

Introduction

In 2021, scientists measured the Gulf of Mexico “dead zone” at 6,334 square miles; this is equivalent to four million acres, an area larger than the state of Connecticut (National Oceanic and Atmospheric Administration [NOAA], 2021). This zone received its grisly name because the level of dissolved oxygen in it is too low to support life for many aquatic species (U.S. Environmental Protection Agency [USEPA], 2017a). Although multiple factors drive the yearly formation of the dead zone, a primary cause are the excess nutrients from farmland that travel to the Gulf via the Mississippi River (USEPA, 2017a; Boehm, 2020). The nutrients fuel algae blooms in the Gulf, and when the algae die, they decompose — a process which consumes oxygen in the water and creates hypoxic (low oxygen) conditions (USEPA, 2017a). The dead zone results in cultural, ecological, and economic losses for the communities in the Gulf (USEPA, 2017a; Boehm, 2020). In addition, excess nutrients in waterways pose a health risk through the contamination of drinking water and acceleration of the growth of toxic algae (USEPA, 2017a).

Because a large proportion of the excess nutrients which exacerbate the Gulf of Mexico dead zone originate from upstream farmland, reducing the size of the dead zone requires cooperation by stakeholders throughout the watershed. As such, in addition to federal agencies and the National Tribal Water Council, 12 states with waterways that drain into the Gulf of Mexico participate in the Mississippi River/Gulf of Mexico Hypoxia Task Force: Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin (USEPA, 2021). In 2008, the Hypoxia Task Force states were charged with putting forward a nutrient reduction strategy by 2013 (Mississippi River Gulf of Mexico Watershed Nutrient Task Force, 2008). Many of the state strategies highlight the importance of agricultural conservation practices (e.g., cover crops, riparian buffers, wetlands) that can reduce excess nutrients, especially nitrogen, from reaching waterways (USEPA, 2017b; USEPA, 2021).

Few states regulate the adoption of these conservation practices (Porter et al., 2015), relying instead on voluntary action informed by outreach. Consequently, communication, particularly strategic communication designed to motivate farmer action, could be a critical tool to encourage farmers to voluntarily adopt conservation practices. Reviews of literature about farmer adoption of conservation suggest that communication is an influential factor in the adoption of conservation practices by farmers (Baumgart-Getz et al., 2012; Liu et al., 2018; Prokopy et al., 2019). One potentially important medium for farmer outreach and communication is the news media.

Conservation educators and practitioners engage publics via news media (Ardoin et al., 2013; Horsley et al., 2020; Jacobson et al., 2015), and other research corroborates that lay audiences learn about environmental issues through news media (Witzling et al., 2015; Witzling et al., 2020). Farmers, specifically, rely on news to learn about conservation and water quality (Jackson-Smith et al., 2018; Perry-Hill & Prokopy, 2014; Sundermeier et al., 2009). News directly from agricultural organizations is also important to farmers, as interviews with agricultural leaders from the Western U.S. revealed a preference for environmental information from the Farm Bureau (Bonnie et al., 2020). Consequently, understanding how news stories frame and discuss nutrient reduction can provide clues about what different stakeholder groups may or may not know or believe about it. Nevertheless, little attention has been paid to the role of news media or how different media sources portray nutrient reduction, or more broadly, agricultural conservation practices (Witzling et al., 2021).

To fill this gap, and to better understand the kind of messages about agricultural conservation stakeholders are likely to encounter in news media, we analyzed coverage of the Iowa Nutrient Reduction Strategy (INRS). The INRS aims to reduce nutrients in Iowa's waterways, and ultimately the Gulf. Through the strategy is not exclusively focused on agriculture, it is a central part of it. We conducted a content analysis of news media likely encountered by key agricultural stakeholders in our target area (e.g., farmers, agricultural landowners, agribusinesses, policymakers) by examining coverage in two agriculturally focused newspapers, and two non-agricultural newspapers. Iowa residents who are not involved with agriculture are stakeholders, too, as the decisions about funding and regulating nutrient reduction have the potential to impact the whole state. Building consensus may be complicated if these stakeholders encounter different messages about nutrient reduction in the media they consume.

Literature Review

Theoretical Framework

Before stakeholders encounter information about conservation in the news, editors and journalists make choices about what stories to cover and how to frame those stories. In turn, these choices have implications for how audiences interpret the content. Two media effects theories, agenda setting and framing, explain this process.

