



Contents lists available at ScienceDirect

Water Security

journal homepage: www.elsevier.com/locate/wasec

Advancing human capabilities for water security: A relational approach

Wendy Jepson^{a,*}, Jessica Budds^b, Laura Eichelberger^c, Leila Harris^d, Emma Norman^e,
Kathleen O'Reilly^a, Amber Pearson^f, Sameer Shah^d, Jamie Shinn^g, Chad Staddon^h, Justin Stolerⁱ,
Amber Wutich^j, Sera Young^k

^a Texas A&M University, United States^b University of East Anglia, UK^c University of Texas at San Antonio, United States^d University of British Columbia, Canada^e Northwest Indian College, United States^f Michigan State University, United States^g West Virginia University, United States^h University of the West of England, UKⁱ University of Miami, United States^j Arizona State University, United States^k Northwestern University, United States

ARTICLE INFO

Article history:

Received 10 March 2017

Received in revised form 7 July 2017

Accepted 7 July 2017

Available online xxxx

Contents

| | |
|--|----|
| 1. Introduction | 00 |
| 2. Human capabilities approach to water security | 00 |
| 3. Water security, politics, and power | 00 |
| 4. Cultural dynamics of securing water | 00 |
| 5. Conclusion | 00 |
| Acknowledgements | 00 |
| References | 00 |

1. Introduction

Water security is a concept that has gained ascendance in policy circles and academic scholarship, yet it remains loosely defined. Indeed, several review articles and edited volumes attest to the conceptual dynamism in water security research [14,36,65,80,23,31]. Water security analyses to date have focused on a range of sectors (e.g. agriculture, potable water, ecosystem services) and scales (e.g. household, nation state, river basin), and they have considered different external drivers (e.g. climate change, armed conflict, economic growth) and key responses (e.g.

water storage infrastructure, water supply technologies, water policy reforms). While these analyses advance different interpretations of water security – with various emphasis on risk [22], rights [9], environmental sustainability and adaptation [91,70], water quality [13], and complexity [101] – existing approaches generally converge on defining water security in terms of water abundance or scarcity. This position, in turn, leads to calls for a variety of policy measures and metrics to address such deficits and deficiencies in the long-term provision of water [50,56,42,32].

We see this broad position reflected in water security literature, policy, and practice regarding the assessment of water deficiencies among low-income populations around the world, which are increasingly being reframed from integrated water resources management (IWRM) to water security [24,93,80,23]. Academic

* Corresponding author.

E-mail address: wjepson@tamu.edu (W. Jepson).

scholarship has done much to identify the direct and indirect burdens of under-provision of water to socially and economically marginalized communities [10,34,35,95] as well as to explore the effectiveness of solutions that range from low-cost technologies to new pricing regimes [8,77,89,81]. As such, a set of key parameters have been defined to assess household water provision, including access, quantity, quality and affordability [31], which are embodied in the Sustainable Development Goals and have come to be viewed as key benchmarks for evaluating water security by the global community.

Our aim in this paper is not to abandon, but rather reconceptualize, water security in ways that explicitly link to broader social and political relations that enable benefits to water related services (e.g., drinking, recreation, productive uses, cultural practices) rather than focus on the materiality of access to water in and of itself. Our conceptualization of water security draws on Amartya Sen and Martha Nussbaum's "capabilities approach,"¹ a moral and political philosophical framework that centers on well-being, human development, and justice. We envision water security as both grounded in the social relations of access to water as well as critical to a set of relations and functionings that advance human flourishing. As such, we challenge the dominant view of water security that identifies water as a predominantly material object ('H₂O') that needs to be 'secured,' a view that points towards interventions to capture water to alleviate or address situations where it is deficient or scarce. Instead, we reposition water security as a hydro-social process rather than a static goal or objective.

The hydro-social cycle describes "the process by which alterations or manipulation of water flows and quality affect social relations and structure, which, in turn, affect further alteration of water" – its flow, processes and movements ([39], 175). Our use of the term hydro-social cycle makes explicit the co-production of water and society. This is distinct from ideas around socio-hydrology that aim to recognize social influences on hydrological processes [64]. This hydro-social cycle operates at and through multiple scales – household, city, basin, region, and country. Moreover, the meanings of water and cultural practices associated with water are also subject to transformation as physical flows and hydrological processes change. In this way, we advocate a shift from seeing water itself as the object to be secured, and instead, we emphasize the importance of recognizing the wider relations through which water is organized by humans and shapes people's lives [101]. Thus, we propose thinking about water security in its broadest sense: securing the ability to engage with and benefit from the sustained hydro-social processes that support water flows, water quality, and water services in support of human capabilities and wellbeing.

We argue that a relational water security framework informed by the capabilities approach offers new ways to consider politics and cultures of water. Each dimension allows us to better contextualize water security beyond just an object (H₂O) to be secured for a certain population. Instead, the relational perspective demands a fuller consideration of the political structures and processes through which water is secured, with emphasis on the social relations of access as opposed to simply the politics around water supply. We also attend to cultural dimensions, such as the meanings of water and customary practices that are not easily captured by standardized metrics. By including these dimensions, we necessar-

ily broaden analytical space to evaluate water security as a relational and dynamic process tied to lived experience rather than as *solely* parameterized conditions in relation to access, quality, or availability of water. We first move to explain our broader conceptualization of water security as linked to human capabilities, then explore in more detail the specific engagements with politics and culture in the sections that follow.

2. Human capabilities approach to water security

International targets to improve access to water have catalyzed a series of debates over the human right to water [25,94,87,12,52,47,102]. Major critiques of a rights-based approach to water argue that it is largely compatible with privatization [4,78], obscures a critical discussion of underlying inequalities [7], and reflects an implicit bias toward the individual in the Western philosophical tradition [9]. Attention to water as an object to which individuals have rights misses the complex dimensions of domestic water use writ large, often leading to an overly narrow focus on potable water interventions while sidelining productive or other water needs [26]. Nevertheless, the state-centricity of the human right to water might be particularly apposite in an era of neoliberalization where state functions and responsibilities have been radically recalibrated [48].

