



A glass half empty: Limited voices, limited groundwater security for California

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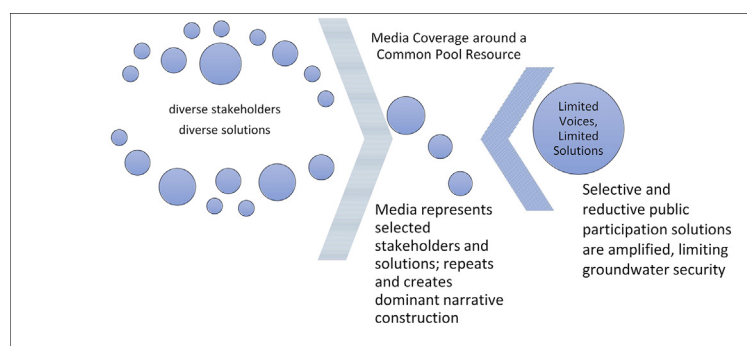
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HIGHLIGHTS

- Media representation of stakeholders is limited to major economic interests.
- Media coverage is focused on simple, singular stakeholder-solution stories.
- Complex news articles cover diverse stakeholders and solutions.
- Representation of economically disadvantaged communities is lacking.

GRAPHICAL ABSTRACT



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ABSTRACT

Groundwater is a common pool resource that supports agriculture, human communities, and the environment. Public participation in common pool natural resources management can be affected by media representation of stakeholders and perceptions of identity as a stakeholder. Newspaper media has an outsized influence on framing subject matter, expertise, organizations, and who should participate. Media shapes individual, local, and regional perspectives around resource management and defines potential solutions to natural resources management. This study analyzes media coverage about California's new Sustainable Groundwater Management Act (SGMA) to understand impacts on public participation in common pool natural resources management and to identify represented stakeholders and solutions involved in groundwater sustainability. A total of 365 newspaper articles were collected from California newspapers in three readership locations. We also searched for representation of SGMA in Spanish-language publications. Article characteristics were analyzed through qualitative content analysis and quantitative nonparametric analysis. Results indicate bias for featuring agricultural industry, politician, and water managers' voices. Solutions for managing water resources were focused on new supply, demand reduction and infrastructure investment, though novel solutions were also presented. Most newspaper articles included few stakeholders and solutions, illustrating isolated, short narratives about a common pool resource. The trends and gaps in representation in California media coverage may contribute to the public's low levels of engagement in groundwater planning.

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1. Introduction

Management of common pool resources is often governed in the United States by public participation processes (Sabatier et al., 2005a; Winslow, 2005). Public participation can range from simple, one-time, one-way online public comment to in-depth and iterative processes that may take several years (Clarke and Peterson, 2016; Ulibarri, 2015). Natural resources management public participation processes can be affected by formal communication from resource managers, including the amount, timing, availability, accessibility of language, and informal communication from interpersonal conversations to corporate mass media campaigns and major news networks. Communication around a natural resource and around its management constitutes the ways in which stakeholders identify with and participate in the management of the resource (Brüggemann and Engesser, 2017; Cox, 2013; Kinsella, 2004). Democratic stakeholder engagement can lead to better outcomes for long-term natural resources management, ecological health, and reductions in pollution (Bulkeley and Mol, 2003; Ulibarri, 2018; Winslow, 2005).

Communication through news media can be especially influential in defining stakeholders, fostering identities around certain issues, and creating social structures (Killingsworth and Palmer, 1992). Trust and identity are critical components of the power and social relations that define, exclude, or include stakeholders in public participation on natural resources management issues (Carolan and Bell, 2003). For an individual or group to participate, engagement requires a perceived opportunity for meaningful, influential participation within a described “decision space” (Daniels and Walker, 2001; Johnson and Walker, 2000; Mitchell, 2006).

Public participation in natural resources management can be influenced by news media; the reader can be defined in their position as either a stakeholder or not through the narrative in the news. Studying media influence entails several challenges around both the production and consumption of mass media in a variety of formats and their transformational impact at large (Carvalho, 2010). In environmental communication discourses, communication, including news media, is a pragmatic conveyance of information and constitutive of the problem and the environment in which it occurs (Cox, 2013). Thus, the public sphere is formed, transformed, and constrained through media communication, influencing the ways in which news consumers perceive of themselves and others in relationship with each other and the issue (Carvalho, 2010).

On the media production side, journalistic processing often presents the environment as a human dimension (rather than a natural dimension, in terms of the human players involved rather than the scientific or environmental components) and contextualizes the issue as urgent and timely (even if it is ongoing) (Herndl and Brown, 1996; Killingsworth and Palmer, 1992). Journalists tend to select vocal experts, often from the lay and experiential realm of expertise rather than technical (Collins and Evans, 2007). These voices may have a greater role in environmental and risk issues, skewing debates toward a discussion of norms to the exclusion of scientific facts (Boyce, 2006; Endres, 2009). Journalists may also select opponents to structure debates as “us-versus-them” issues, rather than more well-rounded, pluralistic discussions; in doing so, journalists tend to overrepresent outlier positions (Boykoff and Boykoff, 2004; Brüggemann and Engesser, 2017). Journalists, intentionally or accidentally, overlook some stakeholders: they know their audience, the culture of the readership, and the details of the location and can use this understanding to invigorate and connect with existing biases among consumers. The media may also be likely to support status quo narratives and rely on authority to impose moral influence on readers (DeLuca, 2009).

On the media consumption side, heuristic and biased processing of information can occur when consumers interpret neutral information as a means to support existing arguments and perceptions (Chaiken and Maheswaran, 1994). Because newspapers are particularly

trustworthy among the public, compared to online and television media, they have more influence (Wakefield and Elliott, 2003). With respect to issues involving personal risk, readers tend to consume journalism more readily without tempering of perceptions through social networks and distrust of media (Wakefield and Elliott, 2003). Communication research has shown that “personal meaning-making draws both on media(ted) discourses and on lived experiences and social relations” (Carvalho, 2010). Media simultaneously reflects and constructs the community of stakeholders.

Media representation matters because individuals' symbolic standing affects the capacity to recognize themselves as a stakeholder or potential participant in natural resources management (Areia et al., 2019; Carolan and Bell, 2003; Hamilton, 2005). Our prior research on dominant narratives has shown their capacity to influence stakeholders and foster a myopic, protracted approach to an otherwise expansive issue, thereby defining what is and what ought to be happening with a natural resource and influencing the scope of decision making processes (Bernacchi and Peterson, 2016; Bernacchi et al., 2015). In sum, newspaper media have significant weight in defining not only stakeholders, who is in and who is not, but also potential solutions for common pool natural resources management. In other words, newspaper media constrain the natural resources management decision space—that is, what is on the table to be negotiated and the degree to which stakeholders and participants can affect or influence the process and outcome; the more issues that are available for discussion in the decision-space, the greater the collaborative potential (Walker and Daniels, 2019).

Although “stakeholders” has varying interpretations, resources that have the most inclusive definition of stakeholder, due to access and lack of exclusion, are often common pool resources. For this paper, we focus on the management of groundwater, a common pool resource. Common Pool Resources are unique among managed natural resources in that excluding benefits to some users or stakeholders is difficult, management decisions may impact a greater breadth of stakeholders than a privately held resource, and that actions by one stakeholder affect the quantity and quality of the resource (Ostrom, 2015). By the definition of limited excludability, subtractability, rivalry in appropriation by a finite set of users for a finite flow of benefits, groundwater in California is a classic common pool natural resources management problem (Castilla-Rho et al., 2020).

Groundwater is water that fills the voids among sediments underground, lies within 4000 m of the earth's surface, and is approximately <1% of the Earth's total water supply, but it is the largest reservoir of available freshwater to humans (Harter and Rollins, 2008). Globally, groundwater is a critical resource for arid and semi-arid parts of the world, and is at greater risk to water security globally than is currently acknowledged (Famiglietti, 2014), and groundwater drought may take many years to recover compared to surface water depletions (Harter and Dahlke, 2014). Like many irrigated agricultural areas globally, California's groundwater is at risk because of interrelated factors, including lowered groundwater table, reduced storage capacity due to subsidence, contamination of aquifers and drinking water and limited data on pumping of groundwater (Ruud et al., 2004; Fram and Belitz, 2011; Lockhart et al., 2013; Schoups et al., 2005; Welch et al., 1988). In California, groundwater accounts for two-thirds of California's water supply (Harter and Dahlke, 2014): groundwater supplies 30% of agricultural water in a wet year or 80% in a dry year, when surface water deliveries are restricted (Hanak et al., 2019). Risks to groundwater availability are far-reaching, presenting challenges to regional and state economic drivers of agricultural production and rural employment (Hanak et al., 2019; Medellín-Azuara et al., 2011; Schoups et al., 2005). Although agriculture is only 2% of the GDP of the state, the region is greatly influenced by agriculture. In the two basins used in this study, the Tulare Basin and San Joaquin Basin, agriculture composes 15% of the GDP (Hanak et al., 2019). The historical relationship between water resources, land use change, and agricultural production is

illustrated through infrastructure investment throughout the state (Arax, 2019).

