Collaborative Governance and Environmental Justice: Disadvantaged Community Representation in California Sustainable Groundwater Management

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Abstract: A consistent critique of the theory and empirical research on collaborative governance is a lack of conceptualization and analysis of the role of political power and inequality. Our paper contributes to this discussion by analyzing the representation of Disadvantaged Communities (DACs) in the 2014 Sustainable Groundwater Management Act (SGMA) in California. Employing primary and secondary data, we model the likelihood of DAC representation in the state's new Groundwater Sustainability Agencies based on key attributes of both the communities and governance setting. We find that overall collaborative governance is associated with increased representation of these marginalized stakeholders. Importantly, however, even in collaborative settings representation of the smallest, most low-income communities and those lacking representation through incorporated cities or public water districts still lags far behind their more advantaged counterparts and in fact, disparities in representation along these lines may increase. Using a uniquely interdisciplinary approach our analysis highlights the opportunity afforded by integrating collaborative governance and environmental justice in the shared pursuit of effective and equitable institutions and the inter-related goals of equity and sustainability.

Key words: Collaborative Governance, Environmental Justice, Representation, Procedural Justice, Recognition, Groundwater, California, Institutions, Equity, Sustainability

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Introduction

A consistent critique of the theory and empirical research on collaborative governance is a lack of conceptualization and analysis of the role of political power and inequality (Foster 2002; Franks and Cleaver 2007; Morrison et al. 2017; Purdy 2012). The critique is more broadly applied to public policy and institutional analysis in general (Knight 1992; Moe 2005), and has implications the democratic legitimacy of governance arrangements (Alexander, Doorn, and Priest 2018). Political institutions provide differential access to decision-making (Besley and Case 2003), while political groups and individuals have higher or lower capacity to participate in governance systems and influence the outcomes (Olson 2009; Sabatier and Jenkins-Smith 1993; Stigler 1971). Thus, there continues to be a need for empirical research focused on the crucial issue of how these factors affect the structure and function of governance institutions.

This article contributes to this discussion by analyzing the representation of disadvantaged communities in the 2014 Sustainable Groundwater Management Act (SGMA) in California. According to Leach (2006, 101), “a representative process ensures that the interests of all affected individuals are effectively advocated, either in person or through proxies.” SGMA provides an unprecedented opportunity to study representation because it mandates the creation of new institutions for governing the classic “tragedy of the commons” of groundwater resources (Hardin 1968; Ostrom 1990). Under SGMA, 127 high- and medium-priority groundwater basins were required to form Groundwater Sustainability Agencies (GSAs) by June 30, 2017. Next, these GSAs have until January 2020 or 2022, depending on their basin condition, to develop mandatory Groundwater Sustainability Plans (GSPs). GSAs are new administrative agencies with significant authority over groundwater resources within a specific geographic jurisdiction, and GSPs will articulate the operational rules that define the allowable, required, and prohibited use of groundwater resources (Schlager and Ostrom 1992).

In addition to being an excellent study system for collaborative governance and common-pool resource management, SGMA is an apt case study for another reason as well. Among U.S. states California continues to lead in advancing an environmental justice agenda, particularly when it comes to safe, clean and affordable drinking water which the state affirmed as a human right in 2012, the first and still the only state to do so. This fact, combined with the high reliance on groundwater for drinking-water supply particularly in the state's most challenged regions (Disadvantaged Community Water Study for the Tulare Lake Basin 2014), means that SGMA is also perfectly situated in both time and space to elaborate on the intersection of these two pivotal trends in environmental policy; collaborative governance and environmental justice (Foster 2002; Patrick 2009). While regional planning and management offers the potential to proactively avoid drinking-water contamination and drought impacts such as loss of water supply, this pathway to addressing drinking water disparities is understudied, and as a result, not well understood (McFarlane and Harris 2018; Patrick 2009).

Throughout the SGMA process GSAs have a responsibility to "consider the interests of beneficial uses and users" including specifically Disadvantaged Communities (DACs), which California defines as communities with a Median Household Income less than 80% of the state's average.[1] Such language led to SGMA receiving the support of the state's environmental justice advocates and was held up as evidence of the state's growing commitment to environmental justice. But in practice there are no specific state guidelines for meeting this requirement. As a result, there

[1] CA Water Code § 10723.2, for the 2010-2014 ACS 5-year estimates used in this investigation this amounts to an MHI of $49,191.20 or less.

is institutional diversity across GSAs that functionally embodies different levels of representation for the 241 of 545 small DACs (population less than 10,000) that fall within SGMA's jurisdiction of high- and medium-priority groundwater basins. Some DACs are not officially represented at all in GSA structures, while others serve on governing boards with full voting authority. This variance in representation is the dependent variable in our analysis.

The focus on power and representation of California's DACs in groundwater management sheds light on three related questions that have not received enough attention in research on collaborative governance. First, to what extent does collaborative governance adhere to broad normative principles of democracy such as representativeness (Leach 2006)? Some scholars argue collaborative governance provides intrinsic normative benefits to the extent it enhances democratic legitimacy, equity, and social fairness (Pahl-Wostl et al. 2007). Yet the majority of empirical research focuses on the instrumental benefits of representation as a pathway to effective policy, for example by increasing commitment, compliance, social learning, and the incorporation of diverse sets of knowledge (Ansell and Gash 2008; Mostert 2003; Neshkova and Guo 2011; Newig and Fritsch 2009; Pahl-Wostl et al. 2007). While as previously noted there has been scholarly discussion of the challenges of ensuring representation and equity in collaborative governance, there is a lack of empirical, and particularly quantitative, assessments on this topic specifically for marginalized actors (e.g. minority groups, the poor). What evidence we do have suggests that collaborative governance is often falling short when it comes to these democratic ideals, especially when it comes low-income communities, but provides little in the way of a pathway forward for understanding or addressing these constraints (C. L. Balazs and Lubell 2014; Leach 2006).