The human right to water debate inspired others to question the object of such claims. Linton [38] asks: "the human right to what?" This question reflects a shift from thinking about water as a material substance that is universally defined ('H₂O') towards understanding the lived experience of water services as an outcome of hydro-social relations ('water') which is diverse and dynamic across space and time. Linton then describes the hydro-social cycle, which emphasizes water's different physical forms and cultural meanings, as well as its processes of production (for example, treated potable water, desalinated water, bottled purified water), all of which shape, and are shaped by, social relations – including institutional arrangements, discourses, patterns of exclusion and identities [39,33]. One of the most powerful examples of the hydro-social construction of water hinges on notions of cleanliness and "pure water." By linking tropes about the rugged purity of the natural world with the industrial process of abstracting, filtering, bottling, shipping and selling drinking water, the modern bottled water industry has created a market for something once thought purely as a public service whilst simultaneously impugning with notions of impurity the highly regulated public drinking water supply in most developed countries.

Building on some of these conceptual foundations, we propose that a dynamic and relational view of water security can be further developed and informed by the capabilities approach of Amartya Sen [74,73,72] and Martha Nussbaum [61,57–60]. The capability approach, originating in welfare economics and political philosophy, is a normative framework to assess how wellbeing and social arrangements contribute to or detract from human flourishing and freedom. This approach defines a person's well-being in terms of beings and doings (functionings) and in terms of his or her capability to choose among such functionings. That is, well-being is linked to justice in terms of people's capabilities to function: a just social arrangement supports individuals' "effective opportunities to undertake actions and activities that they want to engage in, and be who they want to be" ([68], 95).² The capability approach respects people's different ideas of the good life, and their capacity to achieve it.

¹ The capabilities approach is based on several key works by Sen and Nussbaum. Where they differ is in the specification of capabilities. Nussbaum [59] argues for a list of capabilities (life; bodily health; bodily integrity; senses, imagination and thought; emotions; practical reason; affiliation; other species; play; and control over one's environment) whereas Sen argues that a normative list precludes the opportunity for communities to actively to determine the capabilities necessary for their own functioning. The items Nussbaum's list, however, are the result of an evaluative argument that asks the question: "What opportunities are entailed by the idea of a life worthy of human dignity?" ([60], 25).

² Two concepts anchor this approach. First is "functioning." Functioning is defined by what a person does or is; for example, to be nourished, take part in religious community, or engage in political life. There is a second concept: capabilities. Capabilities are understood as what people are able to do and be, or the genuine (and positive) freedoms and opportunities to realize those functionings.

We draw on Nussbaum's normative framework and explicit list of capabilities as a guide to foster a stronger link between a focus on hydro-social relations and human wellbeing. Nussbaum's work frames capabilities as a political goal which holds special ethical significance for social and political arrangements. In brief, the capability approach respects peoples' different ideas of the good life, and this is why capability is the political goal, rather than any particular outcome. In this way, capabilities are foregrounded as the basis for individuals to make claims on society, connected to equity, recognition, participation, and democratic rights. Moreover, the capabilities approach extends beyond the individual to communities [30,83,69]. In particular, attention to indigenous claims to environmental justice demonstrate that, "[s]pecific [political] demands focus not only on religious, cultural, and traditional capabilities, but also on the political freedoms and the self-determination that enable community functioning" ([69], 18).³ And while there are important philosophical differences among capabilities scholars, an underlying common thread ties divergent views of well-being, human flourishing and relationships to freedoms rather than concentrating on commodities or the material conditions of wealth.

We follow that thread to connect the capabilities approach to how we envision water security, drawing on insights from scholars who have considered water scarcity and water justice in developing countries through Sen's capabilities lens [3,46,26]. Mehta considers water scarcity in terms of entitlement and capabilities approaches [45]. She makes a forceful case that the "right to water" (H₂O) in its reproductive (e.g. health, bodily requirements, etc.), and productive dimensions (subsistence, maintaining livelihoods, etc.) are necessary foundations to "allow people to enjoy a host of capabilities" ([45], 66). Thus, Mehta concludes that governments, therefore, "need to prioritize providing poor people with access to water that is safe, affordable and allows them to flourish" ([45], 67).

We extend Mehta's call to reconsider water scarcity in terms of the capabilities approach by attending to hydro-social relations of water security in discourse and practice. In this way, the goal or normative claim we are making is not the right to H₂O, but a "right to water security," or a right to the ability of individuals, households, and communities to navigate hydro-social relations and secure safe and affordable water particularly in ways that support the sustained development of human capabilities and wellbeing in their full breadth and scope. In this way, calls for water security as defined thusly provide an individual and collective ethical claim to policy and actions in ways that are broader than previous considerations of water and human capabilities as we develop below. Indeed, this conceptualization of water security resonates with Jamie Linton's proposition for a relational right to water, one that:

"...can be formulated in ways that go beyond the usual claim of a quantity of water for individual human needs...to define a relation between the collective identity of people on the one hand and the process by which water articulates with society on the other" ([38], 57).

Therefore, a definition of water security informed by the capabilities approach necessarily attends to water as part of a hydro-social process that is simultaneously material, discursive, and symbolic, differently valued – as not solely material or social, but relationally, based on negotiation and interaction at individual and collective scales. Focusing on the capabilities approach also

places more attention on the processual dimensions of water security as a relation – its politics and cultural dimensions – rather than solely on the outcome in terms of whether or not one is able to individually or collectively access affordable and safe H₂O.