We place this analysis in the context of California's newly implemented Sustainability Groundwater Management Act (SGMA), which was signed as a package of three bills by Governor Brown in 2014 (Leahy, 2016). For the first time in California's history, groundwater is a regulated common pool resource, connected to surface water. It is the last western state in the United States to do so (Siders, 2014). Prior to SGMA, groundwater was tied to the overlying landowner. But, spurred by an unprecedented drought (Famiglietti, 2014), diverse groundwater stakeholders, water leaders, and legislators passed SGMA. Under SGMA, an early planning period required public participation, stakeholder engagement, and development of the groundwater sustainability plans (Kiparsky et al., 2016). This planning activity was augmented by the formation of Groundwater Sustainability Agencies, a set of spatially discrete managing organizations tasked with preparation, filing, and implementation of their Groundwater Sustainability Plans within 6 years to 8 years and bringing the basin into sustainability within 20 more years, depending on the priority (California Department of Water Resources, 2019). Under SGMA, sustainability is broadly defined as the avoidance of six undesirable results including lowering groundwater levels, reduction of storage, seawater intrusion, degraded water quality, land subsidence, and depletions of interconnected surface waters (California Department of Water Resources, 2019). Groundwater Sustainability Agencies must write Groundwater Sustainability Plans by 2020 or 2022 and must bring the basin into sustainability by 2040 or 2042 depending on the priority assigned by the Department of Water Resources to critically overdrafted basins. According to legal analysis, Groundwater Sustainability Agencies have "wide latitude to determine what tools to use to achieve sustainable management" (Green Nylen et al., 2017). SGMA functions within a *mélange* of groundwater laws (Harter, 2015), none of which have successfully transformed the common pool resource into a managed natural resource. Significant tradeoffs are likely required to manage groundwater more sustainably (Escriva-Bou et al., 2020).

In this paper, we explore how newspaper media defines stakeholders and solutions, and how news media may impact public participation in management of a common pool resource, such as groundwater. Our overarching question is: how are newspaper media constructing public participation around a common pool natural resource? Using Californian newspaper media coverage of SGMA from the time of its passage to drafting Groundwater Sustainability Plans (January 2014 to April 2019), we rely on a theory-based *a priori* framework to: a) describe who was identified as a stakeholder in the news, b) identify the solutions described with respect to the new groundwater law, and c) analyze the likelihood of co-occurrence with stakeholders and solutions. Our approach may also enable others to assess the role of stakeholder voices and mass media within common pool natural resources management, as well as identify sources of potential shortcomings in public participation. Regionally, our work can serve as a media-representation snapshot evaluation of participation in California's groundwater resources management as SGMA is implemented over the coming decades. And as communities and countries wrestle with the allocation, monitoring, and maintenance of common pool natural resources globally, we believe that an eye on narratives and how stakeholders and solutions are represented in the media is critical to just, effective, and more transparent management and more sustainable outcomes.

2. Approach

We queried a census of geographically limited "Sustainable Groundwater Management Act" newspaper articles for the period January 2014 to April 2019. Our coding of news media centered on identifying stakeholders and management solutions among geographically defined newspaper sources. Stakeholders were based on framing of prior

California water issues and the legal language around SGMA (for example, key groundwater users are engaged in agricultural industry, own more land, and could be subject to more fees). We developed a codebook based on prior media reviews (Areia et al., 2019; Feldpausch-Parker et al., 2013; Takahashi and Meisner, 2012), common pool resources, and groundwater specific issues using a collaborative learning approach (Daniels and Walker, 2001; Walker and Daniels, 2019). Collaborative learning in public participation for natural resources management is based on the concept that stakeholders select solutions that most benefit themselves and "may cling rigidly to one way of viewing the solution," thus requiring explicit incorporation of multiple stakeholder perspectives (qtd. Daniels and Walker, 1996, p. 74). Though the collaborative learning approach is most commonly exercised via in-person stakeholder engagement, where groups build trust over time, we applied it to news media, where individuals build their identity and identify others within a larger context over time. The first stage of public participation in this interpretation is not likely to occur at a public meeting, but rather in the public sphere at large; newspaper media have been found to have a negative impact on political participation generally, stopping participation before it has started (Eveland & Scheufele, 2001). Because reading a newspaper is arguably based on a motivation of learning information about localized or regionalized topics—and that groundwater is a common pool resource affecting all who live in the locality—we claim that this engagement constitutes the initial scoping stage of a collaborative learning moment. In the way that scholars and facilitators have conducted media reviews to scope public participation programs (Feldpausch-Parker et al., 2013), through this frame we explore existing narratives that inform SGMA planning. Newspapers therefore are a site of learning, creating location-based readerships. Journalists' outsized role in selecting and representing stakeholders, based on their own exigencies and focus on new and procedural components rather than engagement, presents challenges to collaborative learning (Boyce, 2006; Wakefield and Elliott, 2003). In the case of novel public participation processes in natural resources management, like SGMA, stakeholders' identity may become exclusively defined by the media and further that "their" solutions may also be exclusively defined for them and entrenched through repetition. On the other hand, a more diverse representation of stakeholders and stakeholder solutions can allow for a larger and more nuanced decision space, and thereby foster greater public participation (Daniels and Walker, 2001).

The codebook was developed around this specific case study: novel groundwater management in California via the Sustainable Groundwater Management Act defined stakeholders as described in the law and in Leahy's (2016) comprehensive description of the intentions behind SGMA (Table 1). We employed a Collaborative Learning approach by describing the stakeholder categories based on stakeholders explicitly specified in SGMA and identified by Leahy (2016). These categories of stakeholders were: *Agricultural Industry*, *Water Manager* (e.g. regional water managers like the Rosedale-Rio Bravo Water Storage District), *Regulators* (i.e. the California State Water Resources Control Board), and multiple-scales of leadership through *Policymakers* and *City and County Officials*, referred to as *City*. We also included an *ex officio* category as a result of searches around disadvantaged communities because these constituents were formally designated under the laws intent to serve such communities. Prior reviews of news media have shown that media often include or exclude certain industries as stakeholders (Feldpausch-Parker et al., 2013). Given that the *Agricultural Industry* is a major contributor to regional GDP (Hanak et al., 2019), major water user of both surface and groundwater, and is heterogenous throughout the San Joaquin Basin and Tulare Lake Basin (Rudnick et al., 2016), we developed a code to include all parties related to agriculture. Technical assessments of natural resources management often construct science or scientific experts as the most important form of evidence, and therefore we also focused on references to *Academics*, defined as researchers, people with a university affiliation, scientists, and those with access to information and recognized expertise (Collins and Evans, 2007;

Table 1
Rationale for codes applied to news media. The codes are short descriptions employed throughout the manuscript as categorical proxies for a broader interpretation of related topics and have been annotated with literature.

Brief definition		Collaborative Learning ^a	California water research ^b	Collaborative Era in water management ^c
Stakeholder codes	Potential participants in influencing decision space			
Agricultural industry	Engaged in production, manufacturing, marketing of agricultural products, lobbyists, land appraisers		•	
Policymaker	State or federal level elected official, including governor	•	•	•
Water manager	Groundwater sustainability agencies, groundwater banks, irrigation districts	•	•	•
City	City and County-scale leaders and decision-makers, elected officials, mayors, supervisors, community members, towns	•	•	•
Academic	Technical experts, scientists, researchers, university affiliates	•	•	•
Regulator	Engaged in the implementation of SGMA, State Water Resources Control Board, Department of Water Resources, regional water quality board	•	•	•
Solution codes	Potential options for implementing SGMA			
Supply	Water sources, including new storage, tunnels		•	•
Demand	Water uses		•	
Infrastructure	Transport, storage, or maintenance of water, usually built, but can include natural aquifers for recharge	•	•	•
Land use	Change in current production of land for alternative purpose		•	•
Laws	New or existing regulatory statutes, propositions and bond measures	•	•	•
Economics	Solutions that use markets and economic principles, including markets, trading, exchange, incentives, fees, and collecting funding	•	•	•
Recharge	All methods and references to returning groundwater to underground storage		•	•
Research	New studies, more information as a solution	•	•	•

^a Walker and Daniels (2019).
^b Grantham and Viers (2014); Hanak et al. (2017, 2019); Lund et al. (2018); Null et al. (2012).
^c Sabatier et al., 2005a, 2005b; Leahy (2016).

Endres, 2009). We based the solutions categories around literature for the case study, our collective expertise in water resources management in California, and the major issues driving California water resources management decision-making (Hanak et al., 2019; Medellín-Azuara et al., 2011; Null et al., 2012; Sabatier et al., 2005; Yarnell et al., 2018). The categories of *Supply* (input), *Demand* (use), *Recharge* (managing supply), *Infrastructure* (dams, reservoirs, aquifers), and *Land Use* were based on groundwater as a source for drinking water, major economic sectors, and food resources globally as well as the human population throughout the state (Hanak et al., 2019; Medellín-Azuara et al., 2011). Additional categories were based around the process of managing groundwater through *Laws* and regulations and *Economics*, including incentives, and finally, *Research* as a solution itself for making more informed rational decisions (Table 1).