Agenda setting theory suggests media coverage can impact how *important* people think issues are. Agenda setting theory puts forward that audiences assign greater importance to issues that are covered in greater volume by news outlets (McCombs, 2015). This theory remains robust — recent meta-analysis of 67 peer-reviewed studies confirms that increased coverage of issues is linked to audiences' perceptions of issue importance (Luo et al., 2018). Taking it a step further, second-level agenda setting describes how the portrayal of people or objects in the news can also influence audience views (Wu & Coleman, 2009). Accordingly, understanding what themes or sources news outlets emphasize when covering the INRS may provide insights about how stakeholders think about the INRS and agricultural conservation.

Furthermore, emphasis framing describes how the way information is presented by communicators, including journalists, can impact audiences' perceptions and understanding of issues (Cacciatore et al., 2012; Cacciatore et al., 2016). If journalists present an issue through a lens that taps into an existing mental structure or schema for their readers, their readers might more efficiently then understand the issue (Cacciatore et al., 2012; Li & Yi-Fan Su, 2018). How an issue is framed may also lead audiences to pay more attention to some aspects of an issue, and then consider those aspects of the issue when making decisions related to that issue (Li & Yi-Fan Su, 2018).

News Coverage of Agricultural Issues

Much previous work about agriculture in the news has focused on how mainstream news outlets cover agricultural issues in terms of which issues which are covered, relevant to agenda setting, and how the issues are framed. For example, previous work has explored the link between animal agriculture and greenhouse gas emissions (King et al., 2006), the use of antibiotics in livestock (Steede et al., 2019), agricultural biotechnology (Lundy & Irani, 2004), or organic agriculture (Cahill et al., 2010). This work is important as it demonstrates how audiences

who are not necessarily involved in agriculture themselves might encounter information about agricultural issues, and in turn which agricultural issues they would likely consider to be important.

A few studies have focused on the intersection of agriculture and conservation-related issues in the news. In one study, researchers examined coverage of water issues in regional news outlets and found that water was often discussed in conjunction with agriculture, but rarely focused on it as a standalone environmental concern (Altaweel & Bone, 2012). In another study, researchers found that media the U.S. and U.K. infrequently discussed the link between climate change and animal agriculture (Kristiansen et al., 2021). Prokopy et al. (2011) examined how conservation was covered in magazines either focused on livestock or horses. They found that livestock magazines contained significantly more information about conservation compared to the publications focused on horses, demonstrating that even among agricultural publications, variation likely exists in how much conservation topics are covered. Recently, researchers examined conservation practices mentioned in agricultural trade publications in Wisconsin and found that tillage, manure, and grazing were covered most often (Chen & Shaw, 2022). They also found that environmental and economic benefits were mentioned more often than agricultural benefits, and that the federal government and Extension were cited most often as sources.

Comparing News Coverage Geared Toward Agricultural and Non-agricultural Audiences

Also relevant to our study is research that has specifically compared coverage of conservation-related topics in agricultural and non-agricultural papers, or relatedly between rural and urban news outlets. Church et al. (2020) compared mainstream news coverage of drought to coverage in agricultural trade publications. They found more reporting about drought impacts in the agricultural trade publications than one of the mainstream news sources that they examined: *The New York Times*. In contrast, there was more discussion of climate change as a cause of drought in *The New York Times*. Corbett (1995) compared urban and rural news coverage about wildlife and found that rural and urban news outlets focused on different themes, with urban papers focusing more on stewardship and rural papers focusing more on utilitarian aspects of wildlife. In another study, researchers found that within communities high in pluralism (i.e., more diverse communities), news coverage more often used science frames when covering local environmental contamination issues, though governmental frames were used both by high and low pluralistic news outlets (Griffin & Dunwoody, 1997). This work has implications for news coverage along urban and rural lines, as rural areas tend to be less diverse (Parker et al, 2018).

Differences in coverage between agricultural and non-agricultural news outlets might be expected given differences in editorial perspectives and audience interests. In interviews about coverage of risk, editors of agricultural magazines reported that they prefer to concentrate content on agricultural risks that differ from agricultural risks already heavily covered in mainstream media, as they felt their readers already knew about such risks or were not concerned with them (Abrams & Meyers, 2010). In contrast, the editors felt a primary concern was to include content related to financial risks, and relatedly, how to save farmers money (Abrams & Meyers, 2010).