3. Water security, politics, and power

The application of critical scholarship to household water deficiencies emphasizes the political processes that limit access to potable water [88]. Loftus [41] brings this perspective to bear on water security by arguing that the political underpinnings of water insecurity are insufficiently recognized in the mainstream water security literature. While some recognize the political dimensions of water provision [99], the key distinction is that politics are often restricted to water supply rather than the ways in which exclusion and changing social relations of water are produced through technology, governance, and discourse. For our reconceptualization, then, a critical dimension of water security centers around securing the capabilities of individuals and collectives to participate meaningfully as political actors in the hydro-social system, including key decision-making and governance practices. As Staddon and James remark, a progressive concept of water security "underpin[s] a process of management based on deliberative democracy rather than state or market fiat" ([80], 262–3).

Repositioning water from an object (H₂O) to a relation within the hydro-social cycle informs our approach to water security and opens new analytical possibilities, including the investigation of how water is produced, how it is evaluated, how it is meaningful, how it becomes enrolled in wider agendas, and how all of these are influenced by power. We argue that for a truly progressive approach to water security, these relations need to be identified and integrated into any assessment. As such, the policy emphasis will be shifted away from the delivery of drinking water as an end in itself. Instead, emphasis must be on the promotion of social relations that are conducive to securing safe and affordable water for individuals and communities so they can live their lives as they choose, achieve freedoms in line with their own vision, and achieve their fullest potential. In short, the focus would shift towards sustainable and just hydro-social processes in support of human capabilities.

The value of the hydro-social cycle in this regard is that it directs attention towards the wider range of relations that merit scrutiny. For example, in Antofagasta, a coastal city in northern Chile, the water supply company providing potable water as well as bulk water to the inland mining industry has diverted mountain water from the city's supply in order to serve the mines, which are closer to the source. This resulted in the replacement of the city's water supply from the mountains with that from a new, closer desalination plant. While the company still provides water to urban areas, the quality is slightly less acceptable to many residents. If policy makers consider mountain water and desalinated water as the same thing ('H₂O'), then the implications of the switch could easily go unnoticed. However, mountain water is different physically than desalinated water, and residents consider desalinated water of a lesser quality. Thus, the change has undermined the urban population's water security by instead rendering it dependent on a costly and potentially fluctuating supply of desalinated water that is not accepted by the population [21]. Inevitably, source water change shifts hydro-social relations by enrolling different technologies and institutions in this reconfigured water-sequence of treatment, provision, and access.

The increasingly popular privately packaged and vended sachet water sold in West African cities is another example of how securing water has paradoxical impacts on water security [85]. Water sachets, comprising treated water packaged in 500 ml polyethylene plastic bags, may reduce risk of gastrointestinal illnesses by

³ Nussbaum recognizes the material premises for the functioning of capabilities and insists on securing this material basis as a minimal threshold level of capability protection; but there are conceptual gaps in her thinking about the environment and even less so in terms of ecosystem services because her understanding of human-environmental relations is one-dimensional ([29]).

mitigating the cross-contamination in household storage containers. Yet, the supply of drinking water is thereby concentrated in the hands of an increasingly formalized corporate network of manufacturers, many of which operate under collective logics that limit customers' participation in water governance [98]. Thus, dependence on sachets renders consumers vulnerable to price shocks or product alterations related not only to water availability, but to political events such as sudden shifts in national monetary and regulatory policy [84]. Moreover, given that sachet water is often sourced from municipal piped water, the volumes of water withdrawn can destabilize public system water pressure and availability, thus, undermining existing water services for network users who depend on that water for their water needs [51]. Sachets also create a stream of plastic waste that, in the absence of adequate solid waste management, can exacerbate flooding, which potentially increases risk of water-related disease. So, while the innovation of sachet water purports to 'secure' clean drinking water, this young industry simultaneously redistributes water risk and vulnerability in new ways.

We also can better conceptualize the importance of state-society relations and politics from a relational perspective that highlights everyday water provisioning technologies and strategies. Rainwater harvesting and grey-water barrels in Tijuana, Mexico not only save money but enhance local expertise and provide a form of everyday autonomy from state power [44]. That is, some households prefer rainwater harvesting and associated technologies that allow them to be disconnected from the centralized water supply, outside the purview of failed state institutions and surveillance. Meehan writes, "ordinary and domestic infrastructures are constitutive of difference – in effect limiting the jurisdiction of the state, through their scattered and individualized modes of water collection" ([44], 223). On the other hand, there are counter examples that demonstrate preference for state or utility provision as it enhances a sense of state legitimacy or citizenship, which has other implications for democracy and shifting state-society relations [89,27].

Together, these examples illustrate that securing water involves securing a set of relationships or capabilities in the political or public sphere, which go beyond just securing water (H₂O) delivery. They show that water access, quality, and governance are a function of different relationships and hydro-social dynamics, all of which have potential implications for human wellbeing and functioning (e.g. from public health, to access to education, to democracy related goals). Moreover, we contend that attention to water security should include the relations that mediate people's access to water rather than simply advocate a particular mode of participation (as clients, recipients, customers or even citizens). While the call for "democratic participation in producing flows of water and social power on which life itself depends" offers a progressive opening ([87], 13), it places too much emphasis on the 'usual suspects' of civil society organizations as the protagonists, given that other actors (such as politicians and officials) are assumed to be too much part of the problem to be part of the solution. For our purposes, the absence of specificity in terms of political form serves to keep the ever-present tensions of social power, gender inequities, and social marginalization within formal political structures and processes at bay, because social activism is not immune to the power inequities that operate in society [1]. Adopting the relational framework of the hydro-social cycle strikes us as a way of engaging in actions to redress water insecurities without prescribing what sorts of universal actions and actors should be involved.