Second, to what extent is collaborative governance pursuing environmental justice, or "distributional and procedural equity in environmental and natural resource decisions" (Foster 2002, 461)? The above mentioned gap in defining the contours of representation of marginalized stakeholders has allowed for little more than speculation about the relationship, either current or potential, between collaborative governance and environmental justice (Foster 2002). Collaborative governance can lead to creative solutions and fruitful relationships, but it can also result in cooptation, undermine trust and be biased towards more powerful actors (Ansell and Gash 2008; Purdy 2012). In the global quest to define and develop governance, the impact of governance on the poor and marginalized has been systematically overlooked, especially beyond the local level (Franks and Cleaver 2007; Pitts 2011; Purdy 2012). As a result, there is a significant need for research that critically situates governance, exploring how multi-stakeholder and integrated approaches "relate and interact with the day-to-day concerns" of less powerful actors "in accessing water" (Franks and Cleaver 2007, 304; Purdy 2012).

Third, and perhaps most importantly, how could collaborative governance contribute to the advancement of procedural justice in natural resource decision-making? While most early environmental justice research focused on distributional justice, the central role of decision-making structures and processes themselves in achieving equitable distribution has slowly migrated from the global grassroots movement to permeate our scholarly understanding and research (Holifield 2001; Schlosberg 2009; Walker 2009). Who decides and how is entirely relevant to the outcome and therefore essential for implementing justice (Hunold and Young 1998). Robust democratic representation is thus considered a necessary component of achieving environmental justice, while exclusion from decision-making is linked to inequitable outcomes (Lake 1996; Schlosberg 2004; Walker 2009). Despite this recognition, however, the implementation of procedural justice for environmental justice has remained relatively understudied (Lake 1996; Schlosberg 2004; Walker 2009) especially in the new era of environmental deregulation (Castree 2008; Foster 2002; Patrick 2009).

Combined, collaborative governance and environmental justice have the potential to fill longstanding gaps in their respective scholarship, offering a path forward for the pursuit effective and equitable institutions and the inter-related goals of equity and sustainability (Lake 1996; Nijaki 2015; Sze et al. 2018). In the next section, we describe several hypotheses about institutional- and community-level factors that may increase or decrease the likelihood of representation of DACs in SGMA grouped around three core considerations: institutions, resources and recognition. We then describe the methods and results of an empirical analysis that considers 241 DACs and 109 unique GSAs. We end with a presentation of predicted probabilities of representation and a broad discussion of the implications of our findings for representation and equity in SGMA and beyond.

Hypotheses: Factors Affecting Representation of Disadvantaged Communities

Drawing from both the collaborative governance and environmental justice literature we posit the following seven hypotheses concerning the role of collaborative institutions, community resources and community recognition in DAC representation. Each of these hypotheses identifies specific independent variables that may be negatively or positively associated with different levels of DAC representation in GSAs. Taken together, these hypotheses demonstrate how environmental justice issues challenge the normative assumptions about democracy and representation espoused by the literature on collaborative governance. By quantitatively testing these hypotheses, we hope to heed David Pitts' (2011) call to move towards assessing and addressing the real-world constraints on equity in these increasingly ubiquitous and important collaborative venues. After stating each hypothesis, we briefly discuss the theoretical basis from the literature.

The role of institutions

Designing institutions to best address the needs and desires of stakeholders and constituents speaks to the core of the environmental administration and management literature of recent decades. The failures of our institutions to do this adequately, in turn, is the constant argument of environmental justice scholars. Hypotheses 1, 2 and 3 explore the role institutional type and the development process in shaping representation.

H1: DACs will be more likely to be represented in collaborative GSAs.

Hypothesis 1 considers the institutional design of GSAs themselves, and the extent to which they adopt more collaborative approaches to governance. To quote Ansell and Gash (2008, 555) "access to the collaborative process itself is perhaps the most fundamental design issue." Inclusive representation and principled engagement are basic principles of collaborative governance (Emerson, Nabatchi, and Balogh 2012; Leach 2006; Schneider et al. 2003). SGMA affords public water agencies the option to create a GSA using their existing agency boundaries or collaborate with others in their basin or sub-basin. Following this argument, collaborative GSAs should offer more opportunity for stakeholder involvement than single-entity GSAs that do not scale up from their current management regimes (Ansell and Gash 2008).

H2. DACs are more likely to be represented in more formalized collaborative GSAs.

Hypothesis 2 focuses on the level of formalization among the various types of collaborative GSAs. GSAs have been created using three different forms of collaborative governance as allowed by the law: Memorandums of Understanding/Agreement (MOU/MOA), Joint Powers Authorities/Joint Powers Agreements (JPA), and Special Act Districts (hereafter referred to as Act Districts or ADs). MOU/MOAs are nonbinding coordination agreements among multiple parties to pursue shared interest or work. They do not create a new agency and each member entity continues to act independently based on their own powers. MOU/MOAs can be dissolved relatively easily, and their development does not require any specific political process that provides opportunity for participation and scrutiny by non-member stakeholders. JPAs are more formal because they allow for either the joint exercise of common powers among two or more members, or the creation a new separate legal entity entirely. Establishing a JPA entails a formal process of notification and filing with the Local Agency Formation Commission but again only requires the consent of the member agencies. ADs, on the other hand, are unique special districts formed by the legislature under state law, and therefore subject to the same mechanisms of democratic accountability afforded any legislative act.

While rigidity due to excessive formalization can constrain flexibility and adaption, institutionalization supports the stability needed for long-term adaptive collaborative management and changes in existing power structures (Pahl-Wostl et al. 2007). The institutional analysis literature has a long-standing discussion with more ephemeral, informal institutions versus formal institutions (Libecap 1989; North 1990). For example, Ostrom (1990) discusses how it is easier to change informal operational rules versus more formalized collective-choice and constitutional rules. In the case of GSAs, the administrative and legislative procedures governing the formation of the more formal institutions also provide more mechanisms for democratic accountability, participation, and transparency. Therefore, within these multi-party "collaborative" GSA types we expect increasing formalization to positively affect DAC representation.

H3: DACs are more likely to be represented in GSAs with third-party facilitation.

Hypothesis 3 focuses on the role of third-party facilitation. Some groundwater basins elected to use a third-party facilitator from a grant-funded network of SGMA facilitators established by the California Department of Water Resources (DWR). The practice of facilitation emphasizes stakeholder analysis and engagement as keys to achieving agreement, at the very least to avoid conflict from excluded stakeholders resorting to legal or legislative workarounds (Fisher, Ury, and Patton 2011). Facilitation has been shown to be important for bringing stakeholders together, initiating engagement and promoting social learning (Ansell and Gash 2008; Pahl-Wostl et al. 2007). In their meta-analysis review of 137 collaborative governance cases, Ansell and Gash find that facilitating leadership is especially important to support the participation of less powerful stakeholders (2008).

