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Representation Justice As a Research Agenda for Socio-Hydrology and Water Governance

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SPECIAL ISSUE: ADVANCING SOCIO-HYDROLOGY

Representation justice as a research agenda for socio-hydrology and water governance

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ABSTRACT

We propose *representation justice* as a theoretical lens for socio-hydrology and water governance studies. An exploratory survey of 496 water sector employees in the United States revealed that self-identifying females felt more strongly discriminated against due to their gender and other social factors, compared to self-identifying males. Responses unveiled how macro- and microaggressions impede career pathways to leadership positions and, therefore, representation. We identify ways in which socio-hydrology can benefit from a representation justice lens by considering the following: (1) how power and politics shape the composition of the water sector and decision-making processes; (2) how available quantitative data do not account for lived experiences of individuals in the water sector; and (3) how intersectionality cannot easily be accounted for in current socio-hydrological models. We offer a representation justice research and water management agenda that goes beyond quota filling to include meaningful engagement with diverse groups, lenses, and knowledge.

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Introduction

Understanding who makes coupled human-water system decisions and how they are made is critical for sustainable water resource governance (Pahl-Wostl *et al.* 2010). However, in practice, women and minoritized[1] populations continue to be underrepresented in the global water sector, in particular among the top managerial positions (Cleaver and Nyatsambo 2011, World Bank 2019). One study of water utility chief executive officers (CEOs) in the United States (US), for example, found that 93.9% were male and 93.4% were white, in contrast to the populations they serve (Teodoro 2013). Empirical evidence in other sectors indicates that gender and racial leadership composition *matters* (Chattopadhyay and Duflo 2004, Devlin and Elgie 2008, Franceschet and Piscopo 2008, Leisher *et al.* 2016, Clayton *et al.* 2017, Cook *et al.* 2019). Notably, Chattopadhyay and Duflo (2004, p. 1440) found that leaders invested more in infrastructures that were directly relevant to the concerns of their respective genders – for example, in West Bengal and Rajasthan, women leaders tended to make more significant investments in drinking water resources. Gendered relationships to water have changed over time, specifically in urban and higher income areas where water infrastructure has been modernized (Katko *et al.* 2006). Gendered (and intersectional) identities continue to inform how water management issues are perceived and how they are acted upon (Katko 1992). Calls to understand changes in water governance regimes have been made (Pahl-Wostl *et al.* 2010), and recent efforts strive to incorporate gender into socio-hydrological and water management models (Baker *et al.* 2015, Packett *et al.* 2018) and make socio-hydrology research socially accountable (Lane 2014).

Unrepresentative decision-making by utilities, water managers, and others can have real societal consequences. In stormwater management, for example, residents are rarely included in planning beyond public hearings, and hydrological routing takes precedence over representation of the people impacted (Schifman *et al.* 2017). Recent newsworthy events have also underscored the consequences of improper water management and environmental injustice. In Flint, Michigan, US, for example, lead contamination in the city's drinking water disproportionately impacts low-income and African-American children (Pulido 2016, Ranganathan 2016). Similarly, some internationally funded adaptation interventions have been criticized for reproducing inequities and creating new ones, largely due to the exclusion and underrepresentation of stakeholders (Eriksen

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[1]Following Harper (2013, p. 207), "minoritized" is a more precise and accurate term than "minority," as in "the social construction of underrepresentation and subordination in US social institutions, including colleges and universities. Persons are not born into a minority status nor are they minoritized in every social milieu (e.g. their families, racially homogeneous friendship groups, or places of religious worship). Instead, they are rendered minorities in particular situations and institutional environments that sustain an overrepresentation of whiteness."

Supplemental data for this article can be accessed here.

et al. 2021). For example, a dam-building mega-project in Lesotho exacerbated existing gender disparities by prioritizing males for development-based employment opportunities and benefits (Braun 2011); others in Brazil excluded the discourse of those whose daily lives were most impacted by dam development (Aledo Tur *et al.* 2018). These effects are well known but continue to occur. We argue that employees in the water sector are key actors in on-the-ground decisions and policy implementation, and representation that reflects the lived experience of publics in these occupations will impact water delivery. There is work to be done in understanding how (mis)representation in water decision-making at the managerial level (diversions, water quality, groundwater withdrawals, etc.) shapes the lived experience of employees, water users, and reciprocal actions.

Socio-hydrology has emerged to account for social impacts on water fluxes and flows and vice versa (see e.g. Sivapalan *et al.* 2011, Montanari *et al.* 2013, Pande and Sivapalan 2017, Di Baldassarre *et al.* 2019). To date, these studies have typically used differential equations to explore change over time (Qi and Chang 2011, Sivapalan *et al.* 2014), although additional methods are emerging (Mount *et al.* 2016). Socio-hydrology research has focused on water governance phenomena in the context of water resources development (Srinivasan *et al.* 2012, Kandasamy *et al.* 2014, Chen *et al.* 2016, Mostert 2018), trade-offs (Csete and Doyle 2002), unequal distribution impacts (Burton and Cutter 2008), and unintended consequences of infrastructure investments (Kates *et al.* 2006, Gleick and Palaniappan 2010, Ludy and Kondolf 2012, Dumont *et al.* 2013, Gohari *et al.* 2013, Kreibich *et al.* 2017, Di Baldassarre *et al.* 2018), among other things. Although government responsiveness to community sentiment is consistently cited as a key macro-scale contextual parameter, studies have yet to consider the representativeness of water governing bodies (Elshafei *et al.* 2014, Gonzales and Ajami 2017, Yu *et al.* 2017, Barendrecht *et al.* 2019).

There have been numerous calls to integrate social science with socio-hydrology to investigate the roles of power relations in water systems (Wesselink *et al.* 2017, Di Baldassarre *et al.* 2019, Ross and Chang 2020). Hydrosocial studies in particular address social, political, cultural, and economic factors affecting hydrological outcomes, including meaning-making, knowledges, and structural oppression in water-society interactions (Lave 2012, Linton and Budds 2014, Haeffner *et al.* 2017, Rusca *et al.* 2017, Zwarteveen *et al.* 2017, Pacheco-Vega 2019, Cantor 2020, Mukherjee 2020). This perspective may enhance socio-hydrology by opening novel lines of inquiry, introducing new methods, and deepening understanding.