Our hypotheses were built around this collaborative learning codebook. We anticipated that (a) some stakeholders were being represented in SGMA articles more than other stakeholders; (b) some solutions were being represented in SGMA articles more than other solutions; (c) that stakeholders and solutions varied by location; and (d) that some stakeholders and solutions are more likely to co-occur than other pairings or clusters. Finally, our key hypothesis is (e) that most media will support a status quo through a dominant narrative (Bernacchi and Peterson, 2016; Boykoff and Boykoff, 2004; Brüggemann and Engesser, 2017; Carvalho, 2010; Endres, 2009; Feldpausch-Parker et al., 2013). In other words, as identified in these prior studies, dominant narratives tend to favor and perpetuate existing constructs because of biased processing (Chaiken and Maheswaran, 1994) and simplified information is more easily processed and more rapidly repeated (Boykoff and Boykoff, 2004; DeLuca, 2009). For this reason, we anticipate that the dominant narrative will include the current largest common pool natural resource -user, or the primary water user, and solutions for maintaining status quo resource management. This hypothesis is also supported by the uneven allocation and status of surface water rights in the state (Grantham and Viers, 2014) that when combined with the newly enacted SGMA will favor entrenched interests.

3. Methods

This study was conducted through iterative steps: 1. definition of the scope of research, 2. selection of news, 3. qualitative content analysis, and 4. quantitative content analysis of a selection of coded news (Fig. 1).

3.1. Definition of the scope of research

We focused on a selected set of geographic areas that also define the readership and potential public participation: the most populous urban areas and the two most critically overdrafted surface water basins. *Tulare Lake Basin* is a terminal lake basin (with no outlets to the ocean) and hydrologic unit which includes the Kings, Kaweah, Tule, and Kern Rivers. Major cities within the *Tulare Lake Basin* include Fresno, Bakersfield, Hanford, Porterville, and Visalia. The *San Joaquin Basin* is a hydrologic region that includes the Stanislaus, Tuolumne, Merced, and San Joaquin Rivers as these flow into the Sacramento-San Joaquin Delta and by the major cities of Stockton, Modesto, Turlock, and Merced (California Department of Water Resources, 2019). A third discontinuous set of locations represents the urban readership: We included all newspapers from the 10 most populous cities in the state and removed the most populous cities that were in either *Tulare Lake Basin* or *San Joaquin Basin*. The major cities included in the *Urban Area* category are Los Angeles, San Diego, San Jose, San Francisco, Sacramento, Long Beach, Oakland, and Anaheim. These categories informed our interpretation of the physical and socio-economic constraints and identified readership and consumers of news media framing.

Spanish-language newspapers were included in order to examine how Spanish-language speakers learn about SMGA. Spanish-language speakers constitute a large demographic of the state, where over 10 million people speak Spanish out of 36 million residents (U.S. Census Bureau, 2017). These articles were only included in the qualitative analysis because the search terms differed.

The research equation was the enacted law and its common acronym as search terms for the given regions and for the time period of enactment to April 2019: “Sustainable Groundwater Management Act” OR

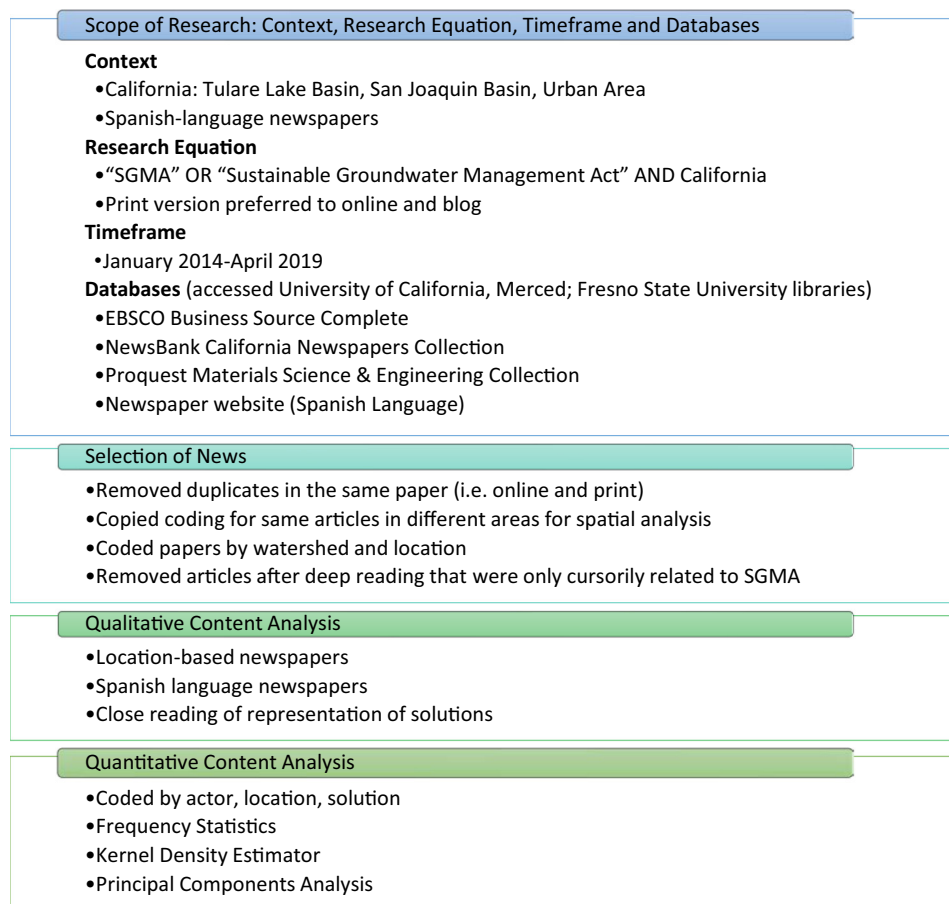


Fig. 1. Study design (after Areia et al., 2019).

“SGMA”. Multiple databases accessed from Fresno State University and University of California, Merced libraries were employed to cover the entire time frame of full-text articles (Newsbank California Newspapers, EBSCO and ProQuest, and individual newspapers as needed to access full-text). In Spanish, various translations, including the official name of the law, yielded zero news articles; we employed terms around groundwater and dry wells: *agua subterranea* or *aguas subterraneas* (groundwater or groundwaters) and *pozos secos* (dry wells).

3.2. Selection of news

Some newspapers reprinted articles within the parent company, and we included reprints to represent different locations within the study design but removed duplicates within the same newspaper. For example, several publications are owned by The McClatchy Company and ran similar stories in each affiliate newspaper (i.e., *Sacramento Bee*, *Modesto Bee*, *Fresno Bee*). Opinion articles were also included. We added metadata for each newspaper to include time, author, and location (i.e. *Tulare Lake Basin*, *San Joaquin Basin*, and *Urban Area*). We removed articles during deep reading that were only relative in passing reference to SGMA. The total number of articles was 325 English-language and 40 Spanish-language (Table 2; Fig. 2).

3.3. Qualitative content analysis

All articles were formatted to count as one case in NVivo 12 Plus by QSR International for qualitative analysis. All articles were read, reviewed, and coded in the *a priori* codebook of 1) stakeholders (Agricultural Industry, Water Manager, Policymaker, Academic, City, and Regulator) and 2) solutions categories (Supply, Demand, Recharge,

Infrastructure, Laws, Economics, Research, and Land Use) (Table 1). The codebook was developed through theory-based approaches around economic drivers, resource managers, and the SPEED technique of searching for policy influences (Daniels and Walker, 2001; Feldpausch-Parker et al., 2013; Stephens et al., 2008). We employed a standard qualitative content analysis approach through systematic, rule-based coding of newspaper media (Krippendorff, 2003). Each article was read and coded by paragraph following the codebook definitions of each *a priori* category. The unit of analysis in the qualitative study was at the paragraph level, where manual coding and text queries developed the coded content. Codes were tabulated for each case and transferred to a SPSS data file for use in the quantitative analysis. This approach enabled examination of the relationships of stakeholders and solutions within the text. After quantitative analysis, the qualitative data were reviewed by each code to ensure accurate interpretation.

3.4. Quantitative content analysis

In order to capture the co-occurrence of stakeholders and solutions within a single article, we created a tabular database containing all identified articles and associated coded categories. For example, for each of the 325 articles the database indicated presence or absence of each coded category (Takahashi and Meisner, 2012). Associations among categories and across locations were studied through cross-tabulation and a linear mixed model. The statistical analysis was performed using IBM SPSS Statistics (IBM Corp, 2017) and R (R Core Team, 2017). We plotted the probability density function of the co-occurrence of solutions and stakeholders in the news using a kernel density estimator. To improve interpretability, we used histograms for each variable, a gradient of

Table 2
Newspapers by location and number of articles covering groundwater law.