The role of resources

Resources are an important and common theme in both collaborative governance and environmental justice literatures. Hypothesis 4, then, considers how resources impact the capacity of stakeholders to participate in governance and advocate for representation.

H4: DACs with higher levels of resources are more likely to be represented in GSAs.

Resource disparities have been found to be barriers to participation for marginalized and low-resources stakeholders in collaborative governance (e.g. Ansell and Gash 2008; Leach 2006) as well as more broadly for procedural justice (e.g. (Hunold and Young 1998; Walker 2009). The finite resource of time, especially for groups that lack paid staff, is perhaps the most limiting factor but a lack of professional expertise (e.g. consultants, lawyers) as well as financial resources are also significant constraints (Ansell and Gash 2008; Franks and Cleaver 2007; Leach 2006). We expect to find these challenges at play in SGMA, with DAC representation in GSAs increasing with increasing community resources as measured by population (rate-payer base) and community Median Household Income (MHI).

The role of recognition

Hypotheses 5, 6 and 7 focus on the important role of recognition in achieving procedural and distributional equity (Fraser 1997, 1998; Young 1990). Young and Fraser note a "direct link between a lack of respect and recognition and a decline in a person's membership and participation in the greater community, including the political and institutional order." Quite simply, they argue,"[i]f you are not recognised, you do not participate." (Schlosberg 2004, 519).

H5: DACs with representation by formalized public institutions, including cities, are more likely to be represented in GSAs.

For DACs, recognition is a multifaceted dilemma. In California, drinking water provision is highly fragmented creating a notable challenge as diffuse, less cohesive and less organized stakeholders are at a disadvantage in collaborative governance (Ansell and Gash 2008). Some DACs rely on individual domestic wells for their water supply, meaning they have no coordinated representation at all. Those that do have centralized water service operate under a wide range of governance and ownership structures (Pannu 2012), not all of which are eligible to participate in SGMA in the same ways. Only public agencies are allowed to create or join GSAs. Non-public agencies, such as mutual water companies, may participate in collaborative GSAs only at the behest of other public agencies, as associate members, for example, which may or may not include decision-making authority. Additionally, with or without public agency drinking-water providers, unincorporated DACs California have long suffered from marginalization and a lack of political recognition compared to their incorporated city counterparts (C. L. Balazs and Ray 2014; Pannu 2012; Ranganathan and Balazs 2015).

This complicated governance and regulatory landscape has been a persistent problem for including DACs in California water governance. For example in Integrated Regional Water

Management, a collaborative water management program that preceded SGMA, participation rates for unincorporated communities have lagged far behind small DAC cities and private-well communities have been essentially absent. Thus we anticipate that incorporated DACs and those with GSA eligible drinking water providers will have higher rates of representation in GSAs.

H6: DACs with smaller Latino populations will be disproportionately represented in GSAs.

In addition to political obfuscation, DACs face a wide variety of additional compounding factors related to mis- and mal-recognition (Walker 2009). DACs are by definition, poor. Many are geographically isolated (Rubin et al. 2007) and most are extremely small. It follows, then, that DACs are also a question of race. Nationally, the majority of unincorporated communities are communities of color (Anderson 2007). California is no different (Rubin et al. 2007), and many are immigrant farmworker communities. The environmental justice literature is replete with the consequences of racism, including increasingly a recognition of the unique challenges of cultural misrecognition and oppression in democratic and participatory spaces (Schlosberg 2003) and vulnerabilities of undocumented residents (Agyeman 2005; Foster 2002; Sze 2006). Ultimately, we expect to see this effect in SGMA through the overrepresentation of DAC with smaller Latino populations in GSA governance.

H7: Higher concentrations of DACs will result in more representation in GSAs.

As a third and final consideration of recognition, we anticipate the number of DACs in a particular GSA will be highly relevant to DAC representation in that particular area. California DAC's are not evenly distributed throughout the state but rather are concentrated in the San Joaquin Valley. In our data, statewide the number of DACs within GSA boundaries ranges from 0 to 13 with an average of 5. We expect that higher number of DACs in a GSA will increase the political and social visibility, and thus lead to higher rates of representation. This hypothesis is supported by the social movement literature where large numbers of actors may reach a critical mass or threshold (Granovetter 1978; Oliver, Marwell, and Teixeira 1985) or allow the formation of coalitions (Diani and Bison 2004). However, the literature on collective action offers a counterargument because large numbers of actors may increase the likelihood of free-riding (Olson 1965). Our empirical analysis will help discriminate between these two arguments.

Methods

Data collection and compilation

To study Disadvantaged Community (DAC) representation in Groundwater Sustainability Agencies (GSAs), the first task was to identify the DACs that fall within the geographic boundary of each GSA. To do this, the base dataset for this study was developed using *Esri's ArcMap* by intersecting the Department of Water Resources (DWR)'s DAC mapping tool layer of 685 DAC Places[2] with the DWR SGMA portal map layer of the 269 exclusive GSAs formed as of January 1,

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[2] Places, as defined by the 2010 census, that meet California's state DAC definition. The census place definition includes both incorporated places (established to provide governmental functions for a concentration of people e.g. cities, towns) and Census Designated Places (CDPs) (the statistical counterparts to incorporated places, based on settled concentrations of population that are identifiable by name but not legally incorporated) (US Census Bureau 2012). Due to the census methodology for defining places based on parcel density, this analysis likely misses the smallest and most disperse DAC communities in the state. Despite this shortcoming, we believe that places are the most politically and geographically meaningful unit of analysis because, unlike census blocks or tracts, they typically represent recognizable and nameable communities and because they more closely mirror public water system boundaries which typically serve as the unit of representation for DACs in water management. Additionally, in rural areas, places are typically the smallest unit compared to tracts and blocks. Because DWR's DAC mapping tool uses 2010-2014 ACS estimates, these 685 DAC Places are all the California places with an MHI of $49,191.20 or below for that period.