We focus on *representation justice*, which examines whose interests are being represented, as a lens to consider *how* water data are collected, *who* makes water decisions, and *what* this means for water users and hydrological processes. We argue that social issues of power, gender, and intersectionality are essential to socio-hydrological understanding. Access to decision-making platforms is a critical component of water governance, and water governance influences how and where water flows (e.g. Srinivasan *et al.* 2012), discrepancies in water quality violations (e.g. Balazs *et al.* 2012, Fedinick *et al.* 2019), and variable rate structures (e.g. Mustafa and Reeder 2009). We focus on the US to illustrate how inequality manifests in water systems in the global North,[2] where access to clean water is often taken for granted (Gandy 2014, Meehan *et al.* 2020). We take cues from feminist and intersectional studies of other white male-dominated industries (Acker 2006, Healy *et al.* 2011, Williams *et al.* 2012, Kelly *et al.* 2015) to explore how the social composition of governance may affect human-environment interactions. Finally, we propose an agenda for future research and discuss how a representation justice approach might benefit socio-hydrology and water management practice.

Representation justice

Representation justice asks, "Who is authorized to speak for whom?" (Young 2000). Representation justice is important for several reasons: it increases the participation of minoritized groups in decision-making and problem solving; it prevents the most powerful groups from dominating processes and outcomes, and it introduces meaningful social perspectives and knowledge that would be overlooked through unjust representation (Young 2000).

It is much more likely that decision makers will attend to their constituencies if they also share their social perspective, but this is complex (Young 2010, p. 196). It is important to note that representation justice does not assume shared identities – for example, that all women share the same life experience or would behave similarly in a given situation (Young 2000). Since structural racial oppression puts white women in different social positions than women of color, white women cannot be said to represent all women. A call for representation justice, then, is not a call for simply numerical or proportional representation, but a call to account for the myriad perspectives that can provide a broader representation of shared aspects of experiences.

Key indicators of representation *in*justice are oppression, misrecognition, marginalization, cultural imperialism, and violence (Young 2014). Márquez (2013) points out that framing racial groups as *expendable* allows states to further their own power interests. Feminist scholar Voyles (2015) uses the term *wastelanding* to connect this concept to land, where both land and the people who live there (i.e. Indigenous, people of color) are deemed "pollutable," resulting in environmental injustice and racially segregated and toxic fenceline communities. In response, Pellow (2018), in developing a critical environmental justice framework, introduced the term *indispensability*. Where expendability seeks to erase difference, indispensability means that a team is not complete without diversity. A call for representation justice is a call to provide space for recognition of difference that opposes homogeneity.

[2]Throughout this essay, we use the terms global North and global South, in line with water resource literature, to refer to two socio-economically distinct regions of the world. The former refers to regions characterized by water systems designed by pro-consumption, capitalist, industrial, colonialist approaches; the latter refers to regions of the world that may have longer histories of developed water infrastructure but have benefited less from recent technological advancements. We recognize these terms are inaccurate because they are not reflective of geography and are misleadingly homogenizing.

Linking social science theories and socio-hydrological studies

Social science theories can support the design of a socio-hydrology research agenda to explain why certain water decisions are made over space and time and the consequences for hydrological fluxes and flows. Incorporating perspectives from complementary theories of feminist political ecology (FPE) and inequality regimes, rooted respectively in geography and sociology, could offer a deeper understanding of water resource management and intersectional power relations, social politics, and cultural practices that shape how our water resources are managed. An inequality regimes approach illuminates the organizational policies, practices, and ideologies that historically marginalized populations (e.g. women, people of color) face in professional settings. At the same time, FPE theory elucidates the implications of these dynamics for water governance, public policy, and decision-making.

Feminist political ecology (FPE)

Here, we use the theoretical definition of feminism as a philosophy of recognition and advancement of systematic protection of equal rights, justice, and fairness in various issues involving humanity. FPE, which stems from geography, is the theory of how the "gender differences in experiences of, responsibilities for, and interests in 'nature' and environments" are real and not only biological (Rocheleau *et al.* 1996, p. 3). FPE scholars have drawn connections between the material dimensions of water (e.g. precipitation patterns, water availability, water quality) and the non-material factors (e.g. management institutions, social and power relations, values, and norms) that shape not only access to clean water but also inclusion in and exclusion from decision-making and governance. For example, Sultana (2009), in an investigation of arsenic contamination in Bangladesh, drew attention to numerous ways in which gender influenced water access, control, and exposure to polluted water. Other studies have focused on how socio-cultural norms, resource politics, gender roles, and stereotypes have far-reaching effects in shaping women's participation in water management and governance (Michael 1998, Agrawal 2001, Cleaver and Hamada 2010). Michael (1998), for example, found that women in Tanzania rarely took leadership positions on water committees – even when husbands were supportive. Patriarchy, skepticism, and stereotypical assumptions about female leadership undermined their willingness to participate. In another study of rural water management in Tanzania, Mandara *et al.* (2017) found that while formal decision-making spaces have been created to enhance women's participation, patriarchal norms and traditions impeded success. In other cases, gendered practices and socio-spatial relations undermined women's agency and ability to participate in water governance (Hawkins and Seager 2010, Nightingale 2011, Sultana 2011, Truelove 2011, Adams *et al.* 2018).

While FPE has contributed to a more robust understanding of gendered practices and relationships in water management, the literature explicitly addressing gender and participation in water governance has engaged primarily with rural livelihoods and gendered participation in irrigation and water management systems in the global South (e.g. Zwarteveen 1997, Meinzen-Dick and Zwarteveen 1998, Were *et al.* 2008, Buechler and Hanson 2015). The majority of this work draws a similar conclusion – that women's participation in water planning and decision-making is low compared to men's (Hemson 2002, Zwarteveen 2017, Adams *et al.* 2018), and that women's leadership in water management had a positive influence on the well-being of rural communities and in creating a more equitable, sustainable and efficient use of water (Kevany and Huisingh 2013). However, it is difficult to extrapolate how this finding applies to the global North without further research.

Inequality regimes

The inequality regimes framework, which comes from sociology, uses an intersectional approach to theorize how multiple systems of inequality, including gender, race/ethnicity, and class, are embedded in the policies, practices, and ideologies of work organizations. Acker (2006, p. 444) focuses on

> the bases of inequality (e.g. gender, race, class), the shape and degree of inequality, organizing processes that create and recreate inequalities (organizing class hierarchies, recruitment and hiring, wage setting and supervisory practices, and informal interactions), the invisibility of inequalities, the legitimacy of inequalities, and the controls that prevent protest against inequalities.

She notes that organizational inequalities are reproduced through means that may be both covert (e.g. gender segregation that appears "natural") and overt (e.g. sexual harassment).

