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Transformation as Practice: Learning From Everyday Dealings With Groundwater

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ABSTRACT: This article provides a theoretical introduction to the Special Issue and briefly presents the various contributions. It starts with a general plea for inserting the analysis of groundwater and its gradual depletion into a broader critical analysis of 'development'; it does so in order to trace how particular forms of groundwater use and management are intrinsic to distinct – gendered and racialised – processes of differentiation and exploitation such as settler colonialism and capitalism. We go on to argue, however, that too much insistence on explaining empirical realities in terms of such structural processes has its limitations. It risks strengthening their overwhelming power and reconfirming the oppression and marginalisation that they create. We therefore suggest that methodological and ethnographic attention to *practices* may help identify less predictable and sometimes surprising trajectories of change. Our foregrounding of practices implies treating terms such as transformation and sustainability as fluid, the discussion of which needs to be anchored in the situated and always-specific practical work of using, accessing, caring for, sharing and knowing groundwater. Theoretical insights about how the world is patterned or structured then serve not as the framework in which to insert empirical findings, but as entry points for further analysis, reflection and conversation, fuelling forms of experimentation and joint learning about how to think and do transformations to groundwater sustainability.

KEYWORDS: Transformations, caring, groundwater governance, ethnography of practice

INTRODUCTION

The 2022 UN World Water Development Report forcefully draws attention to the ways in which intensified use of groundwater results in rapidly falling groundwater tables, declining water quality, and increased rates of saltwater intrusion and land subsidence, while also drying up natural water bodies such as wetlands and rivers with detrimental effects to biodiversity (Misstear et al., 2022; see also IGRAC, 2018; Zwarteveen et al., 2021). The need for better governance of groundwater is thus clear; in the current literature, however, there is concern – and probably a consensus – as to the failure of past and current attempts to alleviate groundwater problems. The "command-and-control paradigm" (Molle and Closas, 2020: 13) that characterises existing modes of governance is largely ineffective and may even perpetuate unsustainable and inequitable groundwater practices (Closas and Villholth, 2020). While this paradigm focuses on keeping the pumping behaviours of individuals under control, the starting assumption of this Special Issue is that achieving groundwater sustainability is also about encouraging and supporting individual and collective forms of caring and sharing for aquifers. An important part of

this Special Issue is thus dedicated to the results of extensive and collaborative (action-)research on the grassroots initiatives of people who are organising around groundwater in places where pressures on aquifers are particularly acute. We studied these initiatives to learn about how the people involved in them care for, share and/or protect available groundwater.

The studies presented in this Special Issue are conscious of how people's individual and collective groundwater behaviours are co-shaped by economic, political and institutional contexts. In particular, they show critical awareness of how planned efforts to intensify agriculture (which is their focus) are importantly premised on making both water/irrigable land and (mainly women's) labour cheaply available to entrepreneurial forms of profit-making. Neoliberal reforms that 'free' land and water from prior investments and attachments help do this, as does the flexibilisation (or indeed feminisation) of agricultural wage labour. In many of the countries where we work and do research, including India, Peru, Morocco, Algeria and California, such neoliberal reforms are accompanied by a publicly promoted and supported push to increase profits per drop of water. Triggered by the increased availability of affordable pumping technologies, this tends to entail a shift from collectively (or publicly) owned and managed surface canal irrigation systems (and at times collectively accessed groundwater) to individually owned tubewells and pumps (Zwarteveen et al., 2021; see also Bhat et al., this Issue), a shift that has the effect of making water – and irrigation – an increasingly private matter.

Underhill et al. (this Issue) underscore the continued importance of revealing such wider patterns in how groundwater is used and managed so as to expose and challenge enduring forms of unevenness and exploitation. Expanding and refining earlier critiques of 'modern water' (Linton, 2014), they mobilise decolonial and Indigenous scholars' insights in order to draw attention to the persistent coloniality and racism of water projects and 'development'. They tell their story through the examples of California, Palestine and Peru. Their analysis shows how always-specific combinations of coloniality and modernity not only create the conditions for, but also normalise and depoliticise, groundwater over-extraction. The article's emphasis on the ongoing-ness of projects of colonialism in water underscores the importance of rethinking the normal terms – crisis, contemporality and climate change – that are used to describe and understand today's groundwater problems. Kuper et al. (this Issue) trace larger patterns in how water is used in agriculture in order to explain how groundwater over-extraction is intrinsic to a particular model – or 'imaginary' – of development, that of 'making the desert bloom'. Underhill et al. (this Issue) also use this phrase, noting it as being central to the ongoing coloniality of modern water. They draw attention to how the power of social imaginaries helps explain the popularity and travel of irrigation policies. They particularly show how the California model of irrigated agriculture – based on high growth and high profit – captured the imagination of governing elites outside of California, including in Morocco and Algeria. 'California' became an important inspiration for irrigation policies in both countries. By pointing to the specific Californian origins of a popular model of irrigation development, Kuper et al. (ibid) create room for other imaginaries of water development and underscore their importance.