2018.[3] Subsequently, intersections that constituted less than 10% of the DAC's total area were removed as were intersections for the 139 non-small DACs (population greater than 10,000). The later was done to focus our analysis on the environmental justice communities that are overburdened by water governance externalities and whose integration into regional water management has been a longstanding issue (C. Balazs et al. 2011; C. L. Balazs et al. 2012; Recommendations 2015; United Nations General Assembly 2011). Two additional census designated places that were University of California campuses we also removed.

The final list included 281 intersections between 241 unique small DACs and 109 unique exclusive GSAs. This dataset was then joined with data from the DWR Water Management Planning Tool, California's Safe Drinking Water Information System (SDWIS) and demographic data from the 2010-2014 ACS 5-year estimates[4]. Information from each of the 109 GSA's formation notification submitted to DWR was hand coded from the SGMA portal between January 2nd and February 28th, 2018 including the dependent variable (described below) and GSA type. The incorporation status of each DAC was added using the league of California cities alpha listing of California cities. To add information related to drinking water provision in each community, a second *Esri ArcMap* intersection between DAC places and public water system boundaries from both the California Environmental Health Tracking Program's Drinking Water Systems Geographic

[3] Because GSAs have the ongoing ability to adjust their boundaries and structure, in theory DAC intersections and participation is not static in time. In reality, thus far few, if any, meaningful changes have occurred after filing for GSA status.

[4] While not the most recent 5-year estimates available, 2010-2014 estimates are used for all demographic data in this study to align with their use in the DWR DAC mapping tool which is the tool provided by the state for the purposes of including DACs in regional water management and the most readily available information identifying DACs during the GSA formation process.

Reporting Tool (Water Boundary Tool) as well as approximated public water system boundaries from the Office of Environmental Health Hazzard Assessment (OEHHA) was also appended. Finally, whether or not a GSA had received state funded facilitation support services for GSA formation was added using the list maintained on the DWR website. Appendix A provides description and source for each dataset employed.

Dependent variable: Representation

Representation in this paper is defined as a community having a formal role in agency governance. Unsurprisingly, the vast majority (84%) of DACs are not represented in their respective GSAs. In 236 cases, DACs were not formally represented in their GSA. Among the 45 cases where they were represented, representation occurred in one of four ways. In 9 cases, DAC cities or eligible districts primarily serving an unincorporated DAC, elected to serve as a GSA by themselves, making them the exclusive groundwater manager for their boundaries. In 17 cases, DACs occupied one or more voting board seats of a collaborative GSA, typically allocated to their drinking water district or when incorporated, the city itself. In another 17 cases, DACs were involved with a shared governing board seat.[5] In the final two cases, a DAC was not a member of

[5] In four of those cases the seat was shared among a delineated group of two to five DACs who would elect and rotate representation among themselves. These DACs were coded as one for the dependent variable, indicating that they are participating in governance although admittedly their participation is different than in the majority of other cases where communities had their own vote. In contrast, in two other GSAs, DACs were involved in the nominating process for a more open-ended Public Water System and or DAC/Public Water System board seat. While these two seats were not explicitly limited to representing those on the nominating committee we coded those DACs on the nominating committee as participating as well using the logic that they had a formal role in the governance process albeit slightly more removed.

their GSA's board of directors, but they were formal signatories and members to the Joint Powers Agreement creating the GSA. Because of the limited frequency of representation types, we combine them into a single binary dependent variable where zero indicates a DAC with no formal representation in the GSA and one indicates a DAC with formal representation of some type. Figure 1 shows the distribution of the dependent variable.

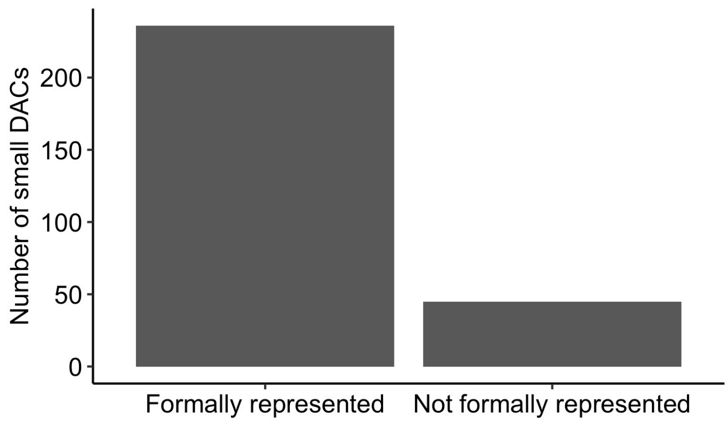

Figure 1. Histogram of the dependent variable

Independent Variables

Table 1 summarizes the independent variables considered in the analysis, the majority of which were drawn directly from the dataset described above. Two additional independent variables required further analysis: Number of DACs and GSA eligibility. Number of DACs indicates a count of how many other small DACs are located within the same GSA. This number was summarized in R and appended as a new column in the dataset.

The variable GSA eligibility was a bit more complicated to develop. As previously mentioned, SGMA restricted the right/responsibility to become or create a GSA to only public water and land-use agencies (note that for non-GSA eligible entities, there are alternative pathways to formal representation, one case of which was identified for a DAC in our dataset). To develop a binary term for whether (1) or not (0) a given DAC had a GSA eligible representative then, we first needed to identify which water districts and land-use agencies represent each DAC and second, for water districts, determine if they are public.[6]

Incorporated cities are land-use agencies, such that all incorporated DACs were automatically coded as GSA eligible. For the remaining unincorporated DACs, we presume the only GSA eligible representative would be a public drinking-water provider. This is because, besides cities and drinking-water providers, other common water and land-use agencies such as counties, stormwater districts, irrigation districts etc. tend to operate at a county or regional level and therefore are not uniquely representative of any individual tiny unincorporated community. Thus, for those unincorporated communities that have a public drinking water provider, we used SDWIS to determine if the provider was GSA eligible (publicly owned) or in-eligible (privately owned). In implementing this coding procedure, we excluded for consideration those drinking water providers where the DAC constituted less than half of their service area/service connections as such a provider is also not uniquely representative of that DAC. Any unincorporated DAC with one or more public drinking water provider meeting this service provision criteria was assigned as GSA eligible. A DAC either with a) no identified drinking water provider (presumably served by domestic groundwater wells), b) a non-public drinking water provider, or c) a public drinking water provider that did not meet the service provision criteria was assigned not GSA eligible.