Acker's work has been widely applied in sociological and interdisciplinary research on work organizations, particularly concerning workers in occupations that have historically been white male-dominated, such as construction tradespeople (Kelly *et al.* 2015), geoscientists in the oil and gas industry (Williams *et al.* 2012), and public-sector workers in health, local government and higher education (Healy *et al.* 2011). These studies have assessed how organizational policies, practices, and ideologies disadvantage marginalized workers. For example, Williams *et al.* (2012) studied women geoscientists in the oil and gas industry, focusing on four dimensions of this occupation that disadvantaged some women: job insecurity, teamwork, networking, and career maps (characterized by individual responsibility for career development). Kelly *et al.* (2015) identified similar findings in their research on the construction trades: apprentices who were women and/or people of color experienced barriers to consistent employment, networking, and mentorship as well as overtly racist and sexist harassment on the job site. Both studies described policies, practices, and ideologies that were, on the surface, gender and race-neutral; however, these conditions disadvantaged women and people of color.

While the inequality regimes framework research has primarily focused on identifying mechanisms, Acker (2006) also analyzes how inequality regimes might be changed. She first notes that in order for inequalities within organizations to be addressed, they must be both visible and regarded as

illegitimate. The likelihood of organizational inequalities being both visible and viewed as illegitimate depends on the social, political, and economic context. Acker (2006) further notes that, historically, successful change efforts have had several common characteristics: targeting a small number of specific inequality-producing policies, practices, and ideologies; support from within and without the organization, including social movement and legislative support; and coercion or threat of loss if inequalities are not addressed.

Acker (2006) also argues that intersectional systems of inequality within organizations (e.g. race, class, and gender) must be addressed simultaneously to avoid addressing one type of inequality at the expense of another. Intersectionality accounts for overlapping factors including race, gender, and age (among others) and how these are related to structural oppression (Crenshaw 1989, 1991, May 2015, Collins 2017). In other words, the combination of social categories is not additive, linear, or unidimensional. There have been attempts to model intersectionality (Green *et al.* 2017). However, even if a perfect model existed, the results would still need to be contextualized within historical and cultural relationships. Specifically, Collins (2017) underscored the need for a more robust analysis of how capitalism, colonialism, and society's hierarchies of power create social inequalities for both individuals and collectives. This is where the fields of representation justice, FPE, and inequality regime theory (among others) can come into play.

Few studies have applied inequality regimes to topics involving natural resource management; exceptions include an examination of gender in the forestry sector (Johansson *et al.* 2019) and a study of sustainable, carbon-neutral transportation (Kronsell *et al.* 2016), and studies applying this perspective to analyze water resource management are lacking. Drawing on the inequality regimes framework in future studies of representation justice in the water sector calls for assessing the specific policies, practices, and ideologies that impact who is involved in (and who is excluded from) control and decision-making around water resources.

Methods

An exploratory online survey consisting of closed- and open-ended questions was used to explore workers' lived experiences in the water sector. We contacted employees in the water sector through the Women-Water Nexus of the Environmental Water Resources Institute within the American Society of Civil Engineers and the Northeast Water Innovation Network (now part of the New England Water Environment Association) and their networks. Potential respondents were sent two reminders via email. The survey included items related to employment status, relative promotion and wage perceptions, job responsibilities, resources and benefits, discrimination, and other potential career opportunities and barriers. Participants responded to nine options that queried perceived discrimination on the job, including gender, age, career stage, race or ethnicity, disability, religion, marital status, social status, and pregnancy or responsibilities of children. Respondents could also choose multiple options, write in other forms of discrimination, or state that they never experienced discrimination. Participants were also given the opportunity, in the form of a write-in text box option, to share experiences with career barriers and opportunities. The survey was designed to be completed within 10–15 minutes on a personal computer or mobile device. The study period lasted from October 2018 to September 2019. Two duplicates were removed from the final dataset.

Participants accessed the survey via an anonymous link through the Qualtrics program. Respondents chose to participate based on self-identification as a worker in the water sector. Descriptive analyses were performed to calculate the frequencies of categorical variables, while two coders analyzed the text responses for common themes.

Results

The survey received 496 responses from workers in the water sector in the United States. US participant demographics were as follows: 75.8% female, 22.8% male, 0.6% gender non-binary, and 0.8% preferred not to indicate gender. Respondents were employed in a variety of sectors (see Supplementary material, Table S1 for a list of specific job titles), with most working in academia (22%), industry or consulting (23.6%), and government (30.8%); others selected from sector options including non-governmental and non-profit organizations (7.7%) and start-ups (1.4%), while some were self-employed (2.8%), students (4.4%), or retired (1%). 6.3% of respondents did not specify an employment sector. Specific geographic location was not asked to ensure that a person's identity could not be accidentally exposed due to the limited numbers of women, gender nonbinary, and historically marginalized groups in some areas.

To offer agency and grasp the complexities of race/ethnic identity in our survey, we asked respondents whether they identified as a racial/ethnic minoritized group (Y/N) and then provided an open-ended text box in which they could write in their specific race or ethnic identity. Of the 379 female and gender non-binary respondents who responded to the race and ethnicity question, 17.9% identified as belonging to a racial or ethnic minoritized group and wrote in a response. Written answers included: African American (5), Alaska Native/Native American (1), Arabic (1), Asian (6), Asian-American (2), Asian/Chinese(1), Black (4), Caucasian or White (14), Chinese (1), Filipino (2), Filipino-American (1), Hispanic (9), Hispanic (half) (1), Hispanic (Mexican) (1), immigrant Brazilian (1), Indian (1), Indian/Asian (1), Jewish (1), Korean (1), Latina (6), mixed race WOC (1), Native Hawaiian (1), Persian (1), South Asian (1), and South Asian American (2). Responses to the open-ended question in our survey, "Please share any further thoughts on your experiences with career barriers/opportunities in your field" were analyzed to identify both general cross-cutting themes for all women in the survey and differences between women respondents stratified by race/ethnic identity. Of the gender non-binary respondents, only one responded to this question. Half (50%) of the US women provided answers, while the other half left it blank. Notably, 100% of female respondents who self-identified in a minoritized group wrote in a detailed response. Due to the limited number of individuals identifying as non-binary or not

revealing their gender, the quantitative analysis only focused on differences between female and male respondents.

The findings presented here are not meant to be generalizable but highlight concrete experiences that are theorized in the literature and to make space for women in the water sector to represent their lived experience through their own words. Three themes emerged from our research: (1) Power and politics shape the composition of the water sector. (2) Qualitative data can illustrate the lived experiences of those involved in the water sector. (3) Representation goes beyond gender; social identities and experiences are not additive, and intersectionality cannot easily be accounted for in current socio-hydrological models.

Finding 1: power and politics shape water sector composition

There is clear evidence that discrimination plays a role in recruiting and retaining women and people of color in the US water sector. The main quantitative findings in the survey were based on perceptions of discrimination (Fig. 1). For this analysis, responses were limited to US-based participants only and included only respondents who identified as female or male and who submitted answers to this particular survey question.