Due to the news value of proximity, coverage can also differ between outlets when communities have economic ties to an issue at hand—relevant to the context of nutrient reduction. For example, coverage of the northern spotted owl conflict was greater in news outlets

located in cities where more individuals worked in the lumber industry, and in cities that appeared to be more economically connected to the northwest, where spotted owls live (Bendix & Liebler, 1999). Slightly different conclusions were drawn by Griffin and Dunwoody (1995), who found that the likelihood of different news outlets running stories after being sent a press kit about pollution was related to whether those communities relied somewhat on manufacturing, though not heavily — for communities that heavily relied on manufacturing, the topic may have been too sensitive.

News Coverage over Time: The Issue Attention Cycle

Another useful lens with which to examine the INRS is the issue attention cycle (Downs, 1972; Brossard et al., 2004). In his original conception of the cycle, Downs (1972) wrote that a problem may jump into public view and then, even unresolved, fade away. He laid out five stages that public issues tend to go through: 1) a pre-problem stage, in which the problem exists but public attention is not yet focused on the problem, 2) a stage characterized by alarm and enthusiasm, in which a turn of events drives a spike in attention and individuals seek action, 3) a stage when there is a realization of the cost of solving the problem, 4) a decline in interest, due to realizations about the difficulty and funding needed to solve the problem, and 5) a post-problem stage, when less attention is focused on the issue but policies set in place earlier may now (quietly) help address the problem.

Patterns in issue attention cycles can vary by country. For example, Brossard et al. (2004) examined coverage of global warming between the years of 1987 and 1997, and between two sources—the *New York Times* and the French newspaper *Le Monde*. The study found that France’s coverage was event-based with a narrower range of viewpoints presented, while American coverage highlighted conflicts between scientists and politicians, suggesting that the cycle should be considered through a specific cultural context (Brossard et al., 2004). Another study examined differences in H1N1 coverage between U.S. and South Korean media and found different patterns in volume of coverage and sources used (Jung Oh et al., 2011), again suggesting that cultural context matters when it comes to issue attention cycles.

Patterns in coverage over time may also differ based on the type of publication, as Church et al. (2020) showed how there were different patterns in the volume of coverage about climate change in drought reporting over time in agricultural trade publications and mainstream media. The peaks in coverage over a two-year period appeared to be event-driven (e.g., new government reports) for both categories of publications, but with peaks occurring at different times. An additional source of complication relevant to this context is that weather events may influence news coverage related to water issues (Altaweel & Bone, 2012; Church et al., 2020).

Purpose and Objectives

The purpose of this study was to understand the kind of messages about agricultural conservation different stakeholders were likely to encounter in news media in Iowa. Our objectives were to:

1. Determine which themes were dominant in agricultural and non-agricultural news outlets’ coverage of the INRS

2. Determine which sources were referenced when agricultural and non-agricultural news outlets covered the INRS
3. Describe patterns in the volume of coverage about the INRS in agricultural and non-agricultural news outlets over time

Materials and Methods

Study Context: Iowa

Iowa makes a fitting choice for this study as the state is both an agricultural leader and a key contributor of excess nutrients to the Gulf of Mexico (Boehm, 2020). Additionally, the state was an early adopter of a nutrient reduction strategy, as the INRS was adopted in 2013 (Northey & Gipp, 2013) and updated in 2017 (Iowa Department of Agriculture and Land Stewardship [IDALS] et al., 2017). The statewide strategy calls for the use of agricultural conservation practices, suggesting that “watershed planning needs to achieve balanced implementation of off-field and in-field practices, to optimize the resulting reductions of nutrients transported to local and Gulf waters” where possible (IDALS et al., 2017, p. 21).

Since the plan’s adoption, there has been tension between those who favor efforts to voluntarily encourage agricultural conservation practices, and those who favor regulation. An environmental group, the Iowa Environmental Council, supported the idea of regulatory measures, and using sales tax revenue to fund water quality projects (Eller, 2019). The group warned that without mandating participation by farmers in conservation practices, the plan’s ambitious 45% nutrient reduction goal could not be met (Eller, 2019).

Another point of contention in the state was a lawsuit filed two years after the INRS was officially put forward. The Des Moines Waterworks, the utility responsible for providing water to Iowa’s largest city, filed a lawsuit against drainage districts in 10 counties in Iowa (Meinch, 2015). The Des Moines Waterworks argued that they should not be held financially responsible for the cost of treating water contaminated with excess nutrients from agricultural runoff, and that drainage districts should be required to have pollution discharge permits (Meinch, 2015). Support for the lawsuit was split along rural and urban lines. According to a poll conducted in Iowa state the time, 71% of urban residents supported the lawsuit (Eller, 2015). In contrast, only 44% of rural residents were in favor of the lawsuit (Eller, 2015).