San Joaquin Basin			Tulare Lake Basin			Urban Area		
n = 73, 22.5%	n	%	n = 188, 57.8%	n	%	n = 64, 19.7%	n	%
Modesto Bee	22	6.8	Porterville Recorder	77	23.7	Sacramento Bee	25	7.7
Stockton Record	13	4.0	Bakersfield Californian	43	13.2	Los Angeles Times	10	3.1
Merced Sun-Star	12	3.7	Fresno Bee	40	12.3	San Jose Mercury News	7	2.2
Madera Tribune	10	3.1	Hanford Sentinel	21	6.5	San Francisco Chronicle	6	1.8
6 other newspapers	16	4.9	3 other newspapers	7	2.2	4 other newspapers	16	4.9

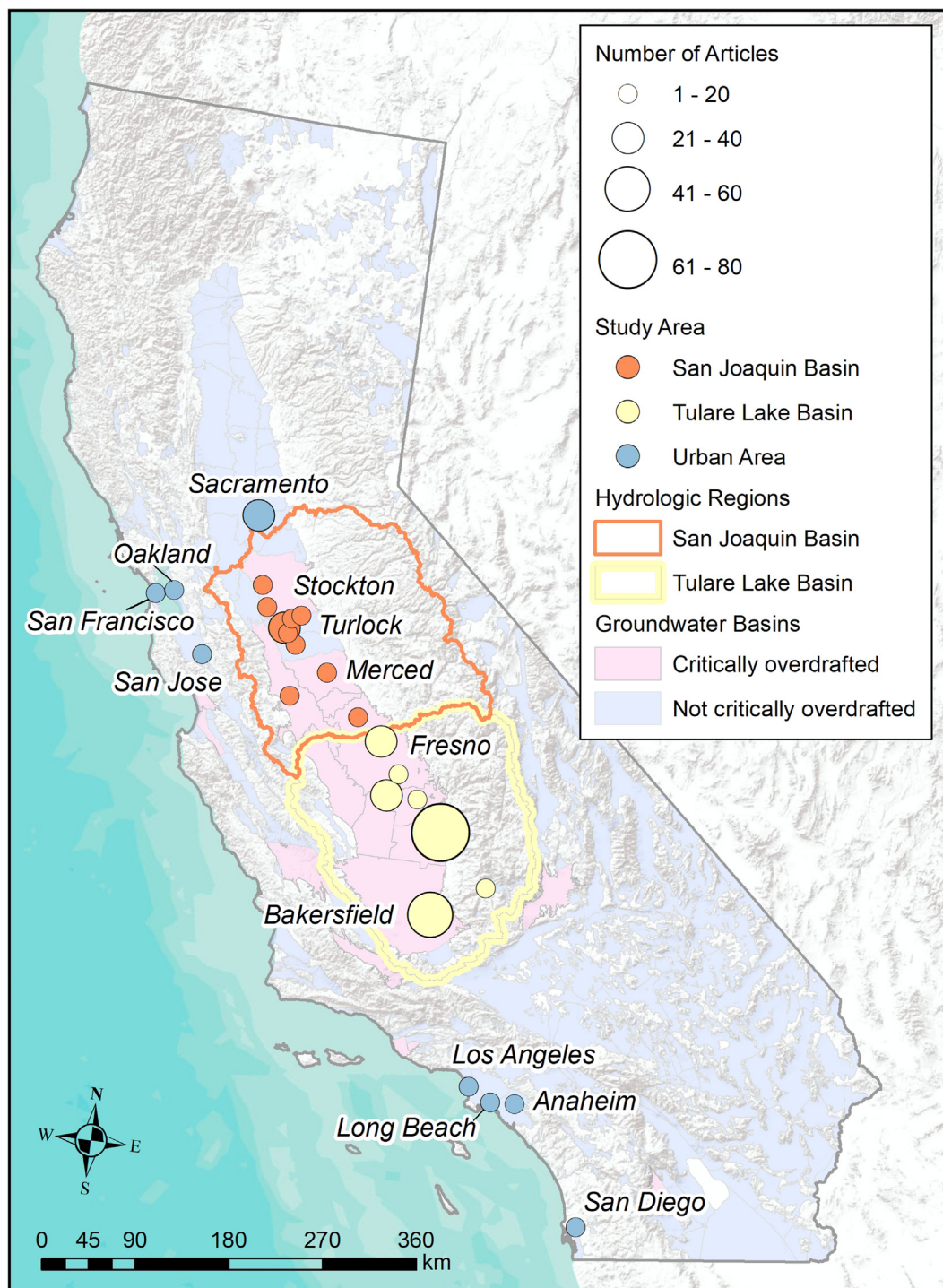


Fig. 2. Map of critically overdrafted groundwater basins and California cities with newspaper articles covering SGMA. The number of articles covering SGMA per city is presented in four intervals to show relative number of articles per city.

colors, and we included uniform random noise (with noise dots ranging from -0.5 to 0.5 from each actual coordinate distributed uniformly).

To examine general relationships among the number of stakeholders and solutions issued per article considering regional readerships, we employed two linear mixed models (LMM) (MASS package in R Core Team, 2017). The dependent variables of each model were, respectively, (i) the number of solutions per article, and (ii) the number of stakeholders per article. The fixed factor in both models was location (levels: San Joaquin Basin, Tulare Lake Basin, and Urban Area). We tested time of publication (levels: years 2014 to 2019) as a fixed factor, but its inclusion did not change model outcomes, and it was not included further. In addition, we performed a cluster analysis (*factoextra* package in R Core Team, 2017; Kassambara and Mundt, 2020) to find subgroups in the dataset of solutions and stakeholders. The variables (the three above-defined regional locations) were transformed to two dimensions using a principal component analysis. The observations were the occurrences of each solution or stakeholder in the news at each region that were distributed according to their relative Euclidean distances (shorter Euclidean distances correspond to more similar occurrences). We found the optimum number of clusters using the average silhouette method (Kassambara, 2020).

4. Results

The presentation of results builds on three groups of variables defined in the *a priori* codebook and by the metadata associated with each publication which includes general characteristics, stakeholder characteristics, and solutions characteristics following Areia et al. (2019). We report qualitative and quantitative results for each category.

4.1. General characteristics

In a search of one California newspaper database (Newsbank), the term “groundwater” appears in 54,476 full text articles from 2000 to 2019. The two years with the least precipitation or most severe drought conditions (2014 and 2015) had approximately 6000 articles annually on groundwater. For comparison, “SGMA” occurs in Newsbank database for the same period in 1283 articles.

Our data represent a subset of all California newspapers selected by location (in the case of the two basins) and population size (for urban areas). In total, 325 news articles were analyzed based on geography. In Tulare Lake Basin, where groundwater overdraft is most severe, *Porterville Recorder* ($n = 77$, 23.7%), *Bakersfield Californian* ($n = 43$, 13.2%), and *Fresno Bee* ($n = 40$, 12.3%) covered the most news related to SGMA. The *Bakersfield Californian* had a reporter focused on water management. All papers covered the development of the governing body (groundwater sustainability agency formation) and which groups were part of each new agency. Porterville, despite being a smaller community, had dry wells during the drought of record and was subject to state intervention, likely affecting the extensive coverage of the new law. Four more papers in Tulare Lake Basin covered SGMA ($n = 28$, 7.7%). By comparison, in the San Joaquin Basin, where groundwater is overdrafted, but surface water supplies are more available, fewer articles covered SGMA: *Modesto Bee* ($n = 22$, 6.8%), *Stockton Record* ($n = 13$, 4%) and *Merced Sun-Star* ($n = 12$, 3.7%), and seven more publications ($n = 26$, 8%) covered SGMA. Finally, *Urban Area* covered SGMA in the news fewer times, especially when considering the population size and that many of the cities are at least partially dependent on groundwater for drinking water. Most of the coverage occurred in the

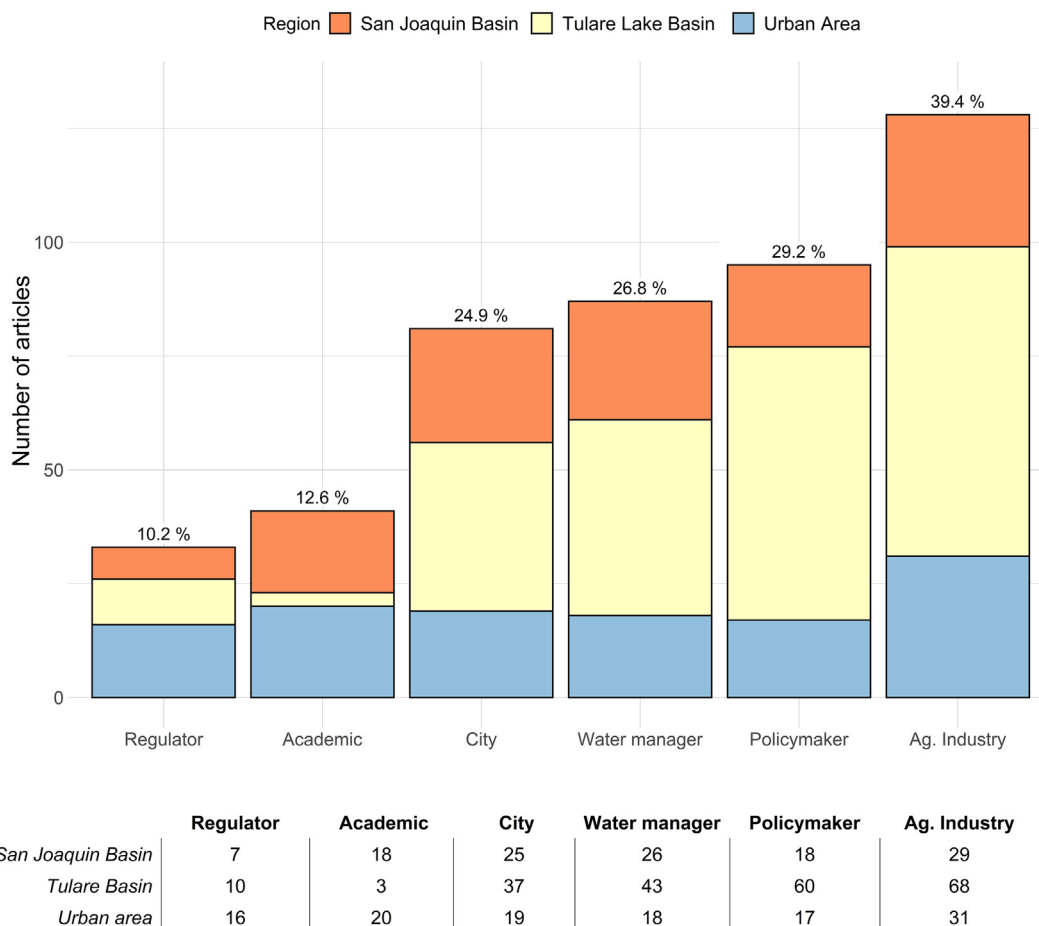


Fig. 3. Prevalence of stakeholder categories across California locations ($n = 282$, 87%). The percent of all newspaper articles containing stakeholder coverage is labeled.