Among these respondents, 57.2% of self-identifying females felt strongly discriminated against due to their gender, compared to only 1.8% of self-identifying males. Of the self-identifying females, 18.1% also felt discriminated against when they were pregnant or had children, again compared to 1.8% of self-identifying males. Self-identifying females reported feeling discriminated against based on age, race or ethnicity, or social status about 7–8 times more often than self-identifying males. A similar number of respondents indicated they had never felt discriminated against; however, based on the uneven distribution of the respondents and their self-identified gender, only 15% of self-identifying females reported not feeling discriminated against, compared to 46% of self-identifying males. Other results from the survey indicated weak trends, in part due to a limited number of respondents, for differences in perception among females and males regarding remuneration and career progress, especially once controlled for race and ethnicity. Overall, this work indicates that there are perceived differences among genders in the workforce, and race and ethnicity often highlight additional differences.

Finding 2: qualitative data can illustrate the lived experiences of those involved in the water sector

General themes expressed by women across both minoritized and non-minoritized identifying groups included being subjected to persistent microaggressions, microassaults, and microinsults; challenges of work-life balance, particularly with regard to children and family; and the resistance to interdisciplinarity in hiring. There was also a frequently expressed theme relating to advancement barriers, although this differed slightly between minoritized and non-minoritized women respondents. In workplace settings, subtle oppression that keeps people from being heard often occurs in the form of microaggressions: "everyday verbal, behavioral, or environmental indignities, whether intentional or unintentional, that convey hostile, derogatory, or negative slights and insults toward members of oppressed groups" (Nadal 2008). Sue *et al.*'s (2007) most influential work on the subject led to a

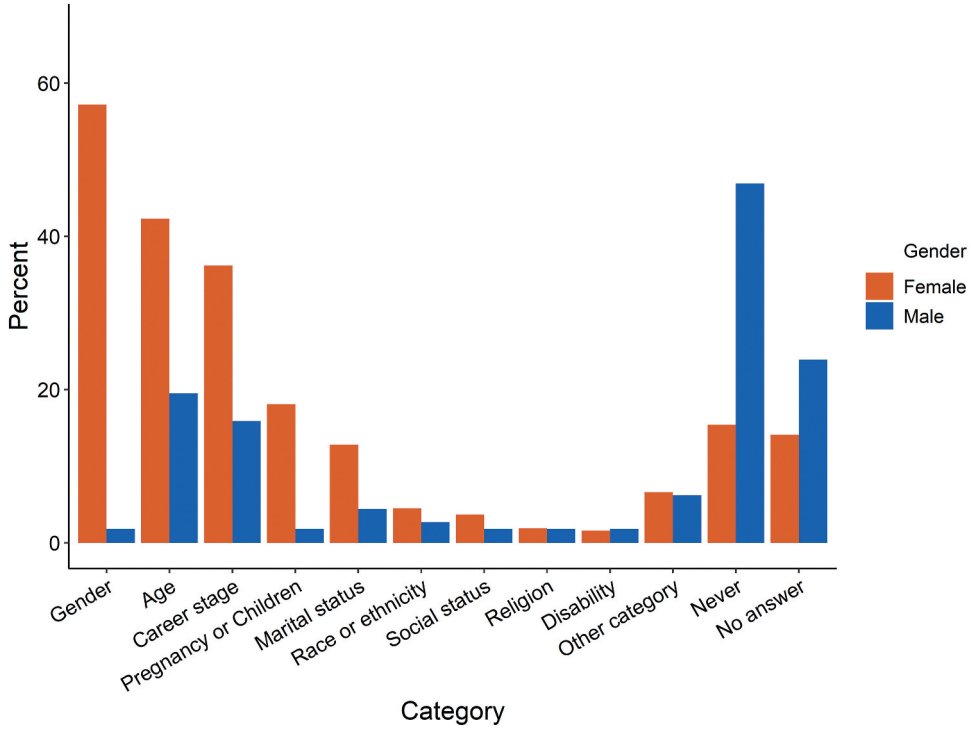

Figure 1. Responses to the question of whether respondents who identified as women or men felt discriminated against in their workplace at least once, based on the categories displayed.

taxonomy of microaggressions: microassaults (explicit verbal or nonverbal attacks, such as name-calling), microinsults (overt comments or actions that are demeaning), and microinvalidations (ambiguous comments or actions that negate the person's experience) (Sue *et al.* 2007, p. 271). These manifest in different ways for women (Basford *et al.* 2014), transgender persons (Nadal *et al.* 2010), Black Americans (Sue *et al.* 2008), Asian Americans (Ong *et al.* 2013), Latinx Americans (Nadal *et al.* 2014), and others. These are important distinctions to make in order to understand the spectrum of overt and covert discrimination that prevents true representation in the water sector. Most respondents commented on the impact microaggressions have had in their careers. What is most telling is that these experiences cross occupations, age, and time in the field.

A few examples from the US respondents who self-identified as female demonstrate the breadth and depth of micro- and macroaggressions that systematically discourage workers from certain social groups to enter or continue in this field (Sue *et al.* 2007). This is neither an individual experience nor one that is universal to all women in the survey, but one that is persistent across many survey respondents. The following are direct quotes from the survey from across the spectrum of water sector occupations and years of experience. Some respondents commented on systematic oppression; for example, a non-minoritized Water Treatment Operator remarked: "I am certified at the same level as the men in my field and hold the same job title. I, however, make $2.00 less an hour than they do."

Some comments exemplified the microassaults that employees face in the water sector. A Hydrogeologist 3 explained: "My supervisor for 15 years engaged in bullying – disparaging, replacing professional duties with nonprofessional duties, ignoring requests for professional development, downplaying accomplishments, magnifying errors, etc." (non-minoritized). A Program Manager in Engineering noticed a change in her work environment when her female manager retired: "The men that replaced her gave me the worst assignments and refused to promote me until I returned to work full time" (non-minoritized).

Some comments demonstrated the breadth of microinsults, such as being called condescending names like "honey." A Staff Engineer II reported:

> [I] have experienced condescending and inappropriate language from senior male staff in consulting at various consulting firms multiple times. I don't feel that it has impacted my progress or development within the field but has made working less enjoyable and brought up more conflict in the workplace. (non-minoritized)

Other comments described the microinvalidations employees receive. Two African-American executive directors reported continually being asked to explain their decisions to male employees. A non-minoritized Director commented on the exclusionary behaviors of her peers:

> We [women] are shut out from many of the unofficial networking that goes on (e.g. going out for a drink alone with a client). Even in terms of volunteer activities, I get asked to do the 'soft' stuff – like communications – rather than lead a technical group.