4. Cultural dynamics of securing water

Capabilities are understood as what people are able to do and be, or the genuine (and positive) freedoms and opportunities to

realize what a person does or is. Capabilities necessarily include imagination, thought, and emotions, all which inform cultural affiliation, expression, values, and practices central to a life that fosters human dignity. Thus, from our perspective – that water security describes the dynamic process by which individuals, households, and communities navigate hydro-social relations to secure safe and affordable water in ways that support sustained development of human capabilities in their full breadth and scope—we must attend to cultural practices, identities, norms, and beliefs as they serve those ends.

Culture can be defined as "beliefs, attitudes, practices, and spiritual and emotional explanations that we use to create norms...in social institutions" [76]. Culturally-shared views of water fundamentally shape people's understandings and experiences of water security [15]. In many cultures and societies, the human-water relationship is not conceptualized as merely consumptive or focused on instrumental water needs. In many contexts, hydro-social relations include spirituality, stewardship, and relational sense of responsibility to other beings. Examining the ways that communities themselves define water security broadens our gaze from access and adequacy to include how cultural knowledge, values, and dynamic practices inform the hydro-social relations of water security at community and local levels. From such a perspective, we gain an appreciation of the broader scope of socio-political interactions with cultural practices and ontologies to reshape water access, quality or water-related well-being—often in ways that extend beyond a narrow utilitarian focus on basic needs for human physical health.

Water is culturally conceptualized as spiritually meaningful in many communities. This includes cultural notions and ontologies of water as "sacred" [75,79], "a gift from the Creator" [43], and "life" itself [5]. While these views have been widely documented in Indigenous communities, such relations exist elsewhere among Western religions that similarly conceptualize water as holy [62,86]. For many, the right to water often cannot be divorced from the responsibility to protect it as part of a common (and therefore not alienable) heritage [54]. At times, while we document notions or ontologies of water as tied to specific cultures and communities, it is important to recognize that all conceptions of water, including as modern water [37] – are, in effect, the outcomes of cultural practice [86].

A starting point that conceives water as having cultural and spiritual qualities is very different from water that is viewed as a resource that is countable, treatable, divisible, fragmented, and policed through multiple jurisdictions, agencies, and technologies [53,16]. For instance, recent work has opened space to query what it might mean for water governance to take seriously the possibility of multiple water ontologies [100]. This call demands that we take seriously the "possibility and politics of a multiplicity of water-related worlds... ways of being with-water, not just different perceptions of or knowledge systems tied to water's (singular) material existence" ([100], 2). These emerging perspectives add to, but also go beyond, work on the epistemologies of water [23]. A key distinction with the 'ways of knowing' approach is that we emphasize the plurality 'water' as co-produced rather than simply the plurality of epistemic positions around physical water flows.

Tensions between water viewed as sacred versus as a resource to be exploited can make defining and enacting water security in culturally-appropriate ways a difficult task. For example, in the Ganga River, conflicts emerged between the state and those who use the river to bathe, drink, and wash their dead about the power of the river to purify [2]. In 2017 a court in Uttarakhand, India, attempted to radically shift the debate by declaring the Ganga and Yamuna rivers to be "legal persons", although it will be some time before we see how the courts adjust to this declaration. Overcoming differences in how water is defined can be further

complicated by the extra-territorial processes of pollution and water governance particularly when communities are impacted by pollution and activities that are outside of their defined jurisdiction [11,6,55,71].

Beyond the spiritual values of water, many societies have cultural norms for water and sharing that are deeply engrained in senses of reciprocity between family, community, and other species, all of which can be critical for how we understand senses of wellbeing and human flourishing. In many societies, water sharing, which lies outside the modern water paradigm is a social obligation that is crucial for survival in times of water scarcity [97,66]. In remote Alaska Native communities, for example, the elderly, disabled, and households headed by single mothers of small children depend on water sharing norms to overcome periods of water shortage [17,18]. Studies also describe how young men and teenage boys are often responsible for providing water to their household and sometimes to households within their kin network [17,28]. Such hauling of water and disposing of wastewater are sources of pride and cultural identity for many young men in remote Iñupiaq and Yupik communities where employment opportunities are few. Therefore, water security in this case necessarily needs to attend to water provision, cultural obligations, and social relations so as not to unduly impinge or constrain freedoms and capabilities to realize what a person or community is, or does, in relation to water.

Cultural variability is particularly salient when we adopt a gender lens for viewing water security. Cross-culturally, women and girls tend to have greater responsibilities for household water acquisition and more intimate knowledge of household water management practices [92,67,96,82,35]. Yet development interventions to secure water for communities at times destabilize gender roles in ways that work against goals of advancing human functioning or capabilities. This happened in rural India, when development projects focused on the commodification of water [63]. Women's roles shifted from the 'traditional' household water manager to 'modern' notions of femininity that involved cleaning public taps, serving on water management committees, and paying for water. In the end, such shifts did not always serve the goals of enhanced capabilities for the women nor for the families who often depend on them.

By reconceptualizing water as a relationship, we are better able to incorporate the interconnectedness of water rights and water responsibilities as core to water security. At the same time, care must be taken to avoid the essentialization of culture and to attend to intra-cultural variability in water beliefs and practices. Culture is not static. Household and communal water practices, resource-based social networks, and water ontologies are continually reworked or co-produced in relation to political, economic, and material worlds. For example, contemporary technologies attached to neoliberal cost-recovery mechanisms, such as prepaid meters and forced disconnections, create new subjectivities that transform social relations and cultural values that promote household water security [40,20,19,90]. We also see that the interplay of cultural politics and power impinge on and transform the operation of alternative water sources or long-standing water provisioning modalities. For example, Stone spouts, indigenous socio-technical water systems in Kathmandu, persist and contribute to household water provision for the Newar people [49]. Such systems offer critical spaces and rules of use for social organization, cultural resilience, and spiritual meaning, yet external entities seek to discipline these systems into water management plans. Thus, securing water is a process that should be as much about cultural reproduction, collective values, and identity in relation to the waterscape as it is about utilitarian needs.