Although the suit was dismissed in 2017, tension around agriculture and water remains. For one, the Iowa Citizens for Community Improvement and Food & Water Watch filed a similar lawsuit (Food & Water Watch, 2021). The Iowa Supreme Court ruled against them, and then the group subsequently filed a petition asking the court to reconsider (Food & Water Watch, 2021). Secondly, there appears to be increased tension between urban and rural counties. Recently, the supervisors of seven rural counties in Iowa passed resolutions stating that they would not support a proposed watershed plan if the urban counties of Dallas and Polk (Polk is the county in which Des Moines is located) remained part of a multi-county coalition that seeks to reduce flooding and improve water quality (Eller, 2020). As a result, there is frequent and diverse news coverage about water quality, the INRS, flooding, and agriculture across the state.

Newspaper and Article Selection

We collected digital articles from four publications that targeted agricultural and non-agricultural audiences in Iowa. For non-agricultural audiences, we examined two newspapers that target a general readership and have the widest circulation in Iowa: the *Des Moines Register* and *The Gazette*. We determined these two papers had the widest circulation using Cision, a company which provides data about media outlets (Cision, 2022). As the two papers were also associated with Iowa's two largest cities (Des Moines and Cedar Rapids, respectively), the readership for these papers is also likely to be more urban. We also examined the Iowa Newspaper Association database to confirm that these two papers had wide circulation in the state (Iowa Newspaper Association, 2020).

Data about readership and agriculturally focused papers was not available in Cision or the Iowa Newspaper Association. Instead, we selected to analyze articles in *Iowa Farmer Today* because it was more often rated a very important source of agricultural information among Iowa crop advisors, compared to other agriculturally focused news outlets in the state (Church et al., 2017). We also chose to analyze the Iowa Farm Bureau's *Spokesman*. We made this selection due to the importance of the Iowa Farm Bureau in the state. Although specific circulation numbers were not available, the Iowa Farm Bureau's (2021) website states that their publication is the "largest circulation ag newspaper in Iowa." We also corroborated our selections with a leading practitioner in the state who works closely with farmers through a prominent statewide agricultural education program.

Next, we selected search terms and a date range. Because the INRS is a guiding force in agricultural conservation adoption in Iowa, we selected "nutrient reduction strategy" as our search term. We experimented with broader terms (e.g., "agriculture" plus "water quality"), which resulted in the retrieval a high volume of unrelated articles. Our date range began in 2012, when the state of Iowa released a draft of the INRS for public comment, and collected articles through 2019, the most recent completed year before we conducted the analysis in early 2020.

To retrieve articles from the *Des Moines Register* and *The Gazette*, EBSCOhost was used. The *Spokesman* and *Iowa Farmer Today* articles were retrieved directly from the outlets' websites. A total of 833 articles were initially retrieved and downloaded as PDFs following the search criteria. We removed 105 articles because they were retrieved in error (e.g., the article did not actually originate with one of the four target publications) or we did not have access (this was the case with a small number of *Spokesman* articles that were only accessible to their membership). We also removed another 42 articles because they were not applicable or because they included event announcements rather than feature stories or editorials. We randomly selected approximately 8% (57 articles) of the remaining 686 articles for three rounds of practice coding and approximately 20% (146 articles) for reliability testing. This left a total of 483 articles for the final analysis. Of the 483 final articles, 202 were from the *Des Moines Register*, 150 were from *The Gazette*, 83 were from the *Spokesman*, and 48 were from *Iowa Farmer Today*.

Codebook Development

To develop our codebook, we drew on Cacciatore et al. (2012) for key words to represent themes related to the environment, health, risk/benefit/uncertainty, and science. For words related to the agricultural theme, and for developing categories of individuals likely to be used as

sources, we held team meetings to discuss observations we made during practice coding sessions. We also planned to code each article and source quote for valence in terms of showing support, or not showing support, for the INRS and for conservation practices. We created our codebook in the online platform Qualtrics.