Many respondents spoke of work-life balance issues explicitly related to family and children. A Sanitary Engineer 3 experienced a double standard in which a man was promoted for having children while she was punished: "I was once told that I didn't get a promotion because the guy they gave it to had kids and a wife at home he had to feed – I also had a kid at home, but it was expected that my husband made good money" (non-minoritized). Many of the respondents felt that motherhood was a gender-based barrier that affected personal decisions and professional advancement. A Project Engineer worried that: "I do not currently have children, but I fear that if I do it will become a barrier" (white). Meanwhile, an Indigenous Engagement Lead explained that her work "takes away from family time with my two small children" (Alaska Native/Native American), while an Assistant Extension Educator in Residence agreed that she was responsible for "balancing child care and work" (Indian-American). An Acting Assistant Manager explained why a socially gendered approach to parenthood impacts women's careers more: "A great deal of 'networking' with decision makers in our organization occurs after-hours at the bar, this is a significant issue for those of us possibly younger in our careers or with children" (non-minoritized).

Finally, a subtle but interesting theme that emerged across the different groups in the survey pointed to the challenge that interdisciplinarity posed for women's workplace advancement and recognition. That this would be a hindrance is particularly important to consider, given the fact that the water sector incorporates and relies upon a wide range of skills and backgrounds, making it inherently interdisciplinary. Thus, where gender dynamics intersect with disciplinary skills or power conflicts, the productivity and effectiveness of the workforce is likely to be negatively impacted.

The general theme that emerged repeatedly was the primacy of engineering over other types of disciplinary backgrounds and training, including science and scientists, and the workplace challenges associated with interdisciplinary training and backgrounds. A non-minoritized Project Scientist put it succinctly:

> As a scientist working predominantly with engineers, I notice a bias and/or lack of understanding toward how science informs engineering. I often feel like engineers either don't understand what I do or don't assign as much importance to what I do because it's not engineering.

Two other non-minoritized respondents echoed this: "The engineering/academic community feels predicated on individuals having a linear progression and doesn't value non-engineering/scientific experiences." (non-minoritized, no title specified); "My BS is in Earth, Society, and Environmental Sustainability. For future women, I would recommend taking courses in STEM to be taken seriously, like Environmental Engineering." (non-minoritized Community and Events Planner for Water Quality Sector). An African-American respondent (no title specified) directly connected the preference for engineering with the gendering of their workplace: "The engineers, who have less than a year of experience, are preferred over non-engineers who have > 10 years' worth of experience. All of the engineers are men; the lab supervisor and chief operator are women."

It appears that even when one's degree is directly related to water, interdisciplinary and non-science degrees present a hindrance: "My Master's degree is in Water Policy. I'm finding it hard to fit into the typical categories/positions because I am not an engineer or a hydrologist, and also not a communications/public media specialist." (non-minoritized, Executive Assistant at Water Utility). "Soft skills" integral to the water industry remain devalued:

> I work in communication and education in the water sector, which is always considered a 'soft skill.' It's a challenge for others to see the value in this vital area of our industry, especially since our industry directly impacts public health, and the public doesn't understand the value of what our industry does. It's hard to be taken seriously or prioritized. (Hispanic CEO)

One respondent, a non-minoritized Assistant Professor in Political Science/Environmental Policy, clearly connected the failure of the field to adapt to interdisciplinarity, describing "rapidly changing norms – I'm evaluated by people who came up in a different era and don't respect the kind of collaborative/interdisciplinary work I do in the realm on water policy and management." Although our survey was not designed to measure the link between interdisciplinarity and intersectional career barriers, this emergent finding can lead to new research. Studies show that women tend to specialize less than men (Leahey 2006). Using coauthorship as a proxy for collaboration, Abramo *et al.* (2013) found that women were more likely to collaborate in all forms except for international collaboration. Rhoten and Pfirman (2007) found that women academic researchers in their US and the United Kingdom surveys were more interdisciplinary, drew on more fields in their research, and spent more research time on collaboration. Notably, their study found that younger women in the physical and engineering sciences were more interdisciplinary than older women, suggesting cohort differences or possibly an aging out (Rhoten and Pfirman 2007). Future research might inquire why water sector employees are perceiving a discrepancy between how specialization and interdisciplinarity are recognized and how this may be related to gender, and any intersectional implications.

Meanwhile, there was a single, but powerful, response that reflected the advantage that having a range of disciplinary interests and skills had brought them: "Computer aptitude, a good attitude, and hav[ing] varying interests in design, art, natural science, and the built environment has helped in my career" (non-minoritized Vice President). Further exploration of how disciplinary background and training intersect with gender in presenting barriers as well as possible advantages in the water sector workplace will be important in devising strategies to bolster the integrated expertise needed to support broad representation and concrete problem solving relating to water-related challenges.

Finding 3: representation goes beyond gender; social identities and experiences are not additive, and intersectionality cannot easily be accounted for in typical socio-hydrological models

While the above themes were expressed consistently across both non-minoritized and minoritized women respondents, there were additional differences between the groups when stratified by minoritized status. In general, non-minoritized women were more likely to mention positive experiences (although most did acknowledge barriers), in contrast with minoritized women who more frequently described a lack of inclusion or access, as well as a lack of respect. While minoritized-identified women respondents mentioned the need for mentoring and "learning the rules of the game," non-minoritized women were more likely to point to their own skills and abilities in the face of discrimination in their responses. Finally, when mentioning gender in their responses, minoritized-identifying women often also mentioned race, while non-minoritized women were more likely to mention other intersections, such as age, religion, or veteran status.

In response to the open-ended question, which asked respondents to comment on "any career barriers/opportunities in your field," non-minoritized women were more likely to cite positive individual experiences, even when acknowledging gender problems in the field in general. A non-minoritized Environmental Engineer stated, "I have had an easier time navigating than some of my female peers, need to pay my luck/experience forward to bring the next generation along." A non-minoritized Environmental Planner acknowledged the double-edged sword that gender played in their individual experience, saying, "I am a masculine-presenting queer person. This has been mostly helpful to me, and I believe I have experienced less sexism in the workplace because of it."

Some non-minoritized women subtly or overtly attributed their positive experiences to their own agency or actions: "I have had to be very conscientious about asking for raises/promotions, because I know that my male colleagues are very assertive/aggressive about fighting for higher scores on their annual reviews. Last year it didn't pan out, but I'm proud that I met with my supervisor and asked for the merit raise" (non-minoritized Research Assistant Professor); and "I have had good support and bosses throughout my career. I have also asked for positions vs. being asked" (non-minoritized Client Service Leader). Others dismissed other women's negative experiences as flaws in individual outlook: "I started in this field when there were very few women. I have only met one person whom I felt was actually prejudice[d] against women. I have worked with many women who would disagree, so I believe it to all be in how the actions of others are perceived by the woman. We need to mentor young women to be strong and confident in their capabilities to succeed rather than to always be looking for prejudices as an excuse" (non-minoritized Operation and Maintenance Manager.); and "I have found that opportunities for growth/promotion include change, and know some people that miss these opportunities because they are not open to change" (non-minoritized Environmental Scientist).

