[ab]			
Neutral	.139[a]			
Positive	.094[b]			
Time of Year		2.13	.09	.006
Q1	.275			
Q2	.134			
Q3	.167			
Q4	.241			
Error		(1064)		404.75
Total		(1081)		651.00

Significant main effects were found for sentiment F(2, 1081) = 7.99, p = .001 and for author profession F(3, 1081) = 16.493, p = .001. To learn more about the effects, post hoc comparisons using the Scheffe method were conducted on both sentiment, state, time of year, and author profession. Results indicated those tweets with a negative sentiment (M = .380) were

significantly different than neutral tweets (M = .139) and positive tweets (M = .094). However, the neutral and positive tweets did not significantly differ from each other. Similarly, results for author profession indicated that tweets authored by general media (M = .199), weather experts (M = .035), government (M = .146) each significantly differed from the other (individuals) category (M = .437), while media and weather experts also significantly differed from each other. However, there were no differences between weather experts and government authored tweets. These results lend support to H2, which posited that tweets with negative sentiment would have more effects mentioned. Further, these findings indicated that positional opinion leaders in this study (government and weather experts) were less likely to speak about effects, when compared with other tweet authors.

Additional Scheffe post-hoc analyses were conducted to examine frequency differences across states and observation types. Results indicated that tweets about drought effects originating out of Missouri (M = .126) were significantly less frequent than those originating from Iowa (M = .280) and Nebraska (M = .220). No other significant differences among the states were found. No significant differences were found among the four quarters of the year, in terms of discussion of drought effects.

These results provide insight into the RQs in these analyses in that the frequency of effects likely follow the severity of impact—in 2022, drought severity was significantly higher in Nebraska and Iowa than in Missouri.

Discussion

The goal of this study was to examine public discussion on social media of drought conditions within four states of the Great Plains to learn more about how positional opinion leaders within the region interacted with the public. When examining drought-related tweets across Region 7, our results indicated that those authors who posted an official observation within the region often posted about current conditions or drought monitoring, whereas those who posted an individual observation were more likely to talk about effects of drought, particularly agricultural and livestock effects. A deeper examination suggested that tweet authors who identified themselves as government or weather experts— positional opinion leaders in this study—were significantly less likely to discuss drought-related effects, when compared with other tweet authors. Further, when effects were discussed, the sentiment of the tweets was significantly more negative.

The focus of this study was to look at public discussion of drought conditions in an area where drought severity differed. Our results suggest that more discussion occurs when conditions are more severe—but perhaps the most fascinating finding concerned the different types of discussion. Much conversation originated from government agencies and weather experts—who serve as positional opinion leaders in this space. When those tweets were compared with individuals living in that area—farmers or residents in severe drought locations—their conversations looked notably different. Our findings suggest that two different streams of conversation were running parallel during the 2022 drought. Those writing in their official capacities were talking about precipitation amounts and air temperatures, such as "*Wonderful sights and sounds as rounds of rain come through a drought-stricken portion of the Midwest. With several inches possible by Saturday this will look to make a dent in the severe droughts in Iowa and Missouri."* Meanwhile, those in the trenches were talking about dying crops and watering restrictions, including "*The drought continues in western Nebraska and has ranchers*

on the brink. It's so dry out here a fire in the Halsey forest blew up and destroyed historic 4 H camp last week." Our results indicated that effects of drought discussed were mainly about animal and crop health, which suggests that the impact of drought was mainly felt by agriculture and farming industries, which may limit what emergency managers and officials can do.

What makes this finding particularly noteworthy is that it suggests positional opinion leaders and official observations are not providing much in the way of action items or solutions for the challenges often seen in drought conditions. As noted above, communication may differ based on the type of drought that is occurring. Harkening back to the theoretical model of a two-step flow of communication, it would appear that one of two things is occurring in public discussion of drought: 1) Positional opinion leaders are not effective at swaying public discussion of this topic; or 2) Positional opinion leaders do not have a clear awareness of the public needs in this space.

This result follows previous findings by VanDyke, Armstrong and Bareford (2020), int terms of the way opinion leaders and experts work to disseminate information; however, in the case of drought, they may not be connecting it to their specific audiences. Our findings suggest many posts about "present condition updates" from those individuals—much like weather forecasters. As Weitkamp et al., (2020) noted, this is a reactionary communication focus, without providing proactive strategies as well. To be fair, this study focused on posted tweets and did not dig deeply into individual Twitter conversations—it is an area ripe for future research. However, given the vast differences in what these different groups were posting, our results suggest little connection between positional opinion leaders and individual observations.

Perhaps the results of this study demonstrate further evolution of the traditional two-step flow of communication theory. While we proposed that positional opinion leaders were able to provide specific and relevant information to their individualized publics, that is not what the results indicate. Instead, we found generally separate streams of conversation. This idea lends support to prior work by Jin (2021) who proposed that social media influentials act as information providers, not as conduits or intermediates between public officials and private citizens. "Influential Twitter users present the ability to be information resources and directly control information flow," (p. 199). That is, these influencers create and share their own information—and do not necessarily disseminate others' content.