5. Conclusion

Water security is a powerful concept that has gained much traction in research and policy. The global scope of its applications – from geopolitics to human health—indicates the diverse ways in which it applies to water policy, practice, and governance across multiple levels and scales. The common, central object to be secured is most often understood as material water (H₂O) whether for productive purposes (agriculture, industry, resource extraction), conservation (ecosystem services, recreational uses), or for reproductive needs (domestic use, human health). Certainly water security operationalized in these ways brings issues of water resources sustainability to the fore in useful ways.

Yet, we contend that it is time to reorient the concept of water security away from a utilitarian focus on material water and towards a critical approach based on water-society relations. Rather than securing water *per se*, we argue that water security should be about transforming water-society relations to promote human wellbeing and empowerment. In other words, water security is less about obtaining water, and more about fostering human capabilities as they relate to water. As such, we put forward a progressive and critical framework that is informed by the human capabilities approach and the concept of the hydro-social cycle. This allows us to pose questions that are fundamentally different to the existing dominant concern about how to improve and/or expand water provision. We thus ask: What are the social, cultural, and political relationships with water resources and flows that advance a life that fosters human dignity? And, how are those relationships secured to facilitate the freedom to achieve wellbeing, fulfilling social arrangements, and human flourishing?

From our perspective, water security, then, is not simply a state of adequate water – however defined – to be achieved, but rather a relationship that describes how individuals, households, and communities navigate and transform hydro-social relations to access the water that they need and in ways that support the sustained development of human capabilities and wellbeing in their full breadth and scope. We recognize that our focus on human wellbeing sets aside some critical questions related to sustainability, ecosystem function, or other biophysical considerations, which also can be important to a recasting of water security. Nonetheless, we propose that the first place to begin is with a set of questions that move the debate beyond water supply.

Such a reconceptualization, we suggest, changes the terms of the water security debate in two new and important ways. First, it shifts attention away from physical water scarcity and towards the nature of water-society relations that underpin water security. This highlights the underlying conditions that could be subject to transformation as part of our vision of water security. Second, it emphasizes broad and different types of social relations that exist between particular individuals, households, and communities with water resources, encompassing distinct worldviews, ontologies, traditions, and gender relations. Such an approach, therefore, includes values about water that extend beyond, or in addition to, utilitarian ones. These interrelated dimensions are currently marginalized from mainstream definitions and discussions about water security yet are often essential to people's wellbeing, empowerment, and identity.

Addressing hydro-social flows in the ways we have laid out here will present some methodological and policy challenges. As noted earlier, questions of ecosystem sustainability and resilience are not fully developed above, and how these biophysical dimensions operate within a relational framework require further consideration among the water security community as we move forward. However, if our goal is to increase human capabilities, changes in how we think about water will be necessary. In conclusion,

therefore, a relational approach to water security that is designed to incite reflection about *what* is being secured, *how*, and to *what* end, can inspire new inroads into water security research and practice that seek to enhance the capacities to achieve human dignity for all.

Acknowledgements

Our collaboration on this essay began during a two-day workshop “Rethinking Household Water Security Measurement and Metrics” (September 28 – 30, 2016 at Texas A&M University, College Station TX), organized by Wendy Jepson, Amber Wutich, and Sera L. Young. Not all the participants worked directly on this paper, but we would like to acknowledge their role in the discussion and debates that contributed the paper’s development: Manuel Teodoro, Jen Horney, Karen Simpson, and Jo Geere. The workshop was supported by Jack Baldauf, David Cairns, the College of Geosciences, the Water Security Initiative (WSI), and Department of Geography at Texas A&M University. We would also like to thank Christopher Scott for his patience and support as we developed this paper. Chad Staddon would like to acknowledge the support of the Lloyd’s Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research.