Sacramento Bee ($n = 25$, 7.7%), *Los Angeles Times* ($n = 10$, 3.1%), and *San Jose Mercury News* ($n = 7$, 2.2%) (Table 2). Article counts per city are also portrayed in the map of California (Fig. 2).

4.2. Stakeholder characteristics

Stakeholder categories were based on an *a priori* codebook. All categories appeared across all regions (Fig. 3). The *Agricultural Industry* was represented most frequently, in approximately 40% of all articles. The agricultural sector included diverse representation, from farmers, growers, producers, and ranchers to land appraisers describing land values decreasing under SGMA to legal counsel. Other agricultural voices on SGMA included county farm bureaus, commodity groups—especially higher water use crops and those with high upfront establishment costs such as grapes, orchards, and nuts, and those articles that were covering farm shows and expositions, where training for farmers on SGMA was highlighted in the schedules. Farmers were most often quoted with respect to risk to their farms and operations. *Water Managers*, *Policymakers*, and *City* officials appeared in approximately a quarter of all news (24.9% to 29.2%). As sources of technical authority, *Academics* and *Regulators* each appeared in approximately 10% of articles.

As far as representation across regions, *Academics* were more likely to be featured in the *San Joaquin Basin* or *Urban Area* location publications. *Regulators* appeared in *Urban Area* newspapers most frequently ($n = 16$, 48% of articles that included regulators). *City* and county officials were commonly cited across all locations. *Water Managers*, including irrigation districts, were often quoted within *Tulare Lake Basin* ($n = 43$) and the *San Joaquin Basin* ($n = 26$) with respect to formation of a groundwater sustainability agency. *Policymakers* were likely to co-occur with investments in local and regional *Infrastructure*, including reservoirs, or seeking new water funds or against additional legislation that would further restrict access to water resources among constituents. *Agricultural Industry*, as an important component of regional and state economies, was a prominent component of all SGMA discourse. *Urban Area* coverage tended to point to *Tulare Lake Basin* as an epicenter of SGMA activity, and a hydrologically and geographically distant groundwater-dependent agricultural area near San Diego called Borrego Springs.

4.3. Solutions characteristics

Solution categories were based on an *a priori* codebook. All categories were represented in all areas and co-occurred in all stakeholder groups (Fig. 4). The two controls on water management are *Supply* and *Demand*, and each appear in approximately one-third (27.7% and 29.8% respectively) of all news coverage. They are likely to co-occur (39 articles). *Demand* solutions occurred in all three locations at approximately the same total and were more likely to occur in *Urban Area* proportionally. Qualitatively, *Demand* management and conservation included more diversity than initially expected: changing farming practices to grow higher quality fruit but less quantity, using less water, and conservation measures like attempting dry farming (no irrigation) or installing drip irrigation instead of flooding the fields (for example, San Diego newspapers covering Borrego Springs). Several articles in *Tulare Lake Basin* and *Urban Area* covered an additional law or county ordinance to place a moratorium on new well drilling—an immediate halt to water demand because users would not be able access it.

Supply solutions were focused on importing water from one area to another through legal and physical means. *Supply*, *Infrastructure*, and *Economic* incentives were likely to co-occur with reference to the Water Storage Investment Program, a \$1.7 billion bond. For *Tulare Lake Basin*, concern about inter-basin transfers for individual benefit and new *Land Uses* (for example, housing developments and solar farms) were key foci. Repair of supply sources like dams and canals also figured into several *Tulare Lake Basin* and *San Joaquin Basin* articles,

including editorials and opinions and editorials. Some *Supply* discussions included other users of water including the environment and for storage for droughts.

Solutions such as expanding existing or adding new *Supply* and *Infrastructure* were most likely to occur in the *Tulare Lake Basin* articles. *Infrastructure* as a solution occurred in one-third of all *Tulare Lake Basin* articles. “Canal” was the third most frequent word in the *Infrastructure* coding. Several storage investment programs and the development of City of Fresno recharge sites contributed to this category’s prevalence in the media, as an anticipation of SGMA’s changes.

Land Use solutions included changing the “commodity” grown, including solar farms or recharging aquifers, while still having the opportunity to have economic value from the land. *Land use* planning, especially suburban and urban expansion, was covered by *Policymakers* as an issue to consider for overall water use. *Laws* included new legislation and a proliferation of water and natural resources ballot measures (such as the Proposition 3 water infrastructure and watershed conservation bond initiative, which ultimately failed in the 2018 election). *Economics* solutions centered on incentives but also included development of water markets and transfer process for inter- and intra-basin transfers. *Research* was represented as results and a need for advancing groundwater management. *Research* tended to be more inclusive and nuanced and include domestic, economic and environmental supply concerns. *Academics*, and many others, reported on the importance of groundwater data collection for management, with public data and private wells presented at-length in a few articles. The state and counties process around making more data resources, like new well logs which disclose geologic and water table information, transparent and available was illustrated in several articles with an emphasis on the challenging transition of moving from a privately used common pool resource to a collectively managed one: “It’s going to take putting meters on all of the farmers’ wells. They’re going to have to go out and monitor farmers who aren’t reporting to anyone right now” (Ballard, 2015).

4.4. Solutions and stakeholders’ characteristics

Prevalence of stakeholders and solutions clarifies the key issues by stakeholder group (Fig. 5). In the bivariate analysis, *Research* studies solutions co-occurred with stakeholders in approximately 10 articles each, with even coverage across regions. *Economics*, market, and incentive-based solutions and groundwater recharge were more likely to co-occur with *Water Manager* and *Agricultural Industry* stakeholders. Legal solutions (*Laws*) co-occurred variably across stakeholder groups and were most likely to co-occur with *City* managers, *Policymakers*, *Water Manager*, and *Agricultural Industry*. In a bi-variate analysis, *Land Use* changes related to the largest landowners. *Land Use* change was most likely to co-occur with *Agricultural Industry* (36 articles or approximately one in ten SGMA stories). *Infrastructure* solutions were more likely to co-occur with *Policymakers*, *Agricultural Industry*, and *Water Manager*. When paired with other legislation or regulations, SGMA was often presented as a pending and additional constraint under which the economy and communities would suffer. Finally, *Supply* and *Demand* were mostly *Agricultural Industry* stakeholder solutions, but were also likely to co-occur with *Water Manager*, *City*, and *Policymakers*. *Demand* solutions co-occurred with economic incentives for farmers to adopt new irrigation technologies or for the state to purchase water or pay for recharge, winter irrigation to mitigate risks. *Academics* were more likely to comment on *Demand* rather than *Supply* in articles, and education around conservation was more likely to co-occur than with *Supply*.

The number of stakeholders represented and the number of solutions in each article reflects that there is a low incidence of diversity within each article (Fig. 6). In order to assess whether more stakeholder representation led to more solutions represented in a single article, we created a grid for these two aggregated variables by summing stakeholder coding and solution coding per article. Most articles cover less