Table 1. Model terms

Term (unit of analysis)	Hypothesis	Type	Descriptive Statistics
GSA Type (GSA)	H1, H2	4 category factor	52% “Single”, 11% “MOU/MOA”, 31% “JPA”, 5% “AD”
Facilitation Support Services (GSA)	H3	Dummy variable Y/N	43% have facilitation services
Population (DAC)	H4	Numeric	$\mu = 2314$, $\sigma = 2455$

[6] Because all land use agencies are public agencies, this second step applies only to water districts.

Median Household Income (DAC)	H4	Numeric	μ = $33,310, σ = $8,650
Incorporation (DAC)	H5	Dummy variable Y/N	15% Incorporated
GSA eligible (DAC)	H5	Dummy variable Y/N	44% GSA eligible
Percent population Latino (DAC)	H6	Numeric	μ = 57%, σ = 32%
Number of DACs (GSA)	H7	Count	μ = 5 DACs, σ = 4
Groundwater Reliance (DAC)	Control	Dummy variable Y/N	91% groundwater reliant
Percent intersection with GSA (DAC)	Control	Numeric	μ = 81%, σ = 29%

Control Variables

We added two additional controls, also summarized in Table 1, to capture the extent to which DACs have an interest or stake in the groundwater basin managed by a specific GSA. First, using SDWIS, we included whether or not each DAC is reliant on groundwater for their drinking water supply. DACs not intersecting any public water systems were assumed to be reliant on domestic groundwater wells for their drinking water supply. Second, we included the percent of the DAC area covered by the respective GSA as an approximation of the potential impact of groundwater management under that agency to the community.

Model choice

A binomial logit model was employed to test the relative impact of institutions, resources and recognition on DAC representation in GSAs. A logit model is an additive model, in this case for DAC representation in an intersecting GSA. The model coefficients represent the log odds of representation (probability of representation)/(probability of non-representation). The exponentiated coefficients then, are odds ratios, or the change in odds of representation, per unit change in the relevant predictor variable, holding the values of other variables constant. For example, the model coefficient for incorporation is 1.42 which means the odds ratio of representation for an incorporated DAC is 4.14 (exp(1.42)) indicating that the odds of representation for a DAC city are more than 4 times (or 314%) larger than the odds of representation for an unincorporated DAC (Figure 2).[7]

Results

Model Results

A coefficient plot is provided in Figure 2, the logit model is fully reported in Appendix B. Exponentiating the coefficients as described above, all three GSA Type categories show a positive effect on representation compared to the reference category of single entity, non-collaborative GSAs. MOU/MOA GSAs are associated with a more than 600% increase in DAC representation and JPAs are associated with a more than 300% increase relative to a single entity GSAs. By comparison, the odds that a DACs is represented in an AD GSA is more than 350 times greater than in a single entity GSA. Overall the effect of facilitation is negative but with a large standard error that overlaps zero.

Regarding H4, the role of resource disparities, both population and MHI have a fairly large positive effect on DAC representation when accounting for the small units. Per 1,000 person increase in population, a DAC's odds of representation increase by 25%. Per $5,000 increase in a community's MHI, the odds of representation increase by 40%.

Whether a community has a GSA eligible drinking-water provider and whether that DAC is incorporated both have highly significant positive impacts on representation in a GSA. A DAC with

[7] All work was done in RStudio version 1.0.153 with the following packages: tidyverse, dplyr, car, pscl, pROC, ggplot2, cowplot, stargazer, MASS, rms, DAMisc.

a GSA eligible entity is more than 100 times more likely to be represented than one without and an incorporated DAC is more than four times more likely to participate than an unincorporated counterpart, confirming H5. The number of DACs within a given GSA, rather than having a positive effect as hypothesized, decreased chances of representation by 14%. The percent of the population that is Latino also has a negative impact, but it is not significant.

Of the two controls included in the model, only one demonstrated the expected degree of impact. While the percent a DAC was intersected by a GSA significantly increased representation by close to 35 times, whether a community was reliant on groundwater for their drinking water supply shows a much smaller and statistically insignificant affect.

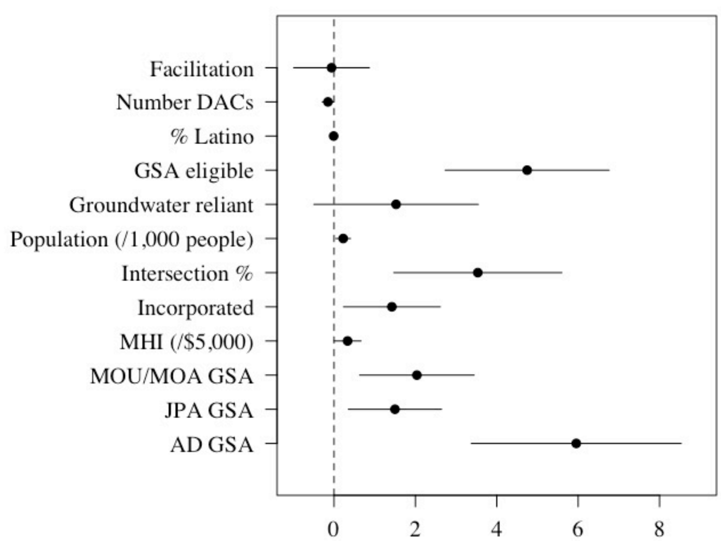

Figure 2. Coefficient plot with 90% Confidence Intervals

Predicted Probabilities of Representation

Overall, the model predicts a representation rate of 0.2% for California's small DACs in non-collaborative settings compared to between 5% and 24% for DACs in MOU/MOA, JPA and

AD GSAs. However, individual DACs vary considerably in their specific characteristics and their institutional and social contexts, especially with regard to some of the model's most formative predictors. To help interpret the results of our analysis, therefore, we calculate predicted probabilities of representation for hypothetical DACs illustrating different combinations of theoretically important and policy-relevant variables.[8] Constructing hypothetical case studies is a statistically appropriate approach given that the model is highly predictive with a Receiver Operating Characteristic (ROC) curve area of 0.95 and a Proportional Reduction of Error (PRE) of 40%.