References

- [1] B. Agarwal, Participatory exclusions, community forestry, and gender: an analysis for South Asia and a conceptual framework, *World Dev.* 29 (10) (2001) 1623–1648.
- [2] K.D. Alley, *On the Banks of the Gangā: When Wastewater Meets a Sacred River*, University of Michigan Press, 2002.
- [3] P.B. Anand, Scarcity, Entitlements, and the Economics of Water in Developing Countries, Edward Elgar Publishing, 2010.
- [4] K. Bakker, *Privatizing Water: Governance Failure and The World’s Urban Water Crisis*, Cornell University Press, Ithaca, NY, 2010.
- [5] R. Boelens, Cultural politics and the hydrosocial cycle: Water, power and identity in the Andean highlands, *Geoforum* 57 (2014) 234–247.
- [6] R. Boelens, *Water, Power and Identity: The Cultural Politics of Water in the Andes*, Routledge, London, 2015.
- [7] P. Bond, The right to the city and the eco-social communing of water: discursive and political lessons from South Africa, in: Sultana, Loftus (Eds.), *The Right to Water: Politics, Governance and Social Struggles*, Earthscan, London, 2012, pp. 190–205.
- [8] J. Budds, G. McGranahan, Are the debates on water privatization missing the point? Experiences from Africa, Asia and Latin America, *Environ. Urbanization* 15 (2) (2003) 87–114.
- [9] R. Bustamante, C. Crespo, A. Walnycki, Seeing through the concept of water as a human right in Bolivia, in: *The Right to Water: Politics, Governance and Social Struggles*, Earthscan, London, 2012, pp. 223–240.
- [10] S. Caincross, J. Hardoy, D. Satterthwaite, *The Poor Die Young: Housing and Health in Third World Cities*, Earthscan, London, 1990.
- [11] G. Cajete, *Native Science. Natural Laws of Interdependence*, Clear Light Pub., 2000.
- [12] J. Chenoweth, R. Malcolm, T. Kaime, S. Pedley, Household water security and the human right to water and sanitation, in: B. Lankford, K. Bakker, M. Zeitoun, D. Conway (Eds.), *Water Security: Principles, Perspectives, and Practices*, Earthscan, New York, 2013, pp. 307–318.
- [13] C. Cook, Implementing drinking water security: the limits of source protection, *WIREs Water* 3 (2016) 5–12, <http://dx.doi.org/10.1002/wat2.1117>.
- [14] C. Cook, K. Bakker, Water security: debating an emerging paradigm, *Global Environ. Change* 22 (1) (2012) 94–102.
- [15] J. Donahue, B.R. Johnston (Eds.), *Water, Culture, and Power: Local Struggles in a Global Context*, Island Press, 1997.
- [16] J. Donatuto, L. Campbell, R. Gregory, Developing responsive indicators of Indigenous community health, *Int. J. Environ. Res. Public Health* 13 (9) (2016) 899.
- [17] L. Eichelberger, Living in utility scarcity: energy and water insecurity in Northwest Alaska, *Am. J. Public Health* 100 (6) (2010) 1010–1018.
- [18] L. Eichelberger, *Manufacturing Insecurity: Power, Water, Waste, and the Silences of Sustainability and Suffering in Northwest Alaska*, University of Arizona, 2011, Ph.D. Dissertation, Anthropology.
- [19] L. Eichelberger, Sustainability and the politics of calculation: technologies of “safe water”, subject-making, and domination, *J. Political Ecol.* 19 (11) (2012) 145–161.
- [20] L. Eichelberger, Spoiling and sustainability: technology, water insecurity, and visibility in Arctic Alaska, *Med. Anthropol.* 33 (6) (2014) 478–496.
- [21] M. Fragkou, J. Budds, Desalination and the disarticulation of the hydrosocial cycle: Stabilising the neoliberal model in Chile, forthcoming. Unpublished Manuscript.
- [22] D. Garrick, J.W. Hall, Water security and society: risks, metrics, and pathways, *Ann. Rev. Environ. Resour.* 39 (2014) 611–639.
- [23] A.K. Gerlak, F. Mukhtarov, ‘Ways of knowing’ water: Integrated water resources management and water security as complementary discourses, *Int. Environ. Agreements: Politics Law Econ.* 1–16 (2015).
- [24] A.K. Gerlak, M. Wilder, Exploring the textured landscape of water insecurity and the human right to water, *Environ.: Sci. Policy Sustainable Dev.* 54 (2) (2012) 4–17.
- [25] P.H. Gleick, The human right to water, *Water Policy* 1 (5) (1998) 487–503.
- [26] M. Goff, B. Crow, What is water equity? The unfortunate consequences of a global focus on ‘drinking water’, *Water Int.* 39 (2) (2014) 159–171.
- [27] L. Harris, State as socio-natural effect: variable and emergent geographies of the state in Southeastern Turkey, *Comparative Studies of South Asia, Africa and the Middle East* 32 (1) (2012) 25–39.