In total, we completed three rounds of practice coding using 57 articles. In the first round, four members of the research team coded 19 randomly selected articles using the codebook. After discussion, the key words were refined and an additional 18 randomly selected articles were coded by the four coders. This procedure was repeated a third time with 20 articles and three coders, as the practice and discussions had resulted in agreement among the coders regarding categories for sources and themes but not regarding the valence. Ultimately, the codes related to valence were dropped as we determined that there was too much nuance in how the INRS was discussed to clearly state whether articles or sources were supporting it. In particular, the INRS and conservation practices were generally discussed supportively, but related funding strategies and regulatory actions were often criticized.

The final themes and their key words for the codebook are listed in Table 1. Their presence or absence was noted by coders in the lead or headline only, as we were interested in the primary themes of the articles. Articles could contain more than one primary theme. The final source quote categories in the codebook included: agricultural organization representative or educator, environmental group representative, farmer, politician, public servant, and scientist. To be included as present, an individual representing the viewpoint category either needed to be quoted directly in the article or be the author of an editorial. If a source was identified as having multiple roles (e.g., a politician who was also a farmer), they could be categorized in more than one category. To assist with coding, we used Adobe Acrobat to auto-highlight key words in the PDFs. Coders could also enter qualitative information into a field in the electronic codebook about problems they encountered or interesting observations.

Table 1.
Key words used to identify themes.

Themes	Key words
Agriculture	Agriculture, crop, expense (on farm), farm, farmland, flood reduction (on farm), profit, rural community, rural life, soil building, soil health, till, yield
Environment	Conservation, dead zone, ecology, ecological, environment, habitat, hypoxia, hypoxic, outdoor recreation, pollutant, pollute, steward, species, waterways (including named waterways or waterbodies)
Health	Contaminant, drinking water, health (excluding soil and water health), human safety, illness, sickness
Risk/benefit/uncertainty	Advantage, benefit, challenge, compliment, controversy, conflict, crisis, criticize, danger, debate, exposure, gain, harm, hazard, inconclusive, innovation, loss, opportunity, promise, problem, strength, risk, threat, weakness, uncertain, unclear, unintended, unknown, unproven
Science	Science, technology, innovation, invention, discovery, research, study

Note: Derivatives of key words were included.

Intercoder Reliability

To confirm intercoder reliability, two coders coded a random selection of approximately 20% of the corpus (146 articles). Using 20% to calculate intercoder reliability is a common practice (Pals Lilgendahl & McAdams, 2011; McLean & Pratt, 2006; Neuendorf, 2017, p. 187).

We calculated both percent agreement, which does not account for agreement that could occur by chance, and Gwet's coefficient. Gwet's coefficient, like Cohen's kappa, accounts for chance, and intercoder agreement at .60 or greater is generally considered acceptable (Neuendorf, 2017, p. 168). We chose Gwet's coefficient as it provides a more robust statistic than other chance-correcting statistics when data is unbalanced (e.g., there were far more articles with no quotes from scientists than with quotes), as it appeared to be with this data (Neuendorf, 2017, pp. 176-178).

The average Gwet's coefficient across sources was .80 and our average percent agreement was .87. For agricultural representatives or educators Gwet's coefficient was .71 and percent agreement was .81, for environmental group representatives Gwet's coefficient was .84 and percent agreement was .87, for farmers, Gwet's coefficient was .91 and percent agreement was .94, for politicians Gwet's coefficient was .73 and percent agreement was .85, for public servants Gwet's coefficient was .76 and percent agreement was .83, and for scientists Gwet's coefficient was .87 and percent agreement was .90. Our average Gwet's coefficient across themes was .77 and our average percent agreement was .87. For agriculture Gwet's coefficient was .80 and percent agreement was .90, for the environment Gwet's coefficient was .63 and percent agreement was .81, for health Gwet's coefficient was .92 and percent agreement was .83, for policy Gwet's coefficient was .51 and percent agreement was .76, for risk/benefit/uncertainty Gwet's coefficient was .85 and percent agreement was .90, and for science Gwet's coefficient was .89 and percent agreement was .90.

Gwet's coefficient for the policy and environmental themes were lower than for other themes. We chose to present data related to the environmental theme given the guideline that percent agreement over 80% is satisfactory (O'Connor, & Joffe, 2020), which it was for that theme. In contrast, we chose to remove the policy theme, one option outlined by Neuendorf for codes with low reliability (Neuendorf, 2017, p. 188), as the percent agreement was not over 80% in addition to the fact that Gwet's coefficient was low.