Figure 3 illustrates the predicted probability of representation for small DACs in all four GSA types by population and MHI for non-GSA eligible unincorporated communities, GSA eligible unincorporated and incorporated cities individually. Resources, measured both by MHI and population, have a consistent positive effect on representation in each case. As both MHI and population increase, regardless of GSA eligibility of incorporation status, so does the predicted probability of representation. Notably while the population graphs span the entire range of the state's classification of "small" (10,000 people), the majority of California's small DACs are extremely small (median = 1214); this is a major reason why the representation of DACs is low overall. Still, moving from the 1st quartile (Q1=424) to the 3rd quartile (Q3=3,769) in population represents an increase in predicted probability of representation of 9%. For MHI, moving from Q1 ($27,297) to Q3 ($40,000) results in a very similar magnitude increase (10.1%).

Yet comparing the graphs from left to right moving from a non-GSA eligible to a city scenario, it is clear that resource-related gains (or loses) in representation are not made equally

[8] All other variables were set to their means (if numeric) or modes (factors) except percent intersection which was set to its mode (100%) rather than its mean (81%).

across all small DACs. Instead, recognition in the form of a community's institutional infrastructure is a clear driver of representation. The predicted probability of representation for a non-GSA eligible DAC shows a consistent steep increase along the resource gradients for Special Act Districts (blue line), but excluding AD GSAs, for MOU/MOA, JPA and Single GSAs the predicted probability of representation remains below 6% regardless of resources. In contrast, for cities, the predicted probability of representation ranges between 29 – 100% depending on resources and GSA Type. In all cases, Special Act Districts are associated with the highest chance of representation, followed by MOU/MOA and JPA GSAs with single entity GSA having the lowest level of representation.

Combining the resource and institutional effects we can calculate best case and worst-case scenarios for small DAC representation in GSAs by GSA type.[9] For single non-collaborative GSAs, a Q3 (population and MHI) city has a predicted probability of representation of 57.9%, compared to 0.06% for a Q1 (population and MHI) non-GSA eligible community. For MOU/MOA, JPA and AD GSAs, a Q3 (population and MHI) city has a predicted probability of representation of 91.3%, 86%, or 99.8% respectively compared to 0.4%, 0.3%, or 18.3% for a Q1 (population and MHI) non-GSA eligible DAC. Thus, based on these three variables, the percent change in probability of representation is largest between for single GSAs (96,400%) but the actual increase in probability of representation is much larger for collaborative GSAs (average increase of 86%) than non-collaborative GSAs (58%).

[9] Again, holding all other predictors at their mean/mode with percent intersection set to 100%.

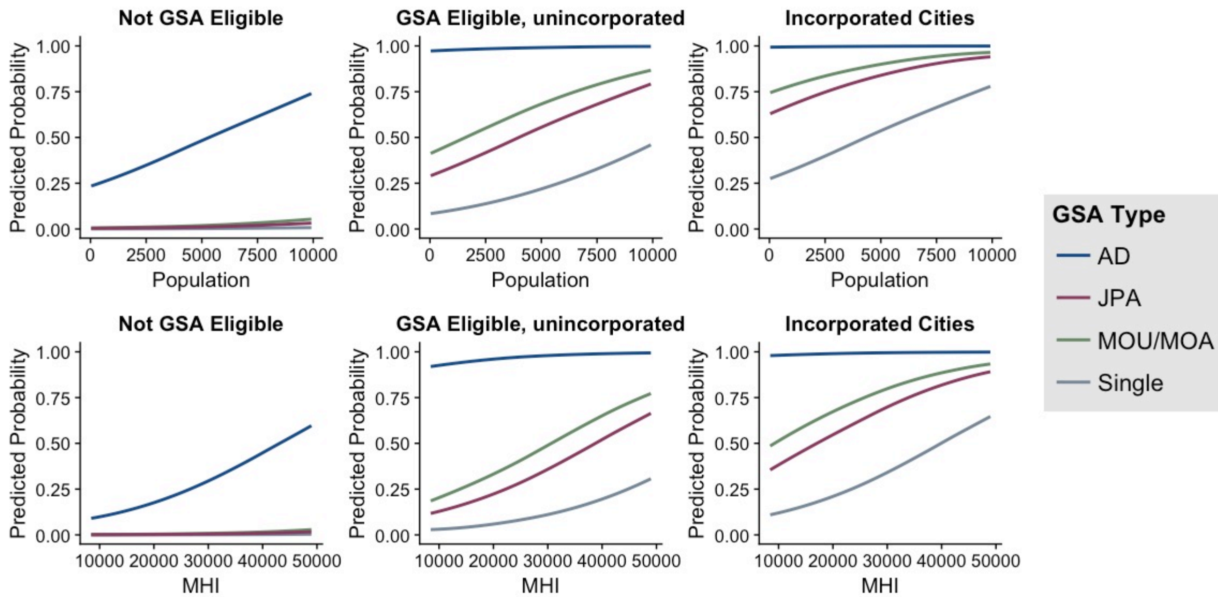

Figure 3. Predicted probabilities of DAC representation in GSAs by MHI, Population, GSA Type, incorporation and GSA eligibility.

Discussion

Clearly formal representation of DACs in GSA is far from typical: only 16% of DACs are formally represented, and only 28% of GSAs with DACs have a formal institutional arrangement for representing them. Our findings highlight several key characteristics that impact representation and some surprising ways that they combine to shape this reality of GSA governance. Clearly resources fundamentally shape which DACs are represented and which are not. While resources have long been recognized as a challenge for collaborative governance and environmental justice, that these disparities here can account for as much as a two-and-a-half-fold difference in the representation of small low-income communities in water management highlights the magnitude of this challenge. Given that the majority of small DACs are extremely small, population size is a clear limiting factor shaping our findings that just 16% of small DACs are represented in GSAs. Yet the potential for improving representation by supporting under-resourced actors with added resources for participation is evident, furthering calls for this type of investment in collaborative governance initiatives, an important contribution of the procedural justice and environmental justice literature (e.g. (Hunold and Young 1998)

Political recognition through incorporation and the GSA-eligibility of the local water provider are also important. The design of SGMA, which limited GSA eligibility to only those public water and land use agencies also clearly limited DAC representation from the outset. More than half of the unique DAC communities considered (140 out of 241) do not have such an eligible agency to begin with. While it is possible for non-eligible agencies to participate in collaborative GSAs, in only one case was a DAC doing so. Importantly, however, given that incorporation also has a significant positive effect on DAC representation in addition to GSA eligibility, it would be simplistic to assume that restrictions on GSA eligibility built into the law can fully explain the impact of GSA eligibility on DAC representation. We find that the degree of formalization/organization of community institutions plays a broader role in shaping recognition and thereby representation is supported. That less than half of DACs have these structural advantages highlight a second important bottleneck for SGMA representation. This raises concerns about the potentially constraining role of California's drinking-water governance landscape in impeding community representation in regional and state water management. It also raises a potential opportunity to increase representation by carefully attending to the organization of stakeholders prior to or during the formation of a collaborative entity (Purdy 2012).