- [28] T.W. Hennessy, J.M. Bressler, Improving health in the Arctic region through safe and affordable access to household running water and sewer services: an Arctic Council initiative, *Int. J. Circumpolar Health* 75 (2016), <http://dx.doi.org/10.3402/ijch.v75.31149>.
- [29] B. Holland, Ecology and the limits of justice: establishing capability ceilings in Nussbaum’s capabilities approach, *J. Hum. Dev.* 9 (3) (2008) 401–425.
- [30] S.S. Ibrahim, From individual to collective capabilities: the capability approach as a conceptual framework for self-help, *J. Hum. Dev.* 7 (3) (2006) 397–416.
- [31] W.E. Jepson, A. Wutich, S.M. Collins, G.O. Boateng, S.L. Young, Progress in household water insecurity metrics: a cross-disciplinary approach, *WIREs Water* 4 (2017) e1214, <http://dx.doi.org/10.1002/wat2.1214>.
- [32] W. Jepson, Measuring ‘no-win’ waterscapes: experience-based scales and classification approaches to assess household water security in *colonias* on the US–Mexico border, *Geoforum* 51 (2014) 107–120.
- [33] W. Jepson, H.L. Brown, ‘If no gasoline, no water’: privatizing drinking water quality in South Texas *colonias*, *Environ. Plann. A* 46 (5) (2014) 1032–1048.
- [34] W. Jepson, E. Vandewalle, Household water insecurity in the Global North: a study of rural and periurban settlements on the Texas–Mexico border, *The Professional Geographer* 68 (1) (2016) 66–81.
- [35] N.R. Krumdieck, S.M. Collins, P. Wekesa, P. Mbullo, G.O. Boateng, M. Onono, S. L. Young, Household water insecurity is associated with a range of negative consequences among pregnant Kenyan women of mixed HIV status, *J. Water Health* 14 (6) (2016) 1028–1031.
- [36] B. Lankford, K. Bakker, M. Zeitoun, D. Conway (Eds.), *Water Security: Principles, Perspectives and Practices*, Earthscan, Routledge, New York, 2013.
- [37] J. Linton, *What Is Water? The History of a Modern Abstraction*, UBC Press, Vancouver, 2010.
- [38] J. Linton, The human right to what? Water, rights, humans, and the relation of things, in: F. Sultana, A. Loftus (Eds.), *The Right to Water: Politics, Governance and Social Struggles*, Earthscan, London, 2012, pp. 45–60.
- [39] J. Linton, J. Budds, The hydrosocial cycle: defining and mobilizing a relational-dialectical approach to water, *Geoforum* 57 (2014) 170–180.
- [40] A. Loftus, Reification and the dictatorship of the water meter, *Antipode* 38 (5) (2006) 1023–1045.
- [41] A. Loftus, Water (in) security: securing the right to water, *Geog. J.* 181 (4) (2015) 350–356.
- [42] N. Mason, Easy as 1, 2, 3? Political and technical considerations for designing water security indicators, in: B. Lankford, K. Bakker, M. Zeitoun, D. Conway (Eds.), *Water Security: Principles, Perspectives, and Practices*, Earthscan, New York, 2013, pp. 183–203.
- [43] D. McGregor, Coming full circle: indigenous knowledge, environment, and our future, *Am. Indian Q.* 28 (3) (2004) 385–410.
- [44] K.M. Meehan, Tool-power: water infrastructure as wellsprings of state power, *Geoforum* 57 (2014) 215–224.
- [45] L. Mehta, Water and human development, *World Dev.* 59 (2014) 59–69.
- [46] L. Mehta, J. Allouche, A. Nicol, A. Walnycki, Global environmental justice and the right to water: the case of peri-urban Cochabamba and Delhi, *Geoforum* 54 (2014) 158–166.
- [47] B.M. Meier, J.G. Kestenbaum, G.L. Kayser, U.Q. Amjad, J. Bartram, Examining the practice of developing human rights indicators to facilitate accountability for the human right to water and sanitation, *J. Hum. Rights Practice* 6 (1) (2014) 159–181.
- [48] O. Miroso, L.M. Harris, Human right to water: contemporary challenges and contours of a global debate, *Antipode* 44 (3) (2012) 932–949.
- [49] O. Molden, N. Griffin, K. Meehan, The cultural dimensions of household water security: the case of Kathmandu’s stone spout systems, *Water Int.* 41 (7) (2016) 987–997.
- [50] F. Molle, P. Mollinga, Water poverty indicators: conceptual problems and policy issues, *Water Policy* 5 (5–6) (2003) 529–544.
- [51] C. Morinville, *Beyond the Pipe: participation and alternative water provision in underserved areas of Accra, Ghana*. Institute for Resources, Environment and Sustainability, Vancouver, BC, University of British Columbia, MA, 2012.
- [52] C. Morinville, L. Rodina, Rethinking the human right to water: water access and dispossession in Botswana’s Central Kalahari Game Reserve, *Geoforum* 49 (2013) 150–159.