Results

Our first objective was to determine which themes dominated news coverage of the INRS and how these themes emerged in agricultural and non-agricultural news outlets. To compare the prevalence of the themes in the leads and headlines of agricultural and non-agricultural papers, we used a Chi-square test and found that both agricultural news outlets led with the agricultural theme more frequently than the non-agricultural outlets (Table 2). In particular, the *Spokesman* stood out as leading with this theme in 85.5% of their articles. There were additional differences among the papers with three themes—health, risk/benefit/uncertainty, and science. Science as a primary theme was more common in one of the agricultural papers: *Iowa Farmer Today*, with 16.7% of its articles leading with this theme. The *Des Moines Register* more commonly led with a health theme (12.4%).

Interestingly, it appears that with risk/benefit/uncertainty theme, one agricultural (the *Spokesman*) and one non-agricultural (the *Des Moines Register*) outlet led with the theme more

commonly than their counterparts, suggesting some differences in coverage are driven by factors other than a focus on agricultural audiences.

We also present results of the overall prevalence of these themes in Table 2 to understand more about how the INRS is generally presented. Looking at all outlets together, themes related to agriculture and the environment were more commonly presented than themes related to risk/benefit/uncertainty, health, or science.

Table 2

Prevalence of primary themes in agricultural and non-agricultural news outlets with Chi-square test results.

	All papers		<i>The Gazette</i>		<i>Des Moines Register</i>		<i>Iowa Farmer Today</i>		<i>Spokesman</i>		<i>p-value</i>
	<i>Prevalence</i>		<i>Prevalence</i>		<i>Prevalence</i>		<i>Prevalence</i>		<i>Prevalence</i>		
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	
Agriculture	256	53.1	74	49.3	81	40.3	30	62.5	71	85.5	<.001
Environment	229	47.5	69	46.0	98	48.8	20	41.7	42	50.6	0.744
Risk/benefit/ uncertainty	107	22.2	22	14.7	56	27.9	6	12.5	23	27.7	0.005
Health	37	7.7	7	4.7	25	12.4	3	6.3	2	2.4	0.008
Science	29	6.0	6	4.0	8	4.0	8	16.7	7	8.4	0.005

Our next objective was to determine which sources were referenced by agricultural and non-agricultural news outlets in their coverage of the INRS. The *Spokesman* stood out for more often including agricultural organization representatives or educators while the *Des Moines Register* more often included politicians and environmental group representatives (Table 3). The *Iowa Farmer Today* included scientists more often as sources, which aligns with their frequent use of the science theme. Looking at source inclusion overall, politicians were most often included, while scientists were the least often included.

Table 3

Prevalence of sources in agricultural and non-agricultural news outlets with Chi-square test results.

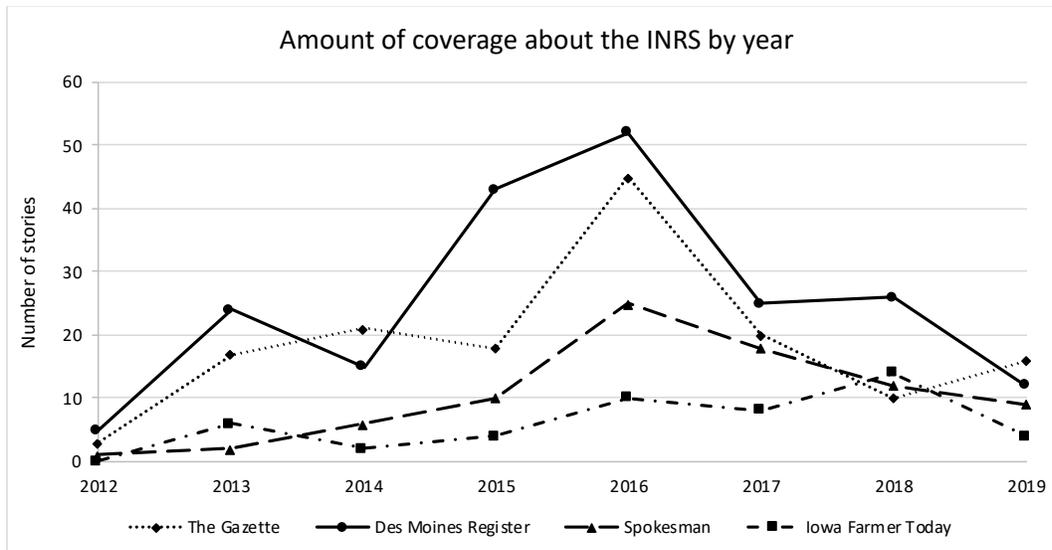
	All papers		<i>The Gazette</i>		<i>Des Moines Register</i>		<i>Iowa Farmer Today</i>		<i>Spokesman</i>		<i>p-value</i>
	<i>Prevalence</i>		<i>Prevalence</i>		<i>Prevalence</i>		<i>Prevalence</i>		<i>Prevalence</i>		
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	
Politician	182	37.7	59	39.3	87	43.1	15	31.3	21	25.3	0.03
Agricultural organization	111	21.0	25	16.7	48	23.8	7	14.6	31	37.3	0.002
Public servant	107	22.2	31	20.7	48	23.8	5	10.4	23	27.7	0.121
Farmer	95	19.7	30	20	32	15.8	9	18.8	24	28.9	0.094
Environmental organization	82	17.0%	28	18.7	48	23.8	4	8.3	2	2.4	<.001
Scientist	66	13.7	17	11.3	24	11.9	17	35.4	8	9.6	<.001