In contrast, minoritized-identifying women described specific instances of exclusion and isolation, including challenges with access to position information as well as discrimination during interviews: "Before I started my MS, I attempted to find work in water treatment. I found it difficult to get an interview. During interviews I did get called in for, I received questions about my physical abilities. In one interview, I was asked repeatedly if I was capable of turning a valve. The question was followed by 'Are you sure?'" (Hispanic-identifying

Hydrologist); "Just getting information on the advertisement of the positions can be somewhat difficult" (Latina Postdoctoral Researcher); and "There is a lot of hidden curriculum going on, specifically when it comes to interpersonal relationships. Environmental science feels like an old white man's club" (South Asian American PhD Student). Isolation was also noted as a problem: "There aren't many folks at work that I can confide in or talk to for mentoring" (Black Postdoc).

Lack of respect was also problematic for women in minoritized groups. An African American Executive Director wrote of

> Disrespect from male employees below and above me. Constant need to explain my decisions but not expecting the past leader to explain his decisions. Anger from employees because I ask questions. Regularly said that this is micromanagement. Disrespect from males in the vendor and development world with "honey" and "what do you do" or "what section do you lead?" Disbelief and sarcastic comments as if they can't remember that I'm the executive director.

A Hispanic Post-doctoral Researcher described "challenges with mentoring male students that don't seem to respect me as much as full professors." In contrast, the only direct mention of respect in non-minoritized responses was a positive one, again with attribution to one's own agency: "I have found that my present situation is that I get as much respect as any other operator, I have earned it" (non-minoritized Senior Filtration Operator).

Perhaps relatedly, a theme mentioned by several minoritized women was the need for mentoring, and for gaining access to skills and "rules of the game" as well as to have those rules applied evenly with regard to gender: "I have an administrative title, and so there really aren't other options available for me at my University. We have also had funding issues statewide . . .. It would be helpful to learn the importance of titles and such in academia (I came from a government laboratory)" (Hispanic (half) Associate Director); "Lack of negotiation skills and self-promotion" (Latina university faculty); and "Sexual harassment is not taken seriously. Men are given more information and mentoring while women don't. Throughout the years I have felt like women have to keep proving themselves and defending their work compared to their male workers" (Hispanic, title not provided).

As noted earlier, in a representative justice approach, it is important to attend to differences within identified groups as well as between them; one voice cannot speak for all. While far more non-minoritized women cited positive experiences than minoritized women, most non-minoritized women did acknowledge and spoke to the many barriers they faced on the basis of gender, and a faculty member who identified as Latina stated, "I do not think that being a woman has impeded me in having a satisfying career in water." Thus, while gender is noted and expressed as a barrier in many ways for both groups of women, the ways in which those barriers are understood and experienced tend to differ along race/ethnic lines. Minoritized women also tended to mention race in their responses to this question, specifically calling out the intersection of gender and race: "[women] are not getting promoted/not getting opportunities at the same rate as equivalently junior white male staff" (Hispanic Supervising Engineer); "It's a 'Good ole boy' system where being a white male and having previous relationships matters" (Asian Vice President); and "Environmental science feels like an old white man's club" (South Asian American PhD student).

In contrast, non-minoritized respondents rarely if ever mentioned race or ethnicity in their responses, although several did mention other identities that either overruled or intersected with gender in their experience of barriers: "I had more issues with my sexuality (lesbian) tha[n] gender on the job search" (non-minoritized Assistant Professor); "I encountered frequent sexism in my original field (fisheries) as well as obvious preferences for a politic/religion/even hobbies in one position working for the USFWS. Veteran's preference in fed jobs has been an issue with closing doors for women and minorities because they are less often veterans too" (non-minoritized Environmental Scientist); "Some workplaces, on the other hand, have been great, and were welcoming as far as me being female, but discriminated against me based on religion" (non-minoritized Stormwater Education Coordinator). In particular, age was mentioned twice as a barrier, in a "no-win" paradox: "When I was younger, men got the promotions. Now that women are getting a fair chance, age is the barrier" (non-minoritized, no title specified); "Because I am a young woman, external clients or others often think I am an intern" (non-minoritized Staff Engineer 2). Regional barriers were referred to as well: "Urban-centric attitudes and leadership present challenges and devalue the experience, knowledge, and lifestyles of rural people and communities" (non-minoritized Watershed Organizer).

There is evidence from this survey that the US water sector is experiencing a redistribution worthy of further research. In the 41 and over age group, some commented about the change in discrimination over time, although it was not universal whether this change has been for the better or worse. A non-minoritized Program Manager in Engineering remarked: "In the 20+ years I have worked in this field, more and more women now hold positions of power and the stigma against working mothers have reduced." However, a Hispanic Supervising Engineer explained that women are still not represented in decision-making roles: "I think our industry is doing a better job of hiring women, but you can see that they are not getting promoted/not getting opportunities at the same rate as equivalently junior white male staff." A Filipino-American Senior Environmental Expert explained the consequences of the lack of representation:

> I left my old [job] because I did not see other women or people of color ahead of me in technical roles. It was hard to see how I could move up when there was not anyone who looked like me in leadership positions.

A non-minoritized Laboratory Analyst/Micro Lab Supervisor remarked that women have to work twice as hard for recognition, while an African American Senior Vice President commented that "even with hard work, women receive less pay and less recognition."

While such a broad and open-ended survey is not intended to provide definitive pronouncements regarding women's experiences in the water sector, this intersectional analysis points to areas worthy of further investigation. Future studies must keep in mind the need to attend to the diversity of women's experiences and the salience that intersections with race and ethnicity and other identities play in tempering biases

and experiences of gender in water-related career paths. There are important differences between women that need to be further explored and elucidated in the quest for justice in the water sector. Without a complete understanding of the role that power plays in the water sector, decisions and their outcomes can appear apolitical, when in actuality, decision-making is biased towards an unrepresentative group. It follows that the outcomes of such decisions are also gendered and racialized.

Discussion

Future directions: towards a representation justice research agenda for socio-hydrology

Using the survey data and literature above, we diagram how the lack of representation in the water sector at multiple levels leads to misprioritization of water investments, incomplete data, and employee turnover, which disconnects water resource management from the community, science, and public (Fig. 2).