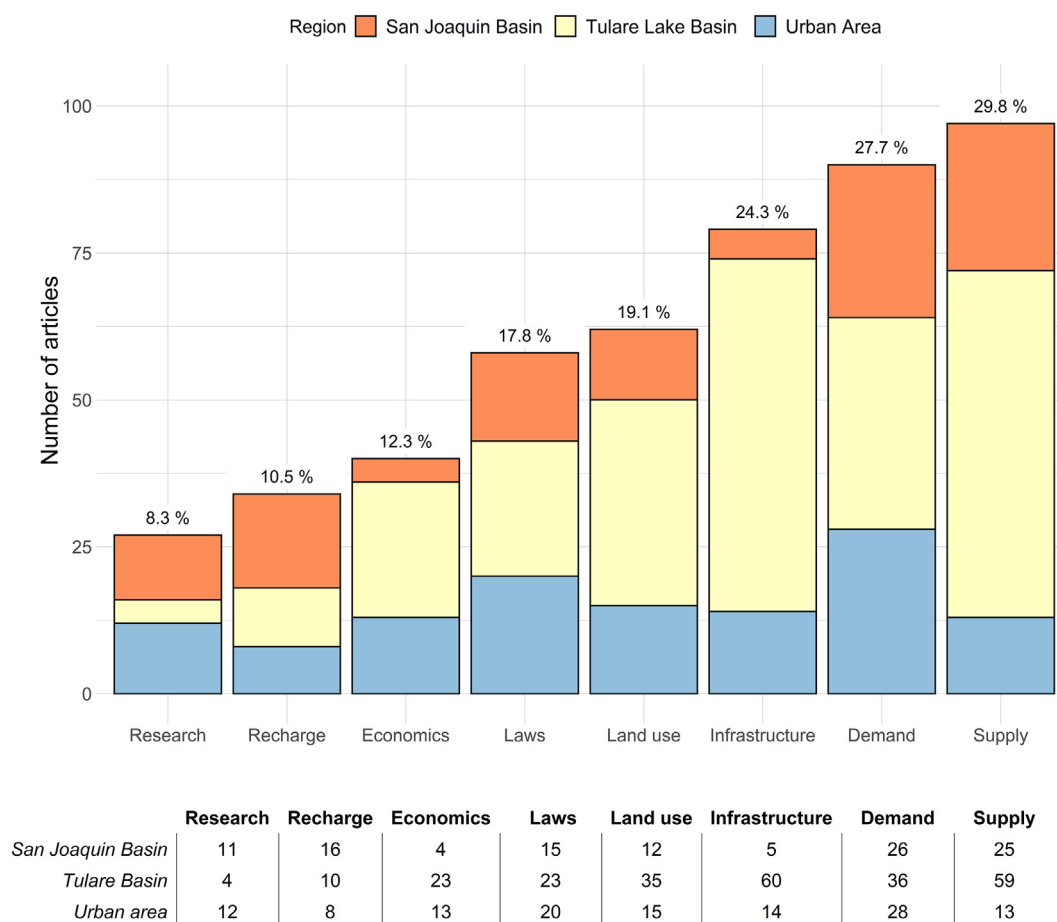


Fig. 4. Prevalence of solutions categories across California locations ($n = 234$, 72%). The percent of all newspaper articles containing solutions coverage is labeled.

than three solution categories and less than three stakeholder categories. These articles are likely to focus on one speaker and the risks or impacts with a couple of interrelated solutions (for example, *Infrastructure* and *Supply* with a *Policymaker*). *Urban Area* was more likely on average to include more stakeholder and solution categories than *San Joaquin Basin* and much more than *Tulare Lake Basin*. The diversity of representation may contribute to a broader set of options and statewide coverage. A kernel density estimator illustrates that most articles have fewer than two solutions and stakeholders in a single article. On the other extreme, <4% of all articles have many stakeholders and many solution categories represented, and these articles are most likely to be found in *Urban Area* papers. Some articles included many stakeholders or many solutions. Articles with a high number of stakeholders and solutions were likely to be written as an opinion by an academic or thought leader and be published in an *Urban Area* newspaper. Qualitatively, highly diverse articles were more likely to focus on drought, larger conservation issues, or have strong opinions regarding conservation, as one journalist titled their article “Come hell or low water, what’s underground must be preserved” (Rosekrans, 2017). Some journalists were particularly focused on water issues in the region, and they also produced more nuanced and inclusive coverage. As Killingsworth and Palmer (1992) have suggested, the exigency of newspaper media, including short timelines and short articles may contribute to little space for exploring multiple “characters” and narratives in a single article. This result suggests media coverage does not address water as a system, instead covering narrow, focused topics (mostly combinations from zero to two stakeholders and solutions). This result and approach could be useful for other media analyses examining the complexity of coverage of a topic.

The linear mixed model (LMM) tested for differences among regions in the number of solutions per article and stakeholders per article to understand if the news is representing the situation holistically (many stakeholders and many solutions are discussed in each article), or if the vision presented by the newspapers is narrow (few per article). The mean number of solutions per article and the mean number of stakeholders per article was between 1 and 2, with the *Tulare Lake Basin* region presenting fewer items per article (1.36 solutions per article and 1.20 stakeholders per article) and the *Urban Area* region presenting more (1.95 solutions per article and 1.89 stakeholders per article), while *San Joaquin Basin* region was between them (1.57 solutions per article and 1.66 stakeholders per article). These differences were significantly different between *Urban Area* and *Tulare Lake Basin* for both stakeholders per article and solutions per article, and they were significantly different between the *San Joaquin Basin* and the *Tulare Lake Basin* for the number of stakeholders per article (Table 3). These results support the same outcomes as the kernel density estimate and the cross-tabular inferences, since the newspapers do not represent the stakeholders and solutions holistically.

The principal components analysis reduced the dimensionality from three regional locations to two location groups that explained 87% of the variability (Fig. 7). The stakeholders *Policymaker* and *Agricultural Industry* and the solution *Supply* are grouped in the same cluster, supporting our analysis that water supply is a popular solution with stakeholders who support agriculture and policymakers. *Water Manager* and *City* stakeholders were more closely aligned than anticipated and may serve as a key source for upper-level relationship-building during planning. Finally, *Demand* was included as the only other solution in this cluster, though it was relatively far from stakeholders and *Supply*, and

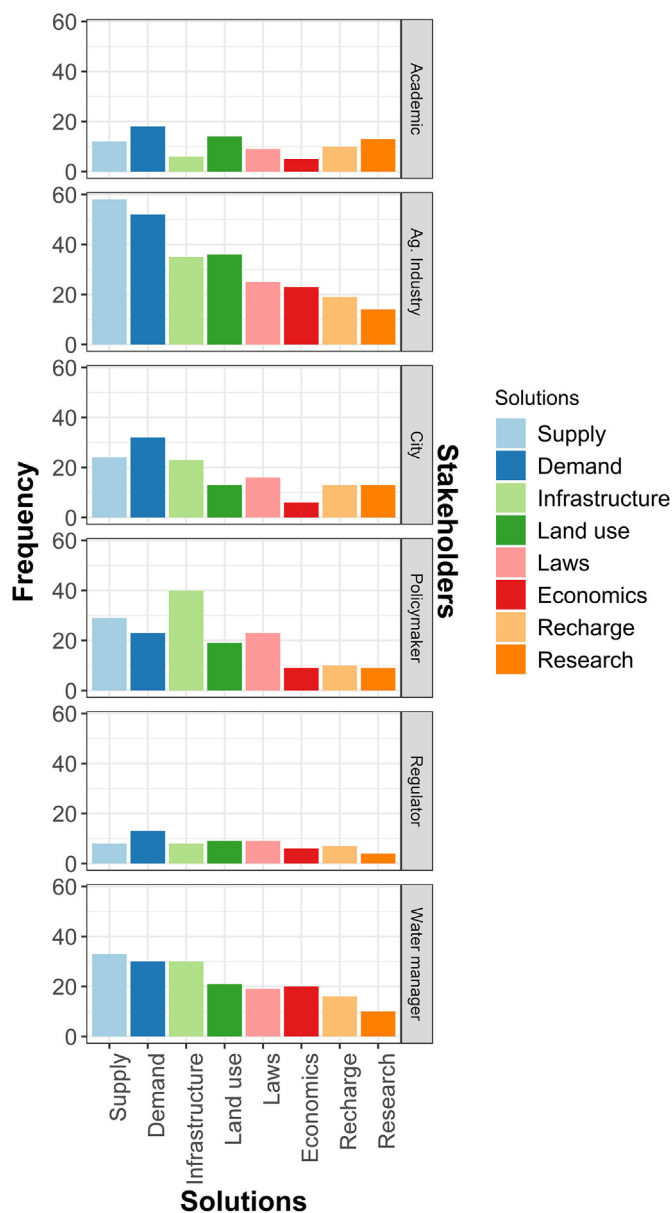


Fig. 5. Prevalence of solutions categories co-occurring with stakeholder category.

therefore less related to each other. In the second cluster, *Infrastructure* solutions and *Academic* stakeholders were unlikely to co-occur for one set of locations and likely to co-occur with *Land Use* and *Laws* solutions on the other set of locations. *Economics*, *Recharge*, and *Research* solutions and *Regulator* stakeholders were clustered together and likely to co-occur. Perhaps due to the nature of recharging aquifers as a novel solution with limited regulatory support and a need for new research on the topic for best practices, this cluster involves novel solutions and stakeholders.

5. Discussion

When stakeholders and solutions repeatedly co-occur in news media, readers may infer who is legitimately connected to the natural resource and what solutions will resolve the environmental conflict or reduce the risk. This may function politically as legitimate public participation scope development or effectively include and exclude participation, from individual to economic sector, in common pool natural resources management. Our analysis supports several of the

hypotheses. *Agricultural Industry* is most likely to co-occur in SGMA news, likely due to the current unrestricted use of groundwater by agriculture and its long-term influence on *Land use*. *Supply*, *Demand*, and *Infrastructure* solutions are most likely to co-occur in SGMA news, likely due to those being the current and funded solutions for California water management generally. Funding from ballot measures, propositions and bonds reifies certain solutions as codified in the legal language. In sum, our interpretation of the multivariate analysis is in line with prior media and communication studies: most media will support a status quo through a dominant narrative, but new ideas and relationships are forming at the breaking edge, the unknown and undetermined interpretation and implementation of a new regulation. Our results indicate that the dominant narrative is around the main characters, *Agricultural Industry*, *Water Managers*, and *Policymakers*, who have a stake by likely co-occurring with *Supply* and *Demand* solutions (Fig. 7). But, as the second cluster indicates, alternative narratives about SGMA are emerging in the news media (Fig. 7).