But it is not just community-level factors that matter, institutions do too. Collaborative governance was associated with an increased probability of representation for DACs, in most cases more than doubling the odds and under certain scenarios increasing the probability of participation by much more. Collaborative governance may, however, increase resource and recognitional disparities in representation, with more material gains in representation occurring for higher income and larger, small DACs as well as those with GSA eligible agencies or that are cities. This influence of collaborative institutions, however, must be carefully interpreted because of the endogenous nature of institutional development and change. Thus we cannot make a strong causal claim that collaborative institutions change the level of representation because the creation of the institutions is a path dependent process that depends in part on the existing constellation of actors and their associated resources and policy preferences. The same disadvantages and resources constraints DACs face in participating in SGMA may translate into a lower capacity to advocate for the creation of more inclusive, collaborative institutions in the first place. As a result, resource disparities and other factors could contribute to the observed disparities between institution types as well. Nevertheless, our results suggest that collaborative institutions are a positive pathway, albeit a potentially discriminating one, to more formal representation of DACs in SGMA going forward. It is crucial to explore exactly why some GSAs selected collaborative institutions, including the involvement of DACs and other environmental justice actors in previous water policy processes. This includes analysis of the costs and benefits of making collaboration mandatory, or incentivizing it, rather than optional in state or national management initiatives like SGMA.

Regarding formalization, while the relationship between formalization and representation was not consistent, with MOUs out performing JPAs, the most-formalized AD GSAs were the only type that demonstrated a significant improvement in DAC representation. This could indicate that a certain high threshold of formalization promotes representation. Alternatively, the findings could highlight the important role of political accountability and public scrutiny given that special-act districts are formed through the legislative process where broader political considerations and potentially different political priorities are brought into play. This raises a third alternative conclusion related to scale. California's Human Right to Water is a state directive, resulting in significantly more attention in state policy and is in and of itself demonstrative of the increased influence of environmental justice advocates at the state compared to the local level. More research should explore the relationship between institution types, the formation process/scale, and representation in collaborative governance as these results indicate that at least sometimes, it may really matter, and could present a potential intervention point for designing and implementing policy with greater attention to social equity.

Surprisingly, rather than the number of DACs increasing their representation in groundwater management, the opposite effect was observed. For each additional DAC in a region, representation in governance was decreased by nearly 25%. One explanation for this is that rather than increasing the visibility of DACs, or maybe in addition to doing so, increased numbers of communities increases competition among them for a potentially finite number of decision-maker positions. Of the 31 GSAs with DACs as decision-makers, twenty-four had just one DAC decision-makers and of the seven that had more than one, in just two of them was each of the DACs entitled to their own vote. This suggests that coordination among DACs at the regional scale could increase DAC representation in SGMA and other water policy processes and emphasizes the importance of formal and informal coalitions in securing representation in heterogeneous and polycentric settings (Tormos-Aponte and García-López 2018).

Two additional explanatory variables were not significant in the estimated model. The effect of facilitation is both negative, and insignificant, is contrary to existing literature on the subject and should be explored more in-depth. That the percent of the DAC that is Latino shows no evidence of significantly impacting community representation in GSAs is also surprising. Whether this insignificant finding reflects a genuine lack of relationship or indicates that percent Latino is an inadequate measure of racial inequities in the process would require further investigation. Of note, because DACs are already significantly more Latino than the rest of the state, that race may place a significant role in shaping representation among a broader subset of communities or stakeholders can't be ruled out by these findings. Indeed, how resources, recognition, institutional factors all influence representation among a more diverse set of stakeholders in collaborative natural resource management is an area for further research that could prove fruitful for differentiating between the unique needs of environmental justice and low-income communities and those that may be shared with other actors.

Interestingly, groundwater reliance, included here as a control, had relatively little to do with DAC representation. This may be because reliance on groundwater for drinking-water supply is an overly is an overly narrow conception of interest when it comes to groundwater management and therefore an individual communities' interest in SGMA. Given the interconnectedness of hydrologic resources and the social, economic and environmental importance of groundwater in the state, a broader look at actor interest in groundwater management, for example a measurement of regional groundwater reliance or economic impact, may be more appropriate in the future. Anecdotally, this understanding is supported by the fact that irrigation districts are among the most active players in SGMA statewide, despite the fact that many do not use groundwater directly. It also could be the case that given the important relationship between incentives and constraints for motivating participation (Ansell and Gash 2008), for highly under-resourced stakeholders, interest in the collaborative process is simply less relevant. Such an interpretation would have major implications for SGMA and other similar collaborative governance programs which often rely on outreach as a primary tool to increase participation among such groups.

Conclusion

We conclude by returning to the three main questions framing our analysis related to representation and environmental justice in collaborative governance. First, to what extent does collaborative governance adhere to broad normative principles of democracy such as representativeness? That overall collaborative governance pathways enhanced the representativeness of SGMA is encouraging, however, from a theoretical perspective, more work is needed to understand the causal processes driving the selection of collaborative institutions (for example the extent to the political organization and involvement of DACs was a driver of institutional design). But perhaps just as important as this potential to increase representativeness is the fact that at least in the case of SGMA, representation itself remains fundamentally shaped by outside factors such as resources and recognition that do not disappear when a collaborative approach is pursued. To the extent that the same is true in other settings, these findings caution against relying on collaboration to achieve representation, particularly in regulatory settings where such failings could lead to significant harm to marginalized actors and/or violations of other legal/political mandates for procedural and distributive justice.