- [53] E.S. Norman, Who's counting? Spatial politics, ecocolonisation and the politics of calculation in Boundary Bay, *Area* 45 (2) (2013) 179–187.
- [54] E.S. Norman, Locating the border in boundary bay: non-point pollution, contaminated shellfish, and transboundary governance, in: Reece Jones, Corey Johnson (Eds.), *Placing the Border in Everyday Life*, Ashgate, Surrey, UK, 2014, pp. 67–92.
- [55] E.S. Norman, Standing up for inherent rights: The role of Indigenous-led activism in protecting sacred waters and ways of life, *Soc. Nat. Resour.* (2017) 1–17.
- [56] E.S. Norman, G. Dunn, K. Bakker, D.M. Allen, R.C. De Albuquerque, Water security assessment: integrating governance and freshwater indicators, *Water Resour. Manage* 27 (2) (2013) 535–551.
- [57] M. Nussbaum, Capabilities as fundamental entitlements: Sen and social justice, *Feminist Econ.* 9 (2–3) (2003) 33–59.
- [58] M.C. Nussbaum, Women's bodies: violence, security, capabilities, *J. Hum. Dev.* 6 (2) (2005) 167–183.
- [59] M.C. Nussbaum, Creating capabilities: the human development approach and its implementation, *Hypatia* 24 (3) (2009) 211–215.
- [60] M.C. Nussbaum, *Creating Capabilities*, Harvard University Press, Cambridge, 2011.
- [61] M. Nussbaum, A. Sen, *The Quality of Life*, Oxford University Press, Oxford, 1993.
- [62] T. Oestigaard, Holy water: the works of water in defining and understanding holiness, *Wiley Interdisciplinary Reviews: Water*, 2017.
- [63] K. O'Reilly, "Traditional" women, "modern" water: linking gender and commodification in Rajasthan, India, *Geoforum* 37 (6) (2006) 958–972.
- [64] S. Pande, M. Sivapalan, Progress in socio-hydrology: a meta-analysis of challenges and opportunities, *WIREs Water* (2016), <http://dx.doi.org/10.1002/wat2.1193>.
- [65] C. Pahl-Wostl, A. Bhaduri, J. Gupta, *Handbook on Water Security*, Edward Elgar Publishing, 2016.
- [66] A.L. Pearson, J.D. Mayer, D.J. Bradley, Coping with household water scarcity in the savannah today: implications for health and climate change into the future, *Earth Interactions* 19 (8) (2015) 1–14.
- [67] I. Ray, Women, water, and development, *Ann. Rev. Environ. Resour.* 32 (2007) 421–449.
- [68] I. Robeyns, The capability approach: a theoretical survey, *J. Hum. Dev.* 6 (1) (2005) 93–117.
- [69] D. Schlosberg, D. Carruthers, Indigenous struggles, environmental justice, and community capabilities, *Global Environ. Politics* 10 (4) (2010) 12–35.
- [70] C.A. Scott, F.J. Meza, R.G. Varady, H. Tiessen, J. McEvoy, G.M. Garfin, E. Montaña, Water security and adaptive management in the arid Americas, *Ann. Assoc. Am. Geogr.* 103 (2) (2013) 280–289.
- [71] O. Sefiha, P. Lauderdale, Sacred mountains and profane dollars: discourses about snowmaking on the San Francisco peaks, *Soc. Legal Studies* 17 (4) (2008) 491–511.
- [72] A. Sen, *The Idea of Justice*, Harvard University Press, Cambridge, 2011.
- [73] A. Sen, *Development as Freedom*, Alfred A. Knopf, New York, 2001.
- [74] A. Sen, *Commodities and Capabilities*, Oxford University Press, Oxford, 1999.
- [75] V. Shiva, *Water Wars: Privatization, Pollution, and Profit*, North Atlantic Books, 2016.
- [76] M.K. Singer, W. Dressler, S. George, C.R. Baquet, R.A. Bell, L. Burhansstipanov, C.C. Gravlee, *Culture, Soc. Sci. Med.* 170 (2016) 237–246.
- [77] S.J. Spronk, Making the poor work for their services: neo-liberalism and 'poor' privatization in El Alto, Bolivia, *Can. J. Dev. Studies/Revue canadienne d'études du développement* 28 (3–4) (2009) 397–413.
- [78] C. Staddon, T. Appleby, E. Grant, A right to water – a geographico-legal perspective, in: F. Sultana, A. Loftus (Eds.), *The Right to Water: Politics, Governance and Social Struggles*, Earthscan, London, 2011, pp. 61–77.
- [79] C. Staddon, M. Everard, Epistemologies of Community-based groundwater recharge in semi-arid north Rajasthan: progress and lessons for groundwater-dependent areas, in: R. Baghel, L. Stepan (Eds.), *Water, Knowledge and the Environment in Asia: Epistemologies, Practices and Local*, Taylor & Francis Ltd, Routledge, 2017.
- [80] C. Staddon, N. James, Water security: a genealogy of emerging discourses, in: *Globalized Water*, Springer, Bonn, 2014, pp. 261–276.
- [81] C. Staddon, R. Sarkozi, S. Langberg, Urban water governance as a function of the 'urban hydrosocial transition', in: *Freshwater Governance for the 21st Century*, Springer, 2016, pp. 81–102.
- [82] E.G. Stevenson, L.E. Greene, K.C. Maes, A. Ambelu, Y.A. Tesfaye, R. Rheingans, C. Hadley, Water insecurity in 3 dimensions: an anthropological perspective on water and women's psychosocial distress in Ethiopia, *Soc. Sci. Med.* 75 (2) (2012) 392–400.
- [83] F. Stewart, Groups and capabilities, *J. Hum. Dev.* 6 (2) (2005) 185–204.
- [84] J. Stoler, From curiosity to commodity: a review of the evolution of sachet drinking water in West Africa, *WIREs Water* 4 (2017) e1206, <http://dx.doi.org/10.1002/wat2.1206>.
- [85] J. Stoler, R.A. Tutu, K. Winslow, Piped water flows but sachet consumption grows: the paradoxical drinking water landscape of an urban slum in Ashaiman, Ghana, *Habitat Int.* 47 (2015) 52–60.
- [86] V. Strang, *Water: Nature and Culture*, Reaktion Books, 2015.
- [87] F. Sultana, A. Loftus, *The Right to Water: Politics, Governance and Social Struggles*, Routledge, 2012.
- [88] E. Swyngedouw, UN water report 2012: Depoliticizing water, *Dev. Change* 44 (3) (2013) 823–835.
- [89] E. Vandewalle, W. Jepson, Mediating water governance: point-of-use water filtration devices for low-income communities on the US-Mexico border, *GEO: Geogr. Environ.* 2 (2) (2015) 107–121.
- [90] A. von Schnitzler, *Democracy's Infrastructure: Techno-Politics and Protest After Apartheid*, Princeton University Press, 2016.
- [91] C.J. Vörösmarty, P. McIntyre, M.O. Gessner, D. Dudgeon, A. Prusevich, P. Green, C.R. Liermann, Global threats to human water security and river biodiversity, *Nature* 467 (7315) (2010) 555–561.
- [92] T. Wallace, A. Coles, *Gender, Water and Development*, Berg Publishers, Oxford, 2005.
- [93] *WaterAid, Water Security Framework*, 2012. Retrieved from London: www.wateraid.org/publications.
- [94] M. Woodhouse, M. Langford, There is no human right to water for livelihoods, *Waterlines* 28 (1) (2009) 5–12.
- [95] C.L. Workman, H. Ureksoy, Water insecurity in a syndemic context: understanding the psycho-emotional stress of water insecurity in Lesotho, Africa, *Soc. Sci. Med.* 179 (2017) 52–60.
- [96] A. Wutich, Intrahousehold disparities and emotional distress in urban Bolivia, *Med. Anthropol. Q.* 23 (4) (2009) 436–454.
- [97] A. Wutich, The moral economy of water reexamined: reciprocity, water insecurity, and urban survival in Cochabamba, Bolivia, *J. Anthropological Res.* 67 (1) (2011) 5–26.
- [98] A. Wutich, M. Beresford, C. Carvajal, Can informal vendors of water deliver the promise of a human right to water? Results from Cochabamba, Bolivia, *World Dev.* 79 (2016) 14–24.
- [99] A. Wutich, A. Brewis, A.M. York, R. Stotts, Rules, norms, and injustice: a cross-cultural study of perceptions of justice in water institutions, *Soc. Nat. Resour.* 26 (7) (2013) 795–809.
- [100] J.N. Wilson Yates, L. Harris, Multiple ontologies of water: politics, conflict and implications for governance, *Environ. Plann. D: Soc. Space* (2017) 1–19.
- [101] M. Zeitoun, B. Lankford, T. Krueger, T. Forsyth, R. Carter, A.Y. Hoekstra, R. Boelens, Reductionist and integrative research approaches to complex water security policy challenges, *Global Environ. Change* 39 (2016) 143–154.
- [102] M.Z. Zwarteveen, R. Boelens, Defining, researching and struggling for water justice: some conceptual building blocks for research and action, *Water Int.* 39 (2) (2014) 143–158.