Finally, in our third objective, we sought to describe patterns in the volume of coverage about the INRS in agricultural and non-agricultural news outlets over time. We found similar

patterns in the timing of coverage among three out of the four news outlets. The *Des Moines Register*, *The Gazette* and *Spokesman* all followed a similar pattern, with small peaks in coverage in 2013 or 2014. Coverage increased over time, with a larger peak in coverage in 2016 (Figure 1). The *Des Moines Register* appears to show a disproportionately higher peak in 2013, indicating stronger and earlier interest in the topic. The *Iowa Farmer Today* coverage volume followed a more distinct trend than the other three papers, with a peak in 2018.

Figure 1.

Volume of coverage about the INRS among four news outlets over eight years.



Discussion

To better understand whether different stakeholders are likely to encounter different kinds of messages about the INRS, we examined coverage of the strategy in agricultural and non-agricultural news outlets in Iowa. We note that prior research has found that news coverage of conservation can differ between news outlets based on factors such as pluralism, urban and rural status, and ties to industry (Bendix & Liebler, 1999; Church et al. 2020; Corbett, 1995; Griffin & Dunwoody, 1995; Griffin & Dunwoody, 1997). Similarly, we found differences as well, primarily that the two agricultural news outlets presented agriculture as a primary theme more commonly than the non-agricultural news outlets. This result may seem unsurprising given that the agricultural news outlets specifically cater to agricultural audiences. For non-agricultural audiences, discussing the INRS through frames that resonate with them, rather than agriculture, may help these audiences more efficiently understand the issue (Li & Yi-Fan Su, 2018). However, the problem of excess nutrients in the state's waterways, and the solutions to addressing this problem, are very much agricultural. In this light, the fact that the non-agricultural news outlets focus less on agriculture in their content becomes problematic as it suggests urban residents may be missing key information.

We also found that the urban papers rarely quoted agricultural representatives or educators, suggesting their readers may not be hearing the same story as readers of agriculturally focused news. Furthermore, though the agricultural and non-agricultural papers did not differ significantly regarding the prevalence of leading with environmental themes, we observed differences in who the news outlets quoted to support that theme, as environmental group

representatives were more commonly cited in the two non-agricultural media outlets. It is possible that agricultural media outlets avoided these sources because they are viewed as less appealing or trustworthy to their audiences. Indeed, a recent survey suggests that farmers are less likely to trust environmental and conservation-oriented organizations than they are to trust other farmers or ranchers, scientists at universities, or government agencies for information about conservation issues (Bonnie et al. 2020).

Not all of the differences we observed between papers were along agricultural or non-agricultural lines. Though used less overall by the news outlets, we found one agricultural outlet, the *Spokesman*, and one non-agricultural outlet, the *Des Moines Register*, led with the risk/benefit/uncertainty theme more than their counterparts. It is important to note that for the purpose of this study, risks and benefits could relate to environmental and health risks, such as the risk of exposure to nitrates in drinking water, or risks associated with financial losses on farms, which is commonly described as a potential outcome of mandatory conservation regulations. Without additional exploration of the articles that included this theme, it is hard to determine if the risk/benefit/uncertainty theme was being used in the same way by these outlets. Thus, future research should explore this question and examine the different contexts in which risk/benefit/uncertainty is used.