Both articles illustrate the usefulness and continued importance of tracing linkages and showing similarities in what happens to groundwater across times and places. Both also 're-place and re-particularise' supposedly universal waters in order to create analytical and political space for other (alternative) waters. In different ways, however, both are careful to not simply replace one global or universal narrative with another better, more sustainable, or more just 'big' narrative or global imaginary. Underhill et al., do this by emphasising that "colonial formations are always partial, contingent and full of cracks and 'otherwhises'" (Underhill et al., this Issue). Kuper et al. (this Issue) draw attention to the 'ambiguity' of the California imaginary, something that makes it amenable and adaptable to a number of different interpretations. Which interpretation prevails depends not just on its cultural appeal; it also depends on the degree to which it resonates with, and can get attached to, prevailing ways of organising (owning, sharing) irrigated land and water. Partiality, contingency, ambiguity and multivocality are all terms that suggest that there may be possibilities for engaging with water that are perhaps less spectacular, that is, engagements with water that sit at, or just beyond, the margins of dominant models,

structures or indeed imaginaries. There may be possibilities for transformative change that do not depend on grand theorisations and/or on the adoption of single idioms, but that rather allow for the simultaneous existence of different smaller stories and knowledges that are more partial and may not always cohere (see Woolgar and Lezaun, 2015; Bertoni, 2016; Domínguez-Guzmán, 2021).

Many of the articles in this Special Issue present such modest and pragmatic stories of dealing with and relating to groundwater. We think that telling such stories may help expand possible pathways to transformation beyond those of resistance to, escape from, or the undoing of (always already-identified) structures of exploitation. It is a way of multiplying realities or truths by looking beyond accepted science-based expertise and solutions to (re-)appreciate and learn from the wisdoms, technologies and institutions that communities have devised – often on the basis of generations of living in a territory – or are experimenting with to protect, recharge, access and share groundwater.

TRANSFORMATIONS TO SUSTAINABILITY

The rapidly growing scholarship on transformations to sustainability (or sustainability transformations) provides inspiration for this type of more practical, pragmatic and forward-looking analysis. One common denominator of this scholarship is that it defines transformation as nonlinear and non-teleological fundamental change. There is less agreement, however, on precisely what is transformational in terms of processes, characteristics or outcomes, and on how transformation arises (Fisher et al., 2021). In a useful review, Scoones et al. (2020: 66) distinguish between: 1) structural approaches that are directed at producing fundamental change in "the underlying foundations of politics, economy and society"; 2) systemic approaches that are directed at normative change by focusing on interdependencies of technologies, institutions and (social coalitions of) actors; and 3) enabling approaches that target "human agency, values and capacities" to support pathways to sustainability.

We situate this Special Issue in an emerging proposal by activists and scholars to shift scholarly attention from the ideal-typical, from what should be, to the actual practices of transformation. Situating (action-)research in what individuals and communities are (already) doing – that is, their practices – allows the identification of spaces and possibilities for enabling transformative action (Feola et al., 2021; Mehta et al., 2021; Chambers et al., 2022). As we explain in more detail below, we are likewise interested in analysing groundwater practices of knowing, accessing, caring for, and sharing as important entry points for learning about (possibilities for) transformative change (Zwarteveen et al., 2021). Where our approach perhaps differs is that we are less convinced that it is possible *before* the analysis or intervention to clearly distinguish between more or less transformative, or between systemic and less systemic, actions, or indeed practices. While recognising the importance of structural hierarchies (class, patriarchy and racism) and processes of uneven development (capitalism, neoliberalism and colonialism) to explain enduring forms of exploitation, we are less confident that practices can be straightforwardly identified as either reproducing, resisting or transforming such structures. Our doubts are shared (and partly informed) by feminist scholars such as Gibson-Graham and Haraway. They posit that before engagement it is impossible to know whether experiments, initiatives or changes are 'good', that is, whether they disrupt and challenge the hierarchies of power that produce environmental degradation and perpetuate social injustice (Gibson-Graham, 2006; Haraway, 2016).