For geographic comparisons, the prevalence of SGMA newspaper coverage was more extensive in the *Tulare Basin* and less extensive in *Urban Area* than initially expected, especially since many of the most populous areas of California are partially-dependent on groundwater for drinking water supplies. The diversity of solutions for the management will likely need to be implemented into each groundwater sustainability plan, under a common shibboleth of a “portfolio approach.” Because solutions were featured across each region, there are many options that have been introduced and reintroduced to readers and stakeholders through news media. However, the low prevalence of highly complex articles, covering multiple solutions and multiple stakeholders, poses challenges to the public sphere and democracy in general; newspapers’ focus on individual events, characters, and solutions leaves the context obscured and the envisioning of a plurality of stakeholders with respect to a common pool resource more challenging and disconnected. Reductive narratives around key issues or complexity, extracted from the greater fabric of options and opportunity, has the potential to render an entire regional readership blind to legitimate alternatives (Bernacchi and Peterson, 2016; DeLuca, 2009). As most articles presented few stakeholders and few solutions, the decontextualized coverage likely has an impact on who is willing to participate in SGMA, water resources management, and the perception of who should (Fig. 6). DeLuca (2009) shows that the journalists are likely to appeal to a moral authority via experts (both local expertise and trained scientific expertise), statistics, laws, and government officials. Including other voices in connection with the laws intended to address a common pool resource will not only improve the public participation but the legitimacy and outcomes of the plan.

The nature of groundwater and the representation of the water cycle may have a role to play in the simplistic coverage. Groundwater is the “dark matter” of the water world, and its common pool nature is obscured by its visible points of access, privately-funded pumps on private agricultural land or public drinking supply wells (Fogg, 2015). SGMA focuses on monitoring over time, for the first time publicly, revealing the depths to which wells have had to go to reach fresh water (Leahy, 2016). The concept of ancient water resources may make it difficult to convey the unlikely nature of recharging the deficit (Harter and Rollins, 2008). Finally, the imagery of groundwater as large pools of water between layers of rock, may be deceiving the general public and water users. General images of the water cycle are needed to represent humanity’s influences on pollution and climate change; for example, images of groundwater in an arid environment with temporal and spatial components may be necessary to describe solutions and engage a wider range of stakeholders around this topic (Abbott et al., 2019). As Abbott et al. (2019) note, we need to emphasize “the finite and fragile nature of freshwater resources [to move beyond] new supply to managing demand” (p. 5).

The coverage of *Supply* and *Demand* as nearly equal signifies a dualistic and strained approach to water management, inherently in conflict.

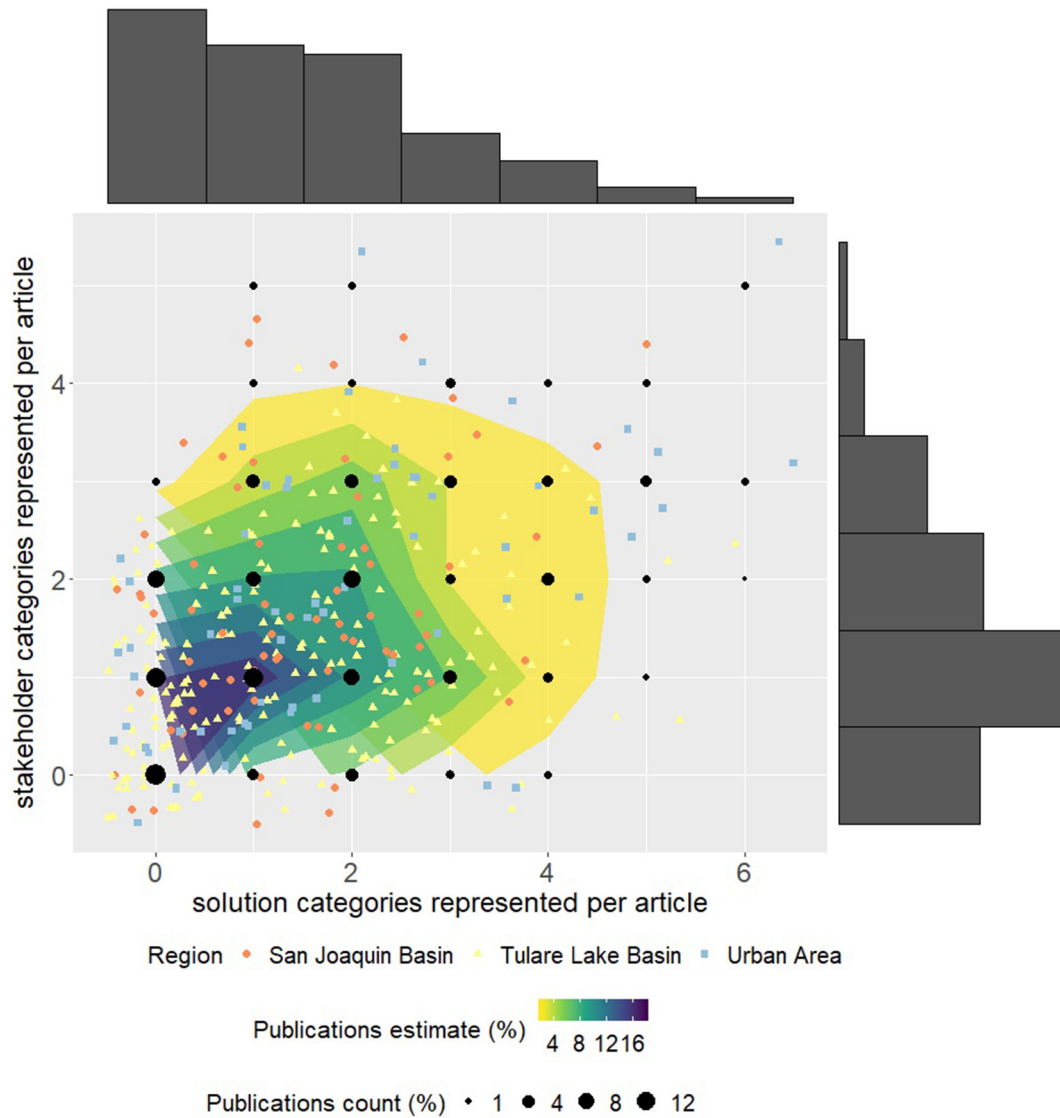


Fig. 6. Prevalence of articles with co-occurring number of stakeholder categories and solutions categories.

First, during the drought of record, California's residents cut back on average 25% of use, mostly by reducing landscaping water, but also taking significant personal actions, showing that demand management and conservation measures were actionable and attainable. Secondly, reducing demand in agriculture may be challenged under the Jevon's Paradox, in which savings in irrigation may not reduce overall water use, because the water may be applied elsewhere (Grafton et al., 2018; Sears et al., 2018; Tran et al., 2019). It is important to note that the technocratic escape for conservation, *Infrastructure*, was twice as likely to co-occur with SGMA in *Tulare Lake Basin* as *Demand* solutions.

Table 3

Comparison of the expected outcomes of number of solutions per article and number of stakeholders per article between pairs of regions.

Media coverage comparison by region	
Solutions	Stakeholders
Urban Area > San Joaquin Basin	Urban Area > San Joaquin Basin
Urban Area > Tulare Lake Basin*	Urban Area > Tulare Lake Basin*
San Joaquin Basin > Tulare Lake Basin	San Joaquin Basin > Tulare Lake Basin*

* Significant difference (p-value < 0.05).

5.1. Selection of stakeholders and prevalence of agricultural industry and policymakers

The prevalence of agricultural sector representation was as initially expected (Fig. 3). Given agriculture's relative success despite the drought of record (Lund et al., 2018) and outsized influence on Central Valley land use (Arax, 2019), the agricultural sector leveraged social and political capital and was selected as a key stakeholder. In the *Porterville Recorder*, the CEO of an agribusiness said "The Central Valley Ag industry is in a fight for its very survival. ...When it comes to the issue of water, we must speak with one voice: the voice of Ag [sic]. This is the kind of issue Horizon Nut Company is bringing into the spotlight as they unite not only pistachio growers, but all growers as an expression of their commitment to community" (Recorder, 2015). The selection of solutions mostly points to potential opportunities for agriculture such as increasing supply through changes in infrastructure, or the use of trading or markets for intrabasin or interbasin sustainability. Though these solutions may remain to be covered in newspaper media, research by Nover et al. (2019) indicates new surface water storage infrastructure will not always make the business case for replenishing groundwater reserves and supply water to agriculture. Future investments in water infrastructure will need to not only embrace conjunctive use, but also reflect a

