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California's Sustainable Groundwater Management Act (SGMA) is a landmark policy that requires achievement of sustainability at the groundwater basin level. In this policy review and analysis, we describe the horizontal, vertical, and network governance processes occurring under SGMA and discuss how they interact with one another. In doing so, we review existing governance theories that can help to shed light on how each governance process may unfold. Depicting SGMA as a complex system of simultaneous and interacting governance processes provides a useful platform for future evaluations of SGMA successes and failures as well as for transferring lessons learned from California's implementation of SGMA to groundwater governance in other locations.

Keywords: California; institutional collective action; implementation; governance; groundwater; networks; Sustainable Groundwater Management Act

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Introduction

In 2014, California passed the Sustainable Groundwater Management Act (SGMA) - a landmark policy that overcame years of stasis. Passage of SGMA advanced California's limited ability to control groundwater depletion towards a nominal commitment to the highest standard of sustainability. The new law requires planning to achieve sustainability at the groundwater basin level, with a novel approach to groundwater governance[1] that distributes authority and responsibility between local and state agencies, seeking to balance the benefits of and demands for local control with the need for oversight.

Prior to SGMA, groundwater across the state was primarily governed by a complex and unsettled combination of overlying, appropriative, and prescriptive rights (Littleworth and Garner 2007). Localized interventions to impose greater control were rare, and largely, though not entirely, limited to the courts and through adjudications, restricted county government regulation, or voluntary adoption of groundwater management plans (Cal. Water Code § 10750 et seq.). Despite acute impacts of groundwater depletion across the state, prior attempts to impose state-level oversight of the resource had been unsuccessful (Sax 2002).

[1] Governance refers to full set of organizations, structures, rules, and processes through expectations, decisions, and actions are collectively decided and acted upon. Management refers to the specific policies and decisions that guide actions as well as day-to-day actions influencing water. Governance is a predecessor to and sets up the framework through which management is decided and acted upon (Lemos and Agrawal 2006).

Resistance from water users, concerns about economic impacts, and the lack of unified political support all contributed to the failure to generate an overarching framework for addressing California's growing groundwater problem (Leahy 2015).

California's challenges in strengthening groundwater governance are not unique. Though groundwater depletion is a well-recognized global concern (Famiglietti 2014) and governance is seen as a solution to the global crisis (Foster et al. 2013), imposition of new forms of groundwater governance is frequently resisted. Water users have a strong short-term interest in unfettered use and resist top-down control, while policy-makers are often unwilling or unable to overcome the political risk of confronting strong constituencies. Further, in spite of the enumeration of multiple paradigms for groundwater governance (see e.g., Varady et al. 2016), it remains unclear which is most effective, under which conditions.

SGMA agencies. In this paper, we refer to several classes of key actors in SGMA.

Local agencies are pre-existing public agencies such as irrigation districts that are eligible to form GSAs singly or in groups.
Groundwater Sustainability Agencies (GSAs) are made up of one or more local agencies[2], and are responsible and empowered to meet SGMA goals.
State agencies including DWR and SWRCB are responsible for oversight, enforcement and technical support of GSAs.

Through SGMA, California adopted an approach to governance that requires a strong movement towards sustainability while allowing the state to retain prior groundwater governance structures, including existing water rights and regulations, and to balance tensions related to local versus top-down control. Scholars and practitioners around the world have rushed to put California's new approach to groundwater governance under their microscopes. Many are eagerly watching as implementation of SGMA unfolds, seeking to evaluate whether and under what conditions the approach can be successful in California and elsewhere (Kiparsky et al. 2017). The valuable developing body of literature on SGMA (see SI Appendix 1) contains many individually insightful observations, yet each study examines only part of SGMA's changes to both the governance and, subsequently, the management of groundwater in California. While SGMA has a unifying statutory core, in practice, it is not a single policy, action, or even approach. Identifying the key facets of SGMA that influence success on the ground, let alone generalizing to other contexts, will require making sense of multiple simultaneous dimensions of action.