Instead, we propose a model of representation justice in the water sector that promotes communication and engagement between water resource management, community, and research. We hypothesize that representation justice at all levels will lead to innovative research questions, more complete datasets, and more comprehensive analysis for socio-hydrology as well as more community-relevant decision-making in water governance and management practice (Fig. 3).

To strengthen understanding of representation justice in the water sector, we propose a research agenda (Box 1). Future research should examine the specific workplace dynamics (including policies, practices, and ideologies) that impact individuals' experiences of discrimination, career barriers, and inclusion and exclusion related to decision-making in the public water sector. Likewise, future research should also inquire how workplace experiences and dynamics vary based on intersectional identities (e.g. gender, race/ethnicity), occupation (e.g. engineer, natural resource manager, wastewater treatment operator), water issues (e.g. drought/supply issues; specific water quality issues), and organizational structure (e.g. division of drinking, sewer, and storm water management across agencies; inclusion of multiple disciplines in public agencies). These questions draw from the theories of representation justice, FPE, and inequality regimes, focusing on coupled human-water systems and the responses to our exploratory survey. The limits of our survey also point towards areas for research. For example, geographic location is relevant for understanding impacts on hydrological decision-making, which our study did not pursue.

Who makes decisions about data determines what information is collected, how, and to what depth (for example, many census surveys include only two options for gender). In designing a Soil and Water Assessment Tool, Baker *et al.* (2015) found that men and women in Ethiopia generated different land-use inputs for the same landscape. Furthermore, who collects data can impact the response rates of different social categories. Inadequate datasets can complicate socio-hydrology models that attempt to build indices from these data, and models tend to discount outliers. However, the "outliers" can help explain vulnerability, resilience, and adaptation dynamics. Existing accounts of representation equity in the water sector tend to focus on quantitative, demographic factors such as gender and age (e.g. Kane and Tomer 2018). However, labor statistics alone do not explain the experiences of women and people of color in the workforce, they do not illuminate conditions that may cause or alleviate inequity, and they do not explain how inequity influences water management and hydrological outcomes including fluxes and flows.

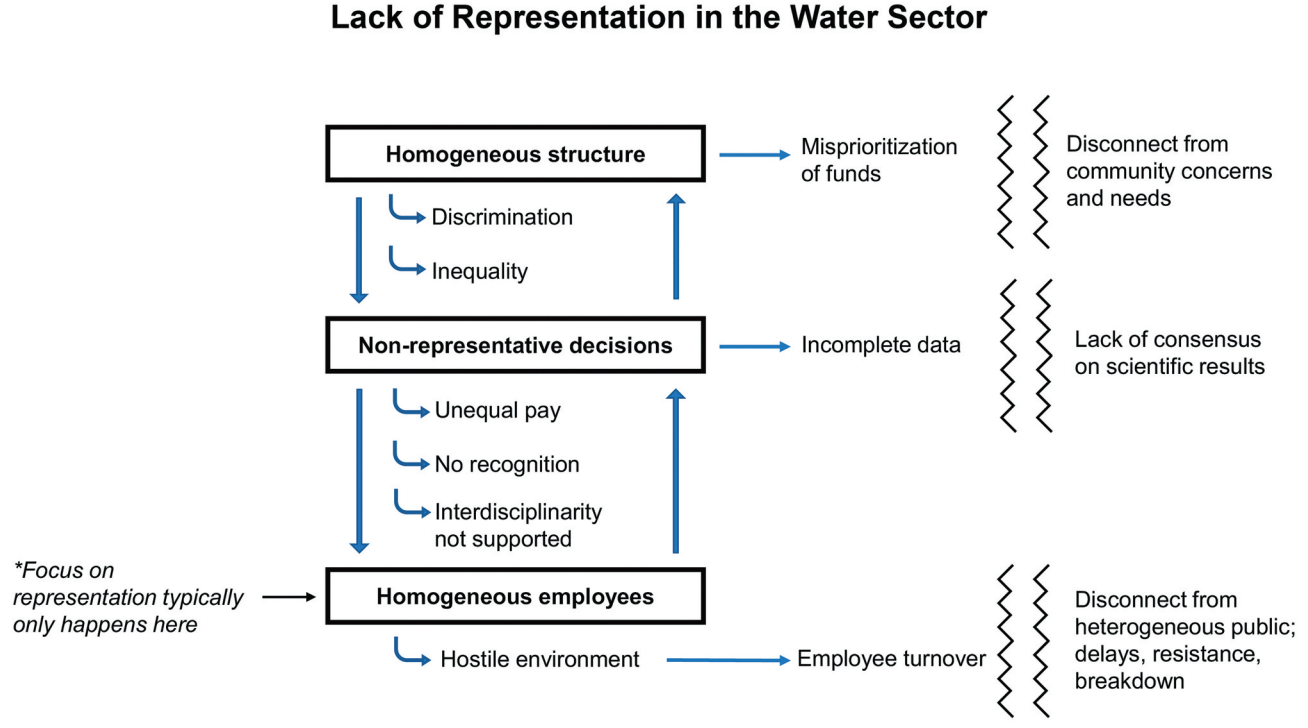

Figure 2. Lack of representation: current conditions in the water sector, where lack of representation can lead to homogeneous organizational structure, non-representative decision-making, discrimination, and employee turnover.