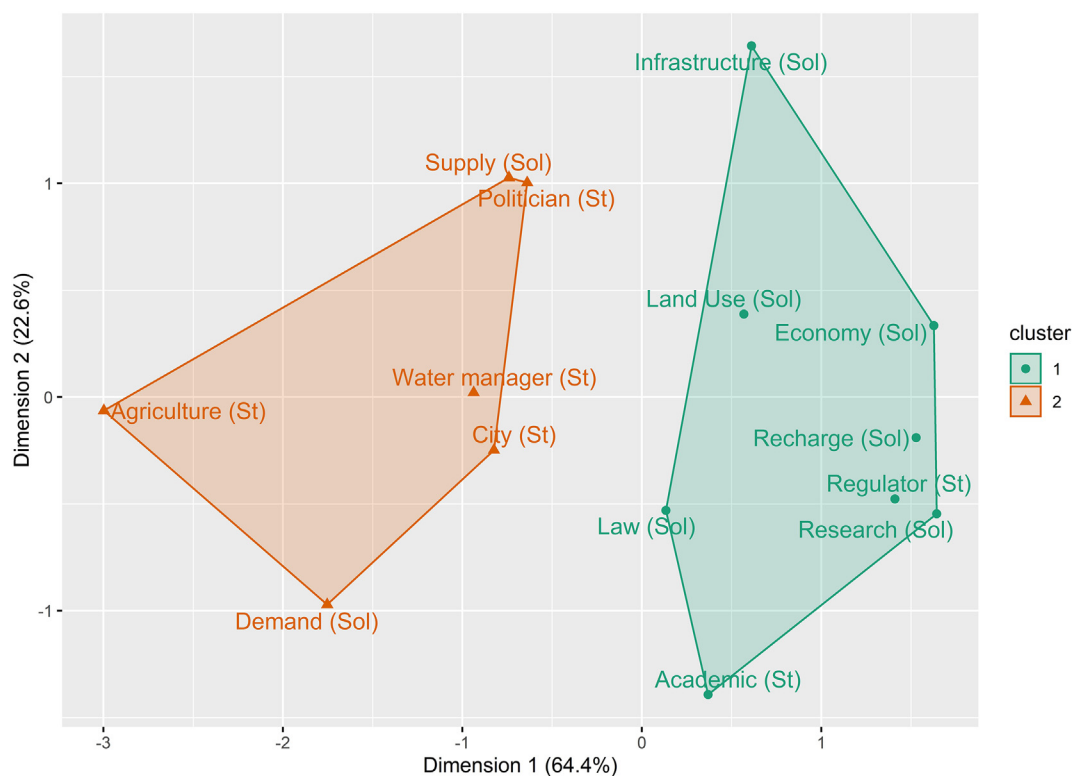


Fig. 7. Cluster analysis of the coverage of solutions and stakeholders. The PCA-transformed axes for the regions explain 87% of the total data variance.

paradigmatic change from the dominant status quo narrative of limitless water supply and unchecked demand. Co-occurrence of other solutions among stakeholders such as reuse, recharge, desalination, and conservation to meet SGMA's mutable definition of sustainability by 2040 will likely increase (Fig. 5), as will the need for complementary actions on more effective water accounting (Escriva-Bou et al., 2016), climate adaptation (Medellín-Azuara et al., 2008), and environmental justice (Dobbin and Lubell, 2019).

5.2. Solution framing: antagonistic supply and demand management

News media notoriously establishes “us-versus-them,” binary power dynamics, much to the detriment of nuanced public policy and scientific debates. Studies on climate change media coverage have shown how journalists and networks structure binary debates, positioning scientific experts against political or economic opinions (Boykoff and Boykoff, 2004). Similarly, in this study *Supply* and *Demand* co-occurred and were often presented as co-equal counterpoints to each other. For example, *Demand* reduction could be avoided only if alternative *Supply* is obtained, providing a convenient journalistic device but limiting the decision space for readers and stakeholders. Articles often presented solutions as “either or” binary options, setting up a dynamic of contention rather than “all the above” portfolio management.

5.3. Limited stakeholders and limited solutions

The coverage of stakeholder categories and solution categories (Fig. 6) was as expected. We anticipated that urban coverage of SGMA would likely be more inclusive of both risk and solutions. We also anticipated that regional sympathies for status quo economic drivers would reinforce existing disparities of access and inclusion in water management processes. The risk of these self-reinforcing narratives is that biased representation will limit the potential management solutions working into the required Groundwater Sustainability Plans. More

integrative coverage regarding risks, responsibilities, and opportunities will be needed to overcome exclusive management of this complex common pool resource. From an interventionist methodological standpoint, researchers and resource managers may find a media review useful in familiarizing themselves with the current dominant narratives and the key characters who are recognized in the media.

5.4. Absent from media coverage: disadvantaged communities

Media is as revelatory for who is included as it is for who is excluded. In other words, the exclusion of stakeholders in the dominant narrative is as telling as the prevalence of included stakeholders. Whether intentional or not within the reviewed media, we observed that despite the explicit intentions of SGMA disadvantaged communities were largely absent as stakeholders. These disadvantaged communities (often referred to as “DACs”), who are defined as <80% of the statewide annual median household income by census tracts, are also at significantly greater risk of environmental and health disparities (California Office of Environmental Health Hazard Assessment, 2020). SGMA legislation requires disadvantaged communities to be a stakeholder in all planning documents. For SGMA's purposes, disadvantaged communities are people most affected by uncontrolled use of groundwater water: groundwater-dependent communities, small water systems, well-based rural communities, isolated or separate from larger water supply networks, and those systems with impaired water quality.

In our study, 62 articles included references to disadvantages communities, but only one publication, *The Porterville Recorder*, quoted two individuals who reside in a disadvantaged community, perhaps a reflection of journalistic bias or an issue of access. The two quoted individuals were community organizers and environmental justice advocates. People affiliated with non-profit organizations that work with disadvantaged communities like the Community Water Center were also quoted ($n = 2$) and mentioned ($n = 4$), but most of these references were not in direct relationship with SGMA but related water

management issues. This comparative lack of representation poses a significant challenge for community engagement and common pool natural resources management. Few communities were even named. When the term “disadvantaged community” was used, it was a distant and vague reference to a state designation, rather than a specific place, grounded in reality. The term was most often employed by legislators and policymakers in support of infrastructure improvements or supply development.

From a public participation perspective, the lack of inclusion in news will challenge inclusion in decision-making processes and groundwater sustainability plans. The prior groundwater management in California was managed through adjudicated basins, and some researchers have found that larger land owners and water users dominated the judge-managed decision (Langridge et al., 2016).

Though Spanish-language articles did not reference SGMA specifically, coverage of groundwater, wells, and the drought presented the challenges disadvantaged communities faced: lack of water in homes, health issues, no gardens, buying potable water, showering in trailers, having water delivered through a state-program, lack of dignity, and the cost of drilling new wells. *La Opinión* and *Radio Bilingüe* featured individual-centered stories of farm laborers and community members who lacked water and some of the community members working to change the overall system. Spanish-language articles were also more likely to name specific towns. Politicians and academics were also quoted. While coverage was generally more thorough, by omitting the name of the law and the public participation opportunities included in the groundwater sustainability planning process, the capacity for stakeholders who might see themselves engaged in the decision space related to this common pool resource is reduced because they would not know what to search for in terms of language or how to attend public participation planning meetings. In English, non-profit organizations advertised for public meetings and training to become engaged in water management in *Tulare Lake Basin*, but these announcements might have reached more people if translated and advertised in Spanish-language papers, if not other prominent languages within small farmer groups such as Hmong (Hanak et al., 2017).

6. Conclusion

Groundwater, as a common pool resource, suffers from overexploitation in California and many areas worldwide. SGMA provides an opportunity to improve its use and replenishment by requiring locally created entities to maintain long term water accounting balance at a basin scale. While SGMA in principle seeks to avoid undesirable effects encompassed in its sustainability definition, it gives a wide range of action to the Groundwater Sustainability Agencies on how sustainability is achieved by 2040. Often, newspaper media has portrayed groundwater as production input and a commodity for a select group of stakeholders, most prominently large urban areas and the agricultural sector more generally. Disadvantaged communities and groundwater-dependent ecosystems (with counted exceptions) were poorly represented in newspaper media regarding SGMA. The intentions of SGMA were myriad, and to its many contributors and critics, long overdue (Leahy, 2016). A primary goal, however, was to redistribute this vital resource, a common pool safety net for climate change and drought, among the many stakeholders and across generations. For this to occur, the decision space needs to be accommodating, and therefore news coverage will likely need to be more inclusive and a greater diversity of stakeholders will be needed to expand the number and efficacy of potential solutions.

News media is useful to identify stakeholders involved in natural resources management. Journalistic framing and bias of stakeholders can inadvertently lead to self-limiting stakeholder engagement. In other words, if stakeholders do not see themselves in relationship with the resource in the media, they may be less likely to engage in the decision-making around natural resource management. More diverse stakeholder representation may be appearing in media other than

newspapers. For example, social media has been used as a disruptive technology for democratic purposes in many movements (DeLuca, 2009; DeLuca et al., 2012). Analysis of social media may help identify solutions and stakeholders participating in different ways (Hughes et al., 2019). Further research is needed on how to quickly assess stakeholder engagement in news media and how to encourage more inclusive coverage of natural and common pool resources.

The narratives that are told around natural resources include or exclude stakeholders, implicitly and explicitly; limiting stakeholder identification in media effectively excludes stakeholder groups from public participation (Endres, 2009; Hamilton, 2005). From a collaborative learning approach, the initial stages of forming potential resource management plans are cut off by stakeholder exclusion, if only in media representation (Daniels and Walker, 2001). This may be the most important step: determining who has a seat at the table occurs through early recruitment, as notified in newspaper media, or through stakeholder groups. It may not be who sits at the table, but who is included in print that matters in public participation and thus the ultimate use and fate of common pool natural resources and their management.

CRedit authorship contribution statement

Leigh A. Bernacchi: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing - original draft. **Angel S. Fernandez-Bou:** Visualization, Formal analysis, Writing - review & editing. **Joshua H. Viers:** Conceptualization, Writing - review & editing, Funding acquisition. **Jorge Valero-Fandino:** Validation, Visualization, Formal analysis. **Josué Medellín-Azuara:** Funding acquisition, Project administration, Resources, Software, Supervision, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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