While this idea certainly has merit in a marketing or product-selling scenario, this study may be the first to link the idea of "influentials" to a public safety or risk communication event. Prior work has noted the challenges among emergency personnel in sharing relevant information during a disaster event (Roy et al, 2020). These authors argue that the public is seeking relevant information during a crisis event and that officials need to have more *situational awareness* for different populations. It could be that influentials are providing more key information for these publics. This argument gains more traction through a recent study by Rust et al., (2021) who found that European farmers are putting more trust into peer networks than local officials to get information they need to move their operations forward. "Social media users as information seekers perceive influencers as trusted and experienced voices of authority on specific topics, so these influencers are useful messengers to share information" (Rust et al., 2021, p. 40). Results of this study suggest influencers may have a role in drought discussions as well, although future research is needed to better flesh out this idea.

In reviewing our tweet authors, the majority come from media representatives and state/local government agencies, along with individuals. Only a few came from university extension offices, which are agencies that often contribute to discussion within social media

spaces. Perhaps they focused more on solutions or remedies during the drought and were not connected to our keywords, or perhaps they do not engage in social media monitoring. As Avery (2017) noted, this could be from lack of resources, given the rural population areas throughout much of Region 7—more study is needed to confirm. Our findings suggest that the use of social media to gather incoming data about conditions and issues within local communities does not appear to have been a practice in this area, despite recommendations to that effect (Hadi & Fleshler, 2016).

In times of crisis, a key function of emergency officials and personnel is to communicate current and relevant information to the public, as well as education about the situation (Mitcham et al., 2021; Communicating about Drought, n.d.). However, given the length of time that drought conditions can exist, which can be months or years, time exists for additional communication strategies. For example, a solution-focused strategy that includes region-specific information presented in a way that addressed the values of the targeted audience is often recommended by the National Integrated Drought Information System (Communicating about Drought, n.d.). This study suggests that drought communication may require different ways of communication. For example, NIDIS also suggests that one of the most effective public communication strategies surrounding drought is to employ personal narratives from those affected (Communicating about Drought, n.d.). Our results indicate very infrequent use of this strategy by official and government agencies and that the individual narratives—where drought impacts and effects were discussed—came from the individuals who were living within these conditions.

Another compelling finding of this study concerns the difference in discussion by location. That is, those areas with more significant drought conditions were more apt to talk about the effects of those conditions—in part. Our results noted that Missouri had much less drought—and much less discussion, than the other states in the region. However, much of the severe drought issues were in western Kansas—many of the positional opinion leaders are located in eastern Kansas (near Kansas City) where conditions were more moderate. It is worth noting as well that in 2023, the Iowa Department of Natural Resources created a comprehensive drought plan (IDNR, 2023), which may have influenced their discussion on social media in 2022. That is, because IDNR was in the midst of creating the plan, their discussion may have been more targeted in 2022 than in prior years. Further, the National Drought Mitigation Center, which conducts considerable monitoring of drought conditions, is located in Nebraska.[4]

A recent report by NIDIS made recommendations about messaging, connected to the level of drought and the geographic conditions of the area (Lookadoo, Bell & Woosley, 2024). The recommendations included 1) using plain language; and 2) communicating both the conditions and suggested activities (such as specific water restrictions or how to obtain drinking water). Those recommendations also include translations of those restrictions to other languages. Our findings suggest that these recommendations did not appear in most of our study tweets. Thus, the public officials and opinion leaders were likely not reaching their audiences. Future research may wish to examine whether following those recommendations makes a difference in reaching their targeted audiences.

These strategies will help to ensure the greatest likelihood that residents take the actions needed to prepare and ensure their safety during water emergencies. The results from this research will improve the technological and economic efficiency of communication and

[4] The National Drought Mitigation Center authored 20 tweets (or 1.8 percent of the overall tweets in this study). We also note that one of our study authors is an employee of the NDMC.

information strategies and products by informing what types of information, strategies are consequential to public responsiveness to drought communication. In this way, organizations, officials, and other decision-makers will save time, money, lives, and property by focusing resources on the channels and strategies that are most trusted or used by their constituents during droughts. Prior research has found that flood forecasting can be more effective when targeted to individual needs and knowledge/expertise levels (VanDyke, Armstrong & Bareford, 2020; 2021).

As with all research, a few caveats are necessary to discuss. First, this study is focused on the year 2022 in a four-state region of the United States. Generalization of this data to other locations or during other drought periods should be done with caution. Drought effects were only mentioned in roughly 50 percent of our overall tweets, so the means of this study are lower than ideal. Our sentiment analyses was based on information provided by Sprinklr, and was not manually coded. We followed prior research in that area in its use for social science research (Sharma et al, 2024).; however, we note that the sentiment analysis here was limited to computer coding. Finally, we note that our study was limited to Twitter, so it is possible that other types of communication were going out from other platforms that were not studied here.

In sum, the results here can benefit the region by using social media as a tool to understand risk communication dynamics between decision-makers and the public during a significant drought event. These results will inform efficient and effective communication strategies designed to support governmental and other management decision-making (e.g., weather forecasters) related to public risk communication surrounding drought preparedness and management. It will also include strategies to better engage local farmers and agriculturalists within this area.

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