

Integrating Governance Frameworks under California's Sustainable Groundwater Management Act

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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 depict SGMA as a complex system of simultaneous and interacting governance processes. 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 the existing governance theories that can help to shed light on how each governance process may unfold. Our analysis highlights two overarching conclusions. First, as scholars continue to examine SGMA's unfolding implementation, their work will paint a more complete picture of its successes and failures if it is situated within a holistic vision of SGMA governance. Second, awareness of the entirety of SGMA governance will help ground lessons learned and enable development of successfully transferable analogues.

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

1. Introduction

As the first state-wide regulation of groundwater in California, the Sustainable Groundwater Management Act (SGMA) is a landmark policy that overcame years of stasis. Despite acute impacts of groundwater depletion across the state, prior attempts to impose state-level management of the resource had been unsuccessful (Sax 2002). 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 groundwater management (Leahy 2015). Prior to SGMA, groundwater across the state was governed through a complex and unsettled combination of overlying, appropriative, and prescriptive rights (Littleworth and Garner 2007). The rare local interventions were 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.).

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.

Passage of SGMA advanced California's very 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 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.

Scholars and practitioners around the world have taken notice and rushed to put California groundwater management 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 immense, multi-faceted, and rapidly evolving set of changes to California’s water management regimes. 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 SGMA as a complex system of simultaneous and interacting governance processes. 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. We describe horizontal, vertical, and network governance processes, and discuss how they interact with one another. In doing so, we highlight two overarching conclusions. First, while there is clear value in the existing research on SGMA, as scholars continue to examine SGMA’s unfolding implementation, their work will paint a more complete picture of its successes and failures if it is situated within a holistic vision of SGMA governance. Second, for policy-makers who may consider adopting some version of SGMA elsewhere, awareness of the entirety of SGMA governance will help ground lessons learned and enable development of successfully transferable analogues.

2. 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 generally must include sustainability goals that include minimum

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* are made up of one or more local agencies, 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.

thresholds for each of the six undesirable results, measurable objectives and interim milestones designed to achieve sustainability within twenty years of plan implementation (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).

3. 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. And 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 melee.

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.

3.1. 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 natural resources management, 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 enacting 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 of a process for oversight, enforcement, and sanctioning of 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 charged with 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, and local governments are often resource-constrained (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.

Further, 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 naturally 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. 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. While this perspective only partly drives GSAs decision-making, within the vertical framework, this game theoretic element emerges and needs to be recognized as a motivational tension.

3.2. 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 management, 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, although some exceptions exist where MOUs are signed. 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 decisions made by individual local agencies, and on 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 management agencies had been taking steps to address groundwater depletion. In some basins, agencies also have a history of collaboration on AB3030, IWRM, and IWM 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. In response to SGMA, institutional collective action has emerged in some basins, with examples including 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).

3.3. Network Governance: SGMA as Norm Creation and Reinforcement

The network governance dimension of SGMA encompasses the informal interactions among government entities and civil society that influence and reinforce actions to achieve groundwater sustainability, often through norm creation and reinforcement (Lebel et al. 2006, Rhodes 1996). Social norms can have tremendous influence on individual and collective behaviour, and shifts in those norms can change behaviour at scale. SGMA spurs myriad and profound shifts in the norms for water governance in California.

Informal structures and relationships perform a vital function in governance, as they serve to mutually produce or reinforce expectations and guide behaviour and action. Networks, the social structures that connect actors and provide forums for interaction and exchange, are particularly influential for developing and changing norms (Carlsson and Sandström 2008, Marsh and Smith 2000). Through networks, actors coalesce and collaborate to deliver services and shape the policy process (Lecy, Mergel, and Schmitz 2014, Klijn and Koppenjan 2012). Networks also allow for the transmission and uptake of ideas and information. 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 reinforce norms and 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 norm creation and reinforcement serves to highlight the central role of the interactions between and among GSAs and civil society in determining groundwater sustainability outcomes. The fundamental norm shift under SGMA is that groundwater sustainability is now a consideration for local and state agencies, as well as considered a primary state-wide water management concern. The groundwater sustainability planning and the coordination requirements of SGMA transcend existing models or practices. How implementation proceeds, including the dozens of decisions that need to be made as part of GSP development and implementation, will be mediated by the transmission of information, ideas and expectations among those charged with implementation. New norms are needed regarding how to develop shared knowledge, define and track progress towards sustainability, and demonstrate coordination at the basin-level. For example, SGMA implementers must learn new ways of thinking about defining and using measurable thresholds in planning, surface ground-water interactions, groundwater dependent ecosystems, and compatibility across technical analysis methods, among other topics. New norms and practices must also be devised for inter-agency collaborations and stakeholder engagement.

To meet these needs for new knowledge and decision-making capacity, a multitude of networks have mobilized to disseminate information, share experience and knowledge, provide recommendations and tools, and oversee or monitor progress (see SI Appendix 2). 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, informal networks have emerged among facilitators, hydrogeologic and legal consultants and other professionals hired to assist GSA formation and GSP development. Through email list serves, conference calls and other forums these individuals have been exchanging information about their experiences and transmitting that information to entities with whom they work. Lastly, through newspapers, blogs, and new websites, third parties are disseminating information, monitoring, and seeking to influence GSAs.

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 muted 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.