Second, to what extent is collaborative governance furthering environmental justice? Clearly, the fact that many DACs lack representation in GSAs suggests that many communities are likely to remain marginalized as SGMA is implemented. That this lack in representation is related to variables long associated with environmental injustice such as resource disparities and lack of political recognition is important but not surprising. Developing collaborative institutions may help, but is clearly insufficient in the face of persistent structural inequities. This is especially true if further analysis reveals that installing collaborative governance in the first place requires DACs to organize and overcome these very same political barriers. Thus these findings paint a relatively bleak picture of both the current state of procedural justice under SGMA and while it is too early to assess the distributive outcomes of the process, bring into question whether DACs will enjoy the same level of benefits as more politically powerful groups with respect to avoiding locally determined “undesirable results” as required by the law. The extent to which similar problems abound in the field requires further research but the lesson is clear: when it comes to policy implementation motivating principles do not equal tangible outcomes. That collaborative governance is aspirational is important, but achieving those aims requires constant oversight, assessment and planning.

This brings us to the third and final question, how could collaborative governance contribute to the advancement of procedural justice in decision-making? By providing increased representation, we suggest that collaborative governance has an important place in the democratization of natural resource management but does not replace the need to address longstanding barriers to accessing decision-making processes themselves. Our findings support Pahl-Wostl et al.'s (2007) assertion that the process and structure of collaborative governance are too narrow of a focus to produce fundamental change in water governance. This should not excuse the discipline from attending to such considerations, rather it should be a call to account for and proactively address the role of inequitable resources and recognition as part of the collaborative governance agenda. Failing to do so may not only perpetuate inequality in representation in resource management but actually increase it. We therefore echo the concerns raised by Foster (2002, 463) that "[w]ithout greater attention to [the social, structural, and institutional conditions necessary to realize its own promises] – particularly the existence of social capital within communities seeking to form collaborative structures – devolved collaboration threatens to simply reinforce some of the regulatory dysfunctionality it seeks to displace".

Yet it is precisely the institutional conditions and underlying philosophy of collaborative governance that also leaves us optimistic about its potential for furthering environmental justice aims. How much representation, and in what form, is necessary to achieve social justice in collaborative governance? And alternatively, what additional pathways or conditions can support that goal? While the answer to this question is highly context dependent (Foster 2002), our analysis does highlight the potential of additional empirical and theoretical analyses to further these conversations. How do specific mechanisms and types of representation compare when it comes to distributive justice and community perceptions of procedural fairness? How does this change based on the specific domain or objective of decision-making considered? What mechanisms exist to effectively address resource and recognitional disparities? What is the role of scale? How could environmental justice be formally (and explicitly) integrated into collaborative governance frameworks and policies and would it facilitate broader inclusivity or improve outcomes?

In our view, much like with SGMA itself, the potential of collaborative governance to invigorate democracy in natural resource management and achieve social justice ends has stood in the way of it actually doing so, at least to its fullest potential. In this paper we combine collaborative governance and environmental justice theory to provide a quantitative environmental justice assessment of representation in California's groundwater reform process. In doing so we hope to provide a model, and incentive, for similar studies in diverse natural resource contexts that can support the growth of empirical, policy-informing, research on social equity in public administration and environmental management (Pitts 2011). Collaborative governance scholars have a lot to learn from environmental justice scholars and practitioners who underscore the importance of procedural justice and recognition in decision-making and have decades of experience exploring the complicated interplay of the political, social and economic marginalization of low-income communities of color (Hunold and Young 1998; Schlosberg 2004). In turn, environmental justice scholars and practitioners have both a lot to offer and a lot to gain in furthering the pursuit of equity in these increasingly ubiquitous venues. That collaborative forums have the potentially to significantly increase representation should be a motivation for all to start that work. After all, both are "part of a larger project, already well underway in numerous disciplines, to both theorize and construct a democratic public sphere … Linked to this broader agenda, the quest for environmental equity can contribute to rather than challenge the ideal of democratic practice" (Lake 1996, 171–72).

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Appendix A.

Data	Source	Description	Data Accessed	Link (if available)
SGMA portal	Department of Water Resources (DWR)	Digital archive of all GSA notifications	January – February 2018	https://sgma.water.ca.gov/portal/gsa/all
Facilitation Support Services webpage	Department of Water Resources (DWR)	Map identifying all groundwater basins and subbasins that received "Phase 1" (GSA formation) facilitation support services	June 2018	https://water.ca.gov/Programs/Groundwater-Management/Assistance-and-Engagement
DAC mapping tool	Department of Water Resources (DWR)	Map of Disadvantaged Communities in California by census place, tract and block.	December 2017	https://gis.water.ca.gov/app/dacs/
Alpha listing of California cities	League of California Cities	2011 list of California Cities	March 2018	https://www.cacities.org/Resources/Learn-About-Cities/Alphabetical-List-of-Cities.aspx
Drinking Water Systems Geographic Reporting Tool (Water Boundary Tool, WBT)	California Environmental Health Tracking Program	Map of Public Water System boundaries in California	June 2018	http://cehtp.org/water/
Approximated public water system boundaries	Office of Environmental Health Hazzard Assessment (OEHHA)	Approximated boundaries for Public Water Systems not included in WBT used in CalEnviroScreen 3.0	June 2018	https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30
2010-2014 estimates	American Community Survey (ACS)	Ongoing survey by the U.S. Census Bureau to collect information such as income and ancestry	April 2018	https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk
Safe Drinking Water Information System	State Water Resources Control Board	US EPA database Safe Drinking Water Information System (SDWIS) as well as the Drinking Water Quality results hosted on the EDT Library dataset	June 2018	https://sdwis.waterboards.ca.gov/PDWW/

Appendix B.

Model coefficients and standard errors

	Dependent variable:
	Representation
GSA type - AD	5.95^{***} (1.57)
GSA Type - JPA	1.50^{**} (0.70)
GSA Type - MOU/MOA	2.04^{**} (0.86)
MHI (per 5,000)	0.33^{*} (0.20)
Incorporated	1.42^{**} (0.72)
Percent intersected by GSA	3.53^{***} (1.26)
Population (per 1,000 people)	0.23^{**} (0.11)
Groundwater reliant	1.53 (1.23)
GSA eligible	4.75^{***} (1.23)
Percent Latino	-0.01 (0.01)
Number of DACs	-0.15^{*} (0.09)
Facilitation	-0.06 (0.57)
Constant	-13.17^{***} (2.64)
Observations	273
Log Likelihood	-53.07
Akaike Inf. Crit.	132.13
Note:	*p**p***p<0.01