Another noteworthy finding was that science and health were uncommonly employed as primary themes. This suggests that the narrative around the INRS may be more narrowly framed around agricultural and environmental consequences, with less attention paid to health or scientific input. This potentially puts all stakeholders involved at a disadvantage, as they may be missing out on important information. Additionally, given recent reports suggesting that rural and agricultural stakeholders place a great deal of trust in scientists regarding environmental issues (Bonnie et al. 2020), there may be a missed opportunity to increase engagement among and between scientists and agricultural audiences.

Additionally, we examined patterns in volume of coverage about the INRS in agricultural and non-agricultural news outlets over time. The *Des Moines Register*, *The Gazette* and *Spokesman* followed a similar pattern that appears to align with how Downs described the issue attention cycle. Coverage in 2012 was quite low, when the issue was in the pre-problem stage, with increased coverage over time during a stage where people became aware the problem, in this case marked by events such as the lawsuit in 2015. Coverage may have also increased due to an election, as 2016 was an election year for the Iowa Secretary of Agriculture. This finding also aligns with the finding by Church et al. (2020) that peaks in coverage can be event driven. Stage three in the issue attention cycle is a realization of the cost. We found evidence of this stage, as in 2018 several stories discussed the possibility of using sales tax revenue to fund conservation measures. Afterward, there was a decline in coverage, corresponding to the fourth stage which is marked by declining interest due to challenges and funds needed to solve the problem (Downs, 1972).

In contrast, the *Iowa Farmer Today* coverage volume followed a more unique trend, with a peak in 2018. This pattern, in addition to the fact that science was more emphasized in this outlet, suggests that the *Iowa Farmer Today* makes distinct editorial decisions that did not necessarily align with the other three outlets included in this study. It is also interesting given that Griffin & Dunwoody (1997) found news outlets in communities higher in pluralism more often used science frames, though in our study an agriculturally focused paper more often led with science. Consequently, this study shows how news outlets, even those that focus on a similar location or industry, can have distinct patterns in the volume of coverage of an issue over

time, and the portrayal of that issue. These findings also show the importance of recognizing diversity in opinion and preferences among agricultural audiences, which are likely reflected in the choices made by *Iowa Farmer Today* editors.

One limitation of our study was that our coding was limited to examining articles for the presence or absence of themes and sources and did not include information about the context surrounding the use of specific themes or sources. As a result, our data does not allow for a deeper understanding of the context surrounding the patterns we found. Second, we did not present data for a general policy theme as our reliability was low for that code. Future scholarship might consider narrowing that theme to focus on references to local, state, or national government agencies or actors. Alternatively, future work could separate terms related to government policy, citizen action, and collaboration. We may have also had difficulty achieving reliability for this code as qualitatively we note that much of the content discussing policies related to the INRS reflected ambivalence surrounding funding strategies and the use of environmental regulations in Iowa. This may have contributed to challenges in identifying the policy theme across the news outlets in this study because each outlet defines and describes policies differently. Future work might also explore when and how specific scientists and environmental groups are included in coverage, as this could highlight new pathways to engage agricultural audiences and other groups often cited as skeptical of environmental actions.

Our work was also limited in scope as we only focused on four news outlets in a single state. Future work might consider news coverage of nutrient reduction efforts in other states with similar policies. Future work might also compare how other sources which are affiliated with an organization, such the *Spokesman*, differ in perspective from news outlets without such affiliations.

Overall, this study demonstrated how differences exist regarding news media coverage of a nutrient reduction strategy, and relatedly agricultural conservation, in ways that may impact agricultural and non-agricultural stakeholders' knowledge or views. We found instances of agricultural and non-agricultural news outlets focusing on different themes, and employing different sources, in their coverage of the INRS. Our findings add to the growing body of literature related to the inclusion or exclusion of scientific sources in the media.

Our work points toward a need for journalists and editors to better reflect on their use of sources and consciously include a diversity of values and voices in coverage of agri-environmental issues, and also for scientists who specialize in agriculture and natural resources to improve their relationships with media outlets, possibly through partnerships with science communication researchers and practitioners. Finding common ground among stakeholders may be more challenging as they are likely to encounter different messages about nutrient reduction and conservation in the news. Nevertheless, the importance of consensus-building in this context cannot be overstated, as addressing Gulf hypoxia requires collaboration among stakeholders across multiple states and with diverse interests.

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