4. Discussion

The above evaluation of SGMA shows how even a single, albeit complex, legislative mandate to manage 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 a top-down (vertical), it incentivizes local-level collective action (horizontal), and local-level collective action is in turn 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.

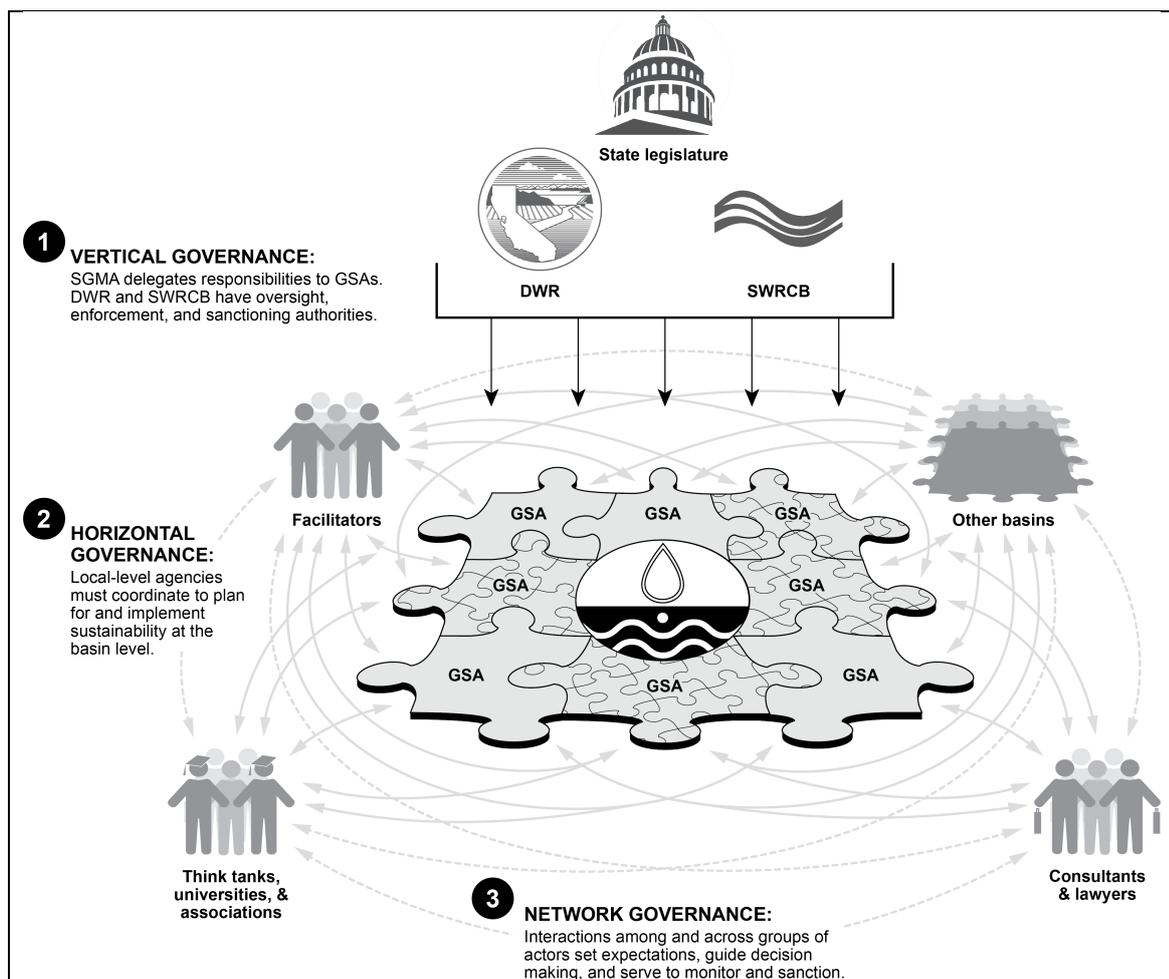


Figure 1. Interaction Across the Multiple Governance Processes Embedded in SGMA. Implementation of the statute (Vertical) will depend on outcomes of institutional collective action within each basin (Horizontal) as well as DWR and SWRCB oversight, and if necessary, intervention (Vertical). Institutional collective action 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 stakeholder engagement; with the integration of land and water policy; and with the integration of science into policy; among others (Roberts, Milman, and Blomquist forthcoming).

5. 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 that emanate from SGMA. 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.

Naturally, every SGMA research effort need not tackle every theoretical aspect of SGMA. Rather, researchers would do well to be cognizant of, and explicitly situate their work within, the broader context of SGMA governance. As the literature on SGMA matures, expanding and refining such conceptual syntheses will be needed to develop a more complete picture of governance dynamics.

Second, for practitioners viewing SGMA as a potential model for governance schemes in other places, we caution against the temptation to pick and choose among SGMA's characteristics. As described in this paper, SGMA elements are interconnected and mutually reinforcing, by necessity and design. Porting any partial analogue for SGMA's model to other areas without careful examination of the potential gaps that might result may have consequences for effective governance.

For media and other commentators observing SGMA's progress, we recognize the challenge in presenting a holistic view of its progress to a broader audience. We applaud ongoing efforts by media visionaries to reflect the nuance and importance of a complex and non-linear system to a public that needs to understand its importance to support its implementation.

Finally, we commend SGMA's authors for their remarkable creativity and foresight. 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, unorthodox as it may be, is strong.

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