In this policy review and analysis, we depict the complex system of simultaneous and interacting governance processes occurring as part of SGMA and examine the ways in which those processes influence how SGMA unfolds. Specifically, we elucidate the vertical, horizontal and network governance processes associated with SGMA and how those processes interact with one another. Our analysis synthesizes well-established theories of governance and draws on our experience researching, observing, and participating in SGMA implementation since the law was first passed. By providing a holistic perspective on the interacting governance processes embedded within SGMA, we paint a more complete picture of the concurrent processes contributing to the successes and failures of SGMA.

[2] Local public agencies could choose to join together to form a GSA either through a Memorandum of Agreement or a Joint Powers Agreement. These two legal mechanisms differ in the structure of the legal entity they create and responsibilities assigned to the agencies entering into the agreement. For more details see Kincaid, V., and Stager, R., (2015) "Know your options: A guide for formation of groundwater sustainability agencies" California Water Education Foundation: Sacramento. http://www.stancounty.com/er/pdf/groundwater/gsa-guide.pdf

California's Sustainable Groundwater Management Act

SGMA sets a state policy of sustainably managing groundwater resources. Under the statute, sustainability is defined as the 'management and use of groundwater in a manner that can be maintained during the [law's] 50-year planning and implementation horizon without causing undesirable results' (Cal. Water Code § 10721). SGMA's six undesirable results include 'significant and unreasonable' (1) depletion of supply, indicated by chronic lowering of groundwater levels; (2) reduction of groundwater storage; (3) seawater intrusion; (4) degraded water quality; (5) land subsidence that substantially interferes with surface land uses; and (6) adverse impacts on the beneficial uses of interconnected surface water (Cal. Water Code § 10721).

To achieve this goal, SGMA encouraged the formation of new local-level institutions for groundwater governance. These new 'Groundwater Sustainability Agencies' (GSAs) were to be self-organized by any existing city, county, water utility, special district, or combination of these agencies by June 2017. SGMA then delegates to GSAs responsibility for the development and implementation of Groundwater Sustainability Plans (GSPs). GSPs must include sustainability goals that include minimum thresholds – quantitative metrics representing the point at which groundwater conditions are unacceptable - for each of the six undesirable results. GSPs must also include measurable objectives – quantifiable goals for maintenance and improvement of groundwater conditions - and interim milestones – target values for groundwater conditions in five year increments - designed to achieve sustainability within twenty years of plan adoption (Cal. Water Code §10727). Where multiple GSAs formed in a basin, they are required to coordinate to ensure they use the same data and assumptions in their planning and that their efforts collectively will lead to sustainability on the basin scale (Cal. Water Code §10727.6). SGMA offers GSAs an array of authorities and substantial flexibility for implementation.

A crucial and unique feature of SGMA lies in the combination of local governance required and supported by state law and the backstop of direct state oversight. The California Department of Water Resources (DWR) is tasked with review and approval of GSPs. Where local agencies are unable or unwilling to carry out SGMA responsibilities, or a GSA fails in its governance, planning, or implementation, SGMA provides for enforcement and sanctions, including potential intervention and takeover of management by the State Water Resources Control Board (SWRCB) (Cal. Water Code §10735).

SGMA's Concurrent Governance Processes

SGMA triggers a complex system of interacting governance processes. The statute and accompanying regulations delegate responsibilities to newly formed GSAs, yet also create substantial guidance and oversight roles for state agencies. GSAs are comprised of existing public agencies, each of which has its own institutional structure, rules and processes to which it must adhere. Further, SGMA is unfolding within the context of existing water and non-water governance, policies (Littleworth and Garner 2007) and politics within California, an already contentious and ever-changing landscape.

We contend that SGMA governance can be conceptualized as three concurrent and interacting processes: vertical, horizontal, and network governance (Figure 1). The remainder of this paper develops this conceptual structure.