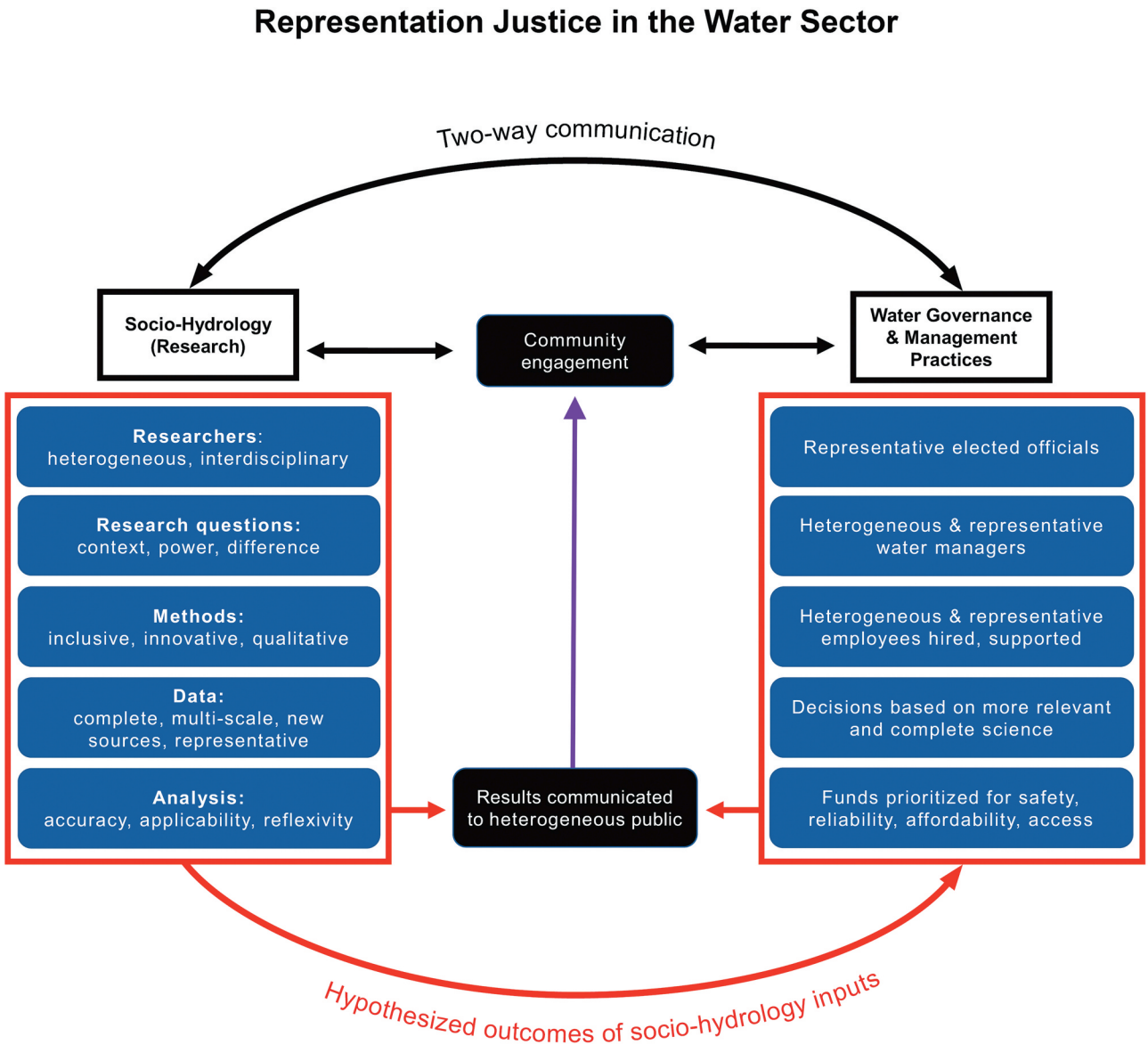

Figure 3. Representation justice: hypothesized outcomes for socio-hydrology research and water governance through a representation justice lens.

Our findings indicate that lived experiences can explain why predictions do not materialize. Digging deeper into social dynamics that propagate inequity, including politics, racism, and historical patterns of marginalization, can offer socio-hydrologists new avenues for explaining how bidirectional feedback loops in coupled human-water systems work. Log-scale regression models such as logistic and Poisson regression are multiplicative and do not represent intersectionality (Bauer 2014), although multi-level modeling is a promising approach (Green *et al.* 2017). Either way, having an intersectionality-informed stance is essential to any quantitative, qualitative, or mixed-methods study involving human data (Bowleg 2012). For example, Savelli *et al.* (2021) found that accounting for the legacy of Apartheid and social class differences between Black informal settlement dwellers and white city elites was more effective than using time-series reservoir storage data in explaining how the 2015–2017 Cape Town drought became a Day Zero crisis. Qualitative interviews and focus groups with residents were critical to framing the research question, identifying key variables, and constructing an appropriate quantitative model given limited data, which gave a more complete and accurate understanding of the coupled human-water system.

Conclusion

Representation in the water sector matters. Applying a representation justice lens will improve socio-hydrologists' ability to address *how* water management decisions are made, *who* makes them, and *what* this means for both water users and hydrological processes. We have identified shortcomings in existing data and methods of analysis as well as opportunities for advancing understanding. Representation justice offers an entry point for socio-political variability and lived experience in the socio-hydrology conversation. The complementary fields of FPE and inequality regimes account for factors such as power, inequality, and systemic oppression, which might restrict access to decision-making roles.

While some of the specific experiences described by survey respondents are unique to the water sector context, the broad findings of this research are entirely consistent with other scholars' examinations of inequality regimes in white male-dominated occupations. Excluded and marginalized workers tend to disproportionately experience harassment (e.g. micro-aggressions, sexual harassment), lack of access to promotion, lower wages, challenges with work/life balance, having their ability or authority questioned, and challenges accessing training and new skills (e.g. interdisciplinarity in the water sector). Holding multiple marginalized identities impacts experiences of oppression in these sectors (e.g. Healy *et al.* 2011, Williams *et al.* 2012, Kelly *et al.* 2015).

Beyond interdisciplinary intellectual contributions, future study of representation in hydrological decision-making can benefit both the water management industry and society, particularly by advancing employment opportunities for women and people of color in the water sector. Lines of inquiry may guide public, private, and non-governmental water management agencies to recruit and retain employees. Furthermore, results may enhance water management organizations' ability to fill employment gaps, improve working conditions and workplace dynamics for women and people of color, and inform a more equitable water governance sector throughout the US, all of which may produce altered hydrological and social outcomes. However, organizations must also consider how to move beyond recruitment to empowerment and inclusion in decision-making processes. Only a strong commitment to representation justice will ensure equitable access to hydrological decision-making, resulting in better hydrological outcomes.

Box 1. Research questions for socio-hydrology through a representation justice lens.

- What datasets do we still need to better understand gender and intersectionality dynamics in the water sector?
- How do gender and intersectionality dynamics alter human-hydrological feedback loops?
- What quantitative tools can be designed to account for intersectionality effects in socio-hydrology? When are qualitative and mixed methods needed?
- How can communities be empowered to collect, analyze, own, and benefit from their data and the results of these studies?
- How are women and people of color represented in water management and decision-making? How do they enter and experience their career paths in the water sector? What procedures do we put in place to ensure equal and appropriate representation in water management and decision-making?
- How do racial and/or gender disparities matter in a water management context? Do these disparities impact decisions or management practices? If so, in what ways?
- How can gender- or race-related disparities in water management be remedied, either through workplace dynamics or other means?
- What is the role of intersectionality with regard to gender representation in water management?
- How do women and people of color describe their experiences working in water management?
- What institutional, historical, or systemic social structures limit access of women and/or people of color to water management jobs and decision-making power?
- How exactly does gender matter in water management and governance, and what are the implications for socio-hydrology models, predictions, and inquiries?
- How do gender, race, and place intersect in water resource management?

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