More recent work on pathways to sustainability may hint at a similar doubt or realisation, in that it calls for new and better engagement with the unexpected, that is, with the complex, the uncertain, the contingent and the context-specific. Reflecting on the COVID-19 period, Leach et al. (2021), for instance, envisage new forms of transformative politics by combining a structural understanding of processes of change with attention to events and disruptions that are unrulier and more difficult to plan or predict. Recent feminist and STS scholars take this one step further; they suggest that the unexpected and the non-fitting are promising places to start imagining and doing things otherwise, indeed to start transforming. Their argument is that such 'surprises' or 'overflows' – which of course only are 'surprising'

precisely because of how they deviate from expectations derived from assumptions about larger patterns – may indicate the existence of other ways of being or relating.

FRAMING AND OVERFLOWING

The term overflowing is borrowed from Callon (1998). It expresses the impossibility of framing a totality, that is, a coherent and overarching structure that contains everything and everyone, or what John Law called the one-world world (Law, 2015: 126). As Law argues, "we do not live in a single container universe, but partially participate in multiple realities or a fractiverse". Others have similarly suggested treating the world as a pluriverse (Strathern, 2005; also see Mol, 2002; de la Cadena and Blaser, 2018; Escobar, 2020). Domínguez-Guzmán (2019) uses the term overflow to show that many smallholder farmers on the desert coast of Peru are only "partially connected" (Strathern, 2005) to the capitalist system and that their farming practices and forms of accessing water are partly their own choice and partly imposed; to some extent, they trace back to a larger, grand (neoliberalism-oriented) narrative, but they also fall beyond (Domínguez-Guzmán, 2019; also see Leonardelli et al., 2022). The same could be said for the strategies engaged in by the communities of Randullabad in Maharashtra and the M'Zab Valley in Algeria to recharge and share their groundwaters, as documented by Saidani et al. (this Issue). While engaging with new market opportunities and technologies, those communities do not fully adopt market logics; instead, they craft ways of using, storing and managing groundwater that allow for a better balance between availability and use, for which old norms of solidarity and frugality are important inspirations (ibid). The young farmers who enthusiastically take up the cultivation of watermelons in the Drâa Valley in Morocco likewise try to benefit from the new possibilities for generating farm profits, while also engaging in the careful crafting of new institutional rules to avoid the aquifer's depletion (Bossenbroek et al., this Issue); in the process, they also 'overflow' existing (positive or critical) narratives of irrigation development.

Such 'overflows', as STS scholars have it, point to the existence of ways of being and relating that elude prevailing categorisations or dominant narratives; they may therefore also be less amenable to straightforward codification or indeed replication. In much of the literature, transformation means contesting and challenging dominant (or hegemonic) structures and relations of power, a definition that hinges on the ability to identify these before engagement. In our approach, transformative change may also consist of smaller attempts to do things differently, of never-finite engagement and experimentation that take the form of ongoing bricolage (Mayaux et al., 2022) that is grounded in practical projects to help solve governance dilemmas. Transformation, in this sense, is a practical form of healing rather than a (re-)construction of wholeness (Haraway, 2016). Documenting and comparing such engagements or practical forms of healing becomes itself a tentative experiment; it involves translating rationalities that are not always easily commensurable into mutually acceptable forms, which can result in sometimes temporal or fragile socionatural expressions, alliances or actions.

This approach speaks to a mode of theorising in which empirical material does not serve as an example to generalise (or provide consistency to predetermined narratives), but is used as a way to talk to or interfere with these narratives (see Haraway, 1988, 1991; Kwa, 2002; Law and Mol, 2002; Tsing, 2005; Gibson-Graham, 2014; Domínguez-Guzmán, 2019). A 'reality' is not considered to be something that is simply waiting to be read, decoded or discovered by human knowers; rather, realities (in the plural) co-emerge and change, with knowing projects and knowers as active subjects and agents.

GROUNDWATER PRACTICES: PUTTING PRACTICE INTO THEORY

Many of the articles in this Special Issue posit 'practice' as the basic unit of analysis, rather than individuals, systems or structures. This is one way of moving beyond problematic dualisms in social theory such as object-subject, mind-body, power-knowledge and actor-structure. For Bourdieu (1977) and Giddens (1984), but also for Norman Long (1977), the concept of practice helps acknowledge that social

structures do not simply 'exist' or influence actors 'from the outside'; rather, they are produced in the interaction between actors and structures (see Arts et al., 2014; Cleaver, 2012). These sociological approaches to practices share with STS scholarship an interest in moving from macro sociological categories to always-specific empirical concerns; however, there are also important divergences between them. One of these relates to the so-called 'ontological turn' or 'material turn'; both of these terms evoke a refocusing of empirical and analytical attention away from how representations are crafted (for example, away from how scientific facts are socially constructed) and towards "how reality is made or enacted" (Michael, 2001: 120). Broadly said, for STS scholars the word 'ontologies' (in the plural), when linked to 'practices', helps acknowledge the multiplicity of both. This multiplication of realities is crucial for slowing down science's aspirations of universality. The point