Vertical Governance: SGMA as Policy Implementation

The vertical dimension of SGMA governance is its primary governance process - a higher level of government requiring action by a lower level of government (Kiparsky et al. 2017). Such mandates occur commonly in the field of natural resources, in part due to the distribution of authority across levels of government. The relationship between state and local governments under SGMA is analogous to the relationship between the federal government and states under cooperative federalism (Owen 2018). Under cooperative federalism, the federal government sets standards and policy goals and states then define and undertake actions to achieve those standards and goals, with federal oversight and potential intervention where states do not comply. Under SGMA, the State of California set requirements for groundwater sustainability and delegates authorities and responsibilities to local agencies to achieve those objectives. Thus, the vertical governance under SGMA is local-level implementation of a top-down mandate.

Implementation – the process of executing a policy – has long been an explanation for variation in successful achievement of policy goals and objectives (Hill and Hupe 2002). Several of the central components of policy, public administration and planning theories of implementation, and their effects on outcomes, are especially relevant to SGMA. Implementation depends in part on the design of the policy mandate, including the specificity and clarity of policy goals and requirements (Hill and Hupe 2002, Hupe and Hill 2016); the inclusion mechanisms for overseeing, enforcing, and sanctioning non-compliance; and the support or resources provided to the local-level entities charged with implementation (Deyle and Smith 1998, Berke, Lyles, and Smith 2014). Characteristics of 'street-level bureaucrats' – the front-line civil servants who undertake implementation – matter (Lipsky 1969), including how they interpret and understand the mandate (Hill and Hupe 2002) and their capacities for and commitment to implementation (Dahill-Brown and Lavery 2012, Tummers, Steijn, and Bekkers 2012, Norton 2005).

Viewing SGMA through a policy implementation lens highlights the importance of the vertical relationship between the state and local levels in determining outcomes. The SGMA statute and regulations are specific and directive, but contain ambiguity. How state agencies and GSAs interpret requirements will influence the content, review, execution, and enforcement of GSPs. For example, SGMA requires defining of sustainable yield, an amount of groundwater extraction consistent with the law's sustainability definition. A GSP will be, in effect, a GSA's initial quantitative interpretation of these definitions in local context, but all GSPs will then be subject to state interpretation through DWR review. Capacities for implementation also vary. GSAs differ in size, technical knowledge, institutional support and budgets (Milman et al. 2018). In spite of state technical and financial support administered by DWR, local capacity will constrain implementation actions in many cases, regardless of motivation.

Local-level pressures also have a strong influence on how GSAs respond to the mandate. GSAs are comprised of agencies with existing authorities and responsibilities, particularly to the constituents whom they serve. These agencies are often run by elected public officials and/or are reliant on public votes for imposing fees or approving decisions. As such, the political will of GSAs in responding to SGMA is defined by their constituents, including how those constituents see implementation of SGMA as affecting their interests and the bottom-up pressures they place upon GSAs.

Lastly, GSAs operate with uncertainty about the state's future choices as backstop, which have not yet been clearly signalled. Given ambiguity in requirements and definitions, combined with the latitude to locally define sustainability and sustainability pathways, many GSAs will weigh the costs of various compliance options against the probability of state

sanctions. GSA perceptions vary regarding the state's enforcement priorities and the potential impacts of such enforcement. Many GSAs recognize that DWR and SWRCB have limited capacity, and expect the agencies to focus on the areas with the most acute problems. [3] Consequently, GSA representatives may anticipate that their GSP only needs to be better than the worst batch, in the same way that an antelope need not run faster than a lion, it only need run faster than the slowest member of its herd. As such, within the vertical framework, decision-making by some GSAs is partly motivated by strategic, game theoretic considerations.

Horizontal Governance: SGMA as Institutional Collective Action

The horizontal dimension of SGMA governance encompasses the institutional collective action that has emerged in GSA formation and GSP development and will continue through implementation. Collective action occurs when interdependent resource users self-organize to jointly pursue a common goal. SGMA implementation in general, and GSA formation in particular, requires such self-organization by local agencies. The need for institutional collective action is common in natural resources, since frequently a separation of powers and authorities across agencies leads to multiple jurisdictions having control and impact on activities that affect shared resources or shared outcomes (Epstein et al. 2015). Under SGMA, GSAs are generally constrained in their geographies by the service areas of their founding agencies. Agency boundaries rarely coincide with the boundaries of the groundwater basin. In order to achieve basin-level sustainability, agencies had the choice of forming a multi-agency GSA or coordinating across GSAs in GSP development. In either circumstance, institutional collective action is necessary.

Whether and how effective institutional collective action occurs is largely determined by how organizations balance a variety of sometimes competing motivations. Inter-organizational relationships reflect bounded rational decisions that weigh the perceived merits of collective action and concerns about autonomy and control, both of which are moderated by existing relationships (Rossignoli and Ricciardi 2015, Feiock 2007, 2013, Scott and Thomas 2017). Institutional collective action is facilitated by linkages, a sense of interdependence, and a shared perspective on the problem and potential solutions (Kwon and Feiock 2010, Watson 2015), and made more challenging when agencies and their constituents have more diverse and divergent populations and interests (Feiock 2013, 2007, Kwon and Feiock 2010). Insufficient resources or the potential for economies of scale can motivate institutional collective action (Feiock 2007, Kwon and Feiock 2010); yet high transaction costs may outweigh potential gains (Feiock 2007, 2013). Lastly, organizational histories and established power relations are important as they influence trust and expectations (Brummel, Nelson, and Jakes 2012, Watson 2015, Kwon and Feiock 2010).

Viewing SGMA through the lens of institutional collective action highlights the central role of the horizontal relationships between local agencies in determining groundwater sustainability outcomes. Outcomes of SGMA will depend on individual local agencies and their willingness to work together to address groundwater management concerns throughout the basin.

Conditions are more ripe for institutional collective action in some groundwater basins than in others (Milman et al. 2018). Even prior to SGMA, some water agencies had been taking steps to address groundwater depletion. In some basins, agencies also have a

[3] This statement is based on structured and semi-structured interviews about GSP development conducted by the authors with representatives from over 40 GSAs in the critically over-drafted basins between January and November 2019.

history of collaboration- for example, through voluntary groundwater management plans, integrated water resources management plans, and urban water management plans. In other basins, tensions are higher and relationships are fraught with histories of lawsuits and disagreements. Further, basins vary in the heterogeneity of groundwater extraction and users within the basin, the distribution of surface and groundwater supplies, and the non-SGMA legal, institutional and procedural factors influencing water management policies and actions. These differences have immense implications for basin-level sustainability. In many basins, access to surface water has become the dividing point, with strong tensions between the haves and have-nots. Yet even variation in prior fees, regulations, and monitoring serve as barriers to agencies working together. As a result, institutional collective action has emerged in some basins yet not in others. Examples include multi-agency GSAs that span an entire basin, multiple GSAs with formal commitments to produce joint GSPs, and coordination agreements and committees working to coordinate across separate GSPs (Milman et al. 2018).

Network Governance: SGMA as Steering and Oversight through Informal Interactions

The network governance dimension of SGMA encompasses the informal interactions among government and other private and public entities that influence and reinforce actions to achieve groundwater sustainability. Through these interactions, actors leverage relationships to disseminate information, create new/shared or reinforce existing norms, place pressure upon one another, and coordinate actions and activities (Jones 1997; Provan and Kenis 2008; Carlsson and Sandström 2008, Marsh and Smith 2000). Not only has passage of SGMA sparked the creation of new actors and relationships (i.e. networks), interactions across networks that pre-date SGMA have had and will continue to have an important role in the outcomes of SGMA.

Network governance can include, yet often occurs outside of formal governmental structures. Epistemic communities (Haas 2007), communities of practice (Goldstein and Butler 2010), boundary organizations (Guston 2001), and other forms of networks serve to create, translate and disseminate knowledge between and among groups of actors (Phelps, Heidl, and Wadhwa 2012, Feldman 2012). This knowledge sharing facilitates policy diffusion and uptake (Lecy, Mergel, and Schmitz 2014). It also serves as a source of soft power (Feldman 2012). Networks can compel emulation of certain values, public policies and practices through the institutionalization of beliefs and values, development of common language and tacit rules for behaviour (Jones, Hesterly, and Borgatti 1997, Carlsson and Sandström 2008). Further, networks can serve as a source of oversight and pressure, particularly when the exchange that occurs through them includes surveillance and the spreading of information about behaviour or reputations (Jones, Hesterly, and Borgatti 1997).

Viewing SGMA through the lens of network governance serves to highlight the central role of the interactions between and among GSAs, non-profits, professional associations, think tanks, mediators, consultants, lawyers, and the media in determining groundwater sustainability outcomes. DWR, professional associations, interest groups, and GSAs themselves have sponsored conferences and calls to promote information sharing among GSAs. Think-tanks, non-profits and universities continue to produce reports, hold workshops and disseminate information, tools and recommendations to GSAs. In addition, facilitators, hydrogeologic and legal consultants and other professionals hired to assist GSA formation and GSP development have developed email list serves, held conference calls and used other mechanisms to exchange information about their experiences and transmit that

information to entities with whom they work. Lastly, through newspapers, blogs, and new websites, third parties are disseminating information about SGMA and its implementation.

These activities serve as governance in a number of ways. First, they are leading to norm formation and reinforcement. Through these interactions, groundwater sustainability has become a focal point of water-related discourse in California, regularly raised as a topic of concern in meetings, announcements, planning and news. Interactions occurring through and across networks have also served to cement interpretations of the requirements of SGMA as well as approaches for complying with the law. For example, interactions occurring as a result of networks are influencing how GSAs as well as DWR understand and make decisions regarding defining and using measurable thresholds in planning, surface ground-water interactions, groundwater dependent ecosystems, and compatibility across technical analysis methods, among other topics (SI Appendix 2). Secondly, the networks responding to SGMA are playing a role in oversight and enforcement. Analyses, examination, and commentaries by third parties serve as a form of transparency as well as public pressure for compliance as well as enforcement. (See SI Appendix 2 for additional examples).

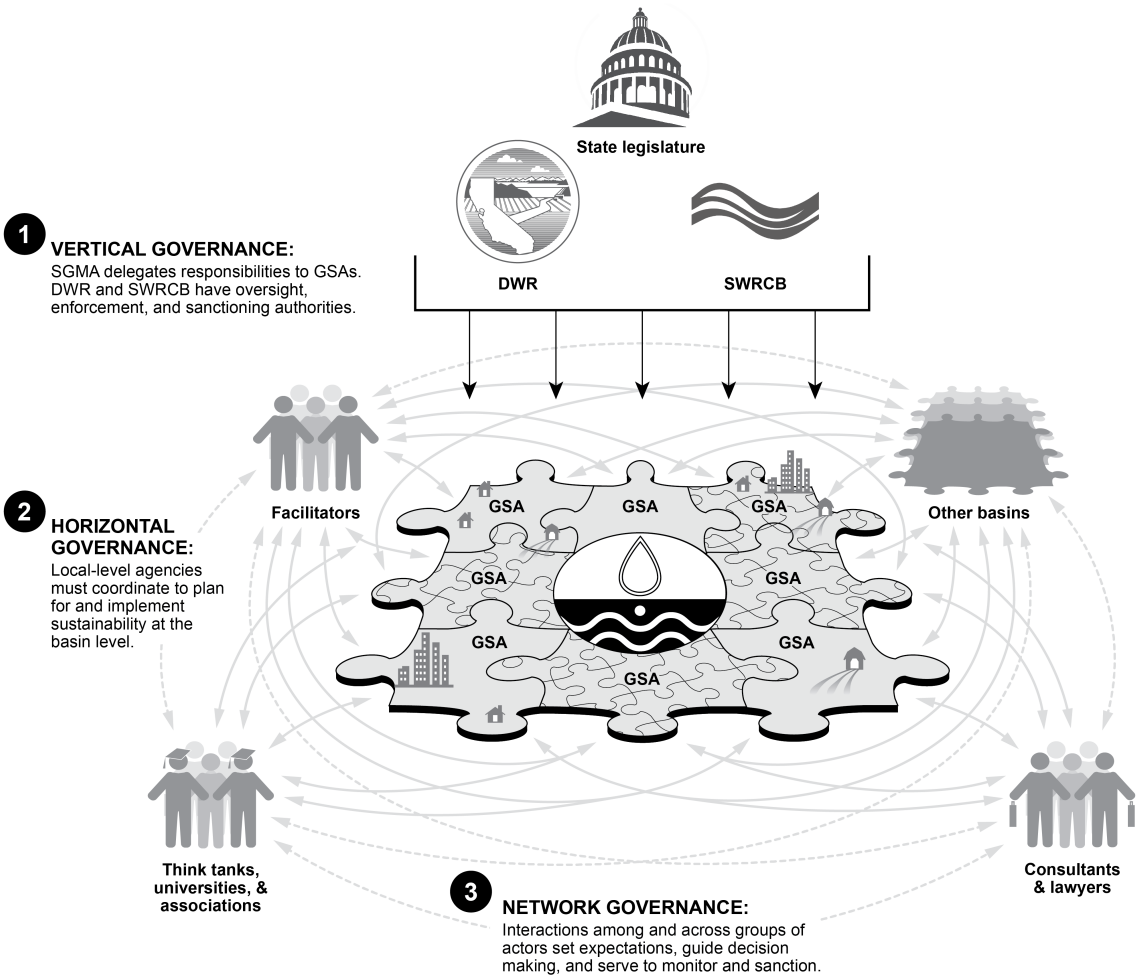
The intent of the information exchange varies across networks and network participants. In some instances, the exchange is intended as objective transmission of expert knowledge. Yet networks are not inherently neutral (Marsh and Smith 2000, Swyngedouw 2005) and in some instances, the underpinnings of exchange seek to steer decision-making in ways that support a particular social, environmental, or professional agenda. Further, the influence of network governance under SGMA will depend on how information, ideas and norms are received. Some GSAs have solidified ideas and norms about groundwater management, and are not easily swayed by outside input, whereas other GSAs are more open to and interested in receiving advice and guidance. Further, where third parties use information to increase pressure on GSAs, through news media, public engagement or lawsuits, network governance may have a stronger impact on implementation of SGMA.

Discussion

The above analysis of SGMA shows how even a single, albeit complex, legislative mandate to address a heretofore relatively ungoverned commons can require multiple, intersecting governance processes. The many concurrent governance processes occurring as a result of SGMA are strongly connected and serve to reinforce one another (Figure 1). While the statute itself is top-down (vertical), it incentivizes local-level collective action (horizontal), which in turn is motivated by the both the threat of potential state-level intervention and the resources, incentives and support provided by the state (vertical). The intersection between horizontal and vertical governance also means that where horizontal governance efforts are incomplete or unsuccessful, the state backstop provides a mechanism for the state to assume responsibilities. Thus, failure of horizontal governance does not indicate failure of SGMA, but rather calls for vertical governance to designate the pathway towards achieving groundwater sustainability. Network governance supports both vertical and horizontal governance by filling gaps in communication and knowledge and aiding in norm formation and enforcement.

Figure 1. Interaction Across the Multiple Governance Processes Embedded in SGMA. Implementation of the statute (Vertical) will depend on outcomes of institutional collective action within each basin (Horizontal) as well as DWR and SWRCB oversight, and if necessary, intervention (Vertical). GSA decisions are influenced by their constituents - depicted as urban, agricultural, and rural residential - and perceptions of the mandate (Vertical). Institutional collective action (Horizontal) within each basin is motivated by the statute and the threat of intervention and facilitated

by resources and support provided by DWR and the state. Institutional collective action is mediated by the support, advice and pressure created through interactions across GSAS as well as with third parties - consultants, lawyers, facilitators, think tanks, industry associations and universities (Network). Lastly, networks emerged in response to passage of the statute and seek to inform both state agency (Vertical) and local-level (Horizontal) decision-making.



Outcomes of SGMA thus need to be understood and evaluated not as simply an experiment in local-level governance, but in light of the interacting vertical, horizontal and network governance processes. However, this conceptual framework is far from comprehensive. Other essential and interrelated processes include those associated with the integration of land and water policy, and with the integration of science into policy, among others (Roberts, Milman, and Blomquist forthcoming). Within each governance process, how politics manifests and is resolved, have implications from SGMA.

Conclusion

SGMA has spawned a novel, hybrid approach to groundwater governance, embedded within specific constraints in California water policy and politics. Our analysis has highlighted some

complexities in SGMA governance, in particular the interplay between vertical, horizontal and network governance processes. This framework has a number of implications:

First, for those invested in the success of SGMA itself, and for scholars seeking clear understanding of SGMA, a holistic view will be important. With multiple moving parts, careful on-going evaluation and refinement of governance processes will be critical for long-term success. Further, it would be a mistake to define success of SGMA narrowly based on basin-scale outcomes. The crucial benefits of norm creation and shifting assumptions, network formation, a structure for broader topical and geographic integration, and learning within and between basins constitute individually and collectively powerful system-level advancement for California water management. Situating evaluations of SGMA within frameworks such as that proposed here could foster a broader, integrative perspective.

Second, for practitioners viewing SGMA as a potential model for governance schemes in other places, it is important to recognize that SGMA elements are interconnected and mutually reinforcing by necessity and by design. Porting any partial analogue of SGMA's model to other areas without careful examination of the potential gaps that might result may have consequences for effective governance.

Finally, we commend SGMA's authors for finding a politically palatable approach through which the State could take action to address its groundwater problem. Much of the hybrid structure described here flows explicitly from SGMA legislation, and many of the essential elements are implicitly embedded in statute and regulations. There remains much work to be done if SGMA is to succeed in its ambitious goals, but the foundation provides a strong point of departure.

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Supplementary Information
Concurrent Governance Processes of
California's Sustainable Groundwater Management Act

Appendix 1: Examples of the Emerging Academic Literature on SGMA

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SI Appendix 2: Examples of Network Governance

As described in the article text, the network governance dimension of SGMA encompasses the informal interactions among government entities, think-tanks, universities, industry associations, non-profit organizations, professionals, and private citizens that influence and reinforce actions to achieve groundwater sustainability. In California, a large network of entities, representing the spectrum of water interests and expertise, has historically sought to influence water governance. In addition, SGMA has catalysed the development of new networks. These networks have mobilized to disseminate information, share experience and knowledge, provide recommendations and tools, and oversee or monitor progress. A key outcome of this network governance is norm creation and reinforcement. Below are several examples of the network governance that is occurring under SGMA. Due to the decentralized nature of network governance and the vast extent of mobilization under SGMA, it is not possible to present a complete depiction of all of the entities involved in the network governance processes of SGMA. As such, information in Table SI A2 is exemplary, rather than comprehensive.

Table A2.2 Network Governance in relation to SGMA

Network Activities	Examples
Events: A number of conferences, workshops, webinars and symposium have been organized that focus entirely or contain dedicated panels addressing SGMA. Through these events, individuals and organizations share ideas and learn from one another about key topics and interpretations of SGMA. Information and norms developed through this exchange is then transmitted from participants in these fora to the deliberations and decision-making of GSAs, state agencies and the consultants, lawyers and facilitators participating in SGMA implementation.	▪ SGMA Survival Roundtable ▪ Groundwater Sustainability Forum ▪ The South Valley SGMA Practitioners Roundtable ▪ GSA Summit (First and Second Annual) ▪ SGMA Conference – Tools for Developing a GSA ▪ Kern County Water Summit ▪ American Pistachio Growers SGMA Survival Toolkit Workshop
Guidance Documents: A variety of organizations and actors have produced white papers, policy-briefs, blog posts and websites explaining SGMA, interpreting its requirements, providing data and information, and recommending best practices for GSP development and implementation. These documents have been disseminated to GSAs, to stakeholder groups and interested parties, to policy-makers, to DWR and to the general public. Anecdotal evidence from decision-makers suggests that many of these products have influenced understandings of SGMA and of groundwater. This information can be particularly influential in generating	California Water Foundation 2014. An Evaluation of California Groundwater Management Planning. 2015. Know Your Options: A Guide to Forming Groundwater Sustainability Agencies. Sacramento, CA. Community Water Center 2015. Collaborating for Success: Stakeholder Engagement in Sustainable Groundwater Management Act Implementation. Duke University - Nicholas Institute for Environmental Policy Solutions 2016. Sharing Groundwater: A Robust Framework and Implementation Roadmap for Sustainable Groundwater Management in California. Public Policy Institute of California 2014. Funding Sustainable Groundwater Management in California. 2019 Water and the Future of the San Joaquin Valley Stanford University - Water in the West & Gould Center for Conflict Resolution 2014. Groundwater Data: California's Missing Metric

innovations by providing new ideas for decision-makers such as GSA managers, agency staff, or consultants) as well as in refining, supporting or legitimizing policies or actions being considered.	2015. California's Sustainable Groundwater Management Act of 2014: recommendations for preventing and resolving groundwater conflicts. 2015. The Sustainable Groundwater Management Act of 2014: Challenges and Opportunities for Implementation. 2016. From the Ground Down: Understanding Local Groundwater Data Collection and Sharing Practices in California. 2016. To Consolidate or Coordinate? Status of the Formation of Groundwater Sustainability Agencies in California. 2017. Projecting Forward A Framework for Groundwater Model Development Under the Sustainable Groundwater Management Act. 2019. Putting Adaptive Management Into Practice: Incorporating Quantitative Metrics into Sustainable Groundwater Management. The Nature Conservancy. 2019. Groundwater Resource Hub: Understanding and Managing Groundwater Dependent Ecosystems. 2019. Groundwater Dependent Ecosystems Under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans Union of Concerned Scientists 2015. Measuring What Matters: Setting Measurable Objectives to Achieve Sustainable Groundwater Management in California. 2017. Navigating a Flood of Information. n.d. Groundwater Technical Assistance Tool Water Education Foundation 2015. The Sustainable Groundwater Management Act: A Handbook to Understanding and Implementing the Law. University of California - Berkeley Wheeler Water Institute 2016. Designing Effective Groundwater Sustainability Agencies: Criteria for Evaluation of Local Governance Options. 2017. Trading Sustainably: Critical Considerations for Local Groundwater Markets Under the Sustainable Groundwater Management Act. 2018 When Is Groundwater Recharge a Beneficial Use of Surface Water in California.

	2018 Navigating Groundwater-Surface Water Interactions Under the Sustainable Groundwater Management Act. University of California - Giannini Foundation of Agricultural Economics 2017 California's New Groundwater Law and the Implications for Groundwater Markets. 2018 The Economic Impacts of Agricultural Groundwater Markets
Information Clearinghouse: Third-party websites have been created to consolidate information on SGMA to make it more accessible to agencies and stakeholders. These websites share experiences and promote learning, as well as track implementation. As concrete elements of a network governance process, these websites enable diffusion of ideas, support norm creation in tandem with the materials they house, and provide guidance. Yet they also serve as indirect oversight by providing a point of comparison across basins, highlighting positive and negative events occurring in basins, and aggregating commentary on how the law will be interpreted and enforced.	▪ The Groundwater Exchange ▪ Water Wrights ▪ Maven's Notebook
Coordination of Activities: Organizations have sought to maximize the effectiveness of their network governance activities. By coordinating their efforts, network actors are able to capitalize on economies of scale, pool resources, or strengthen their influence in norm creation and/or in putting pressure on GSAs, state agencies, or stakeholders involved in implementation of SGMA.	The Water Foundation organized an ongoing, quarterly forum (the Groundwater Leadership Forum) that brings together key representatives from over 15 NGOs from among its grantees, in addition to a few academics in an auxiliary capacity. Participants in this forum jointly produced and sent comment letters to California State government on SGMA implementation generally. Members of the Forum also decided to collectively focus their efforts on supporting a rigorous review of draft GSPs submitted in the first round. They developed a template for evaluation of GSPs and have been collaborating on jointly producing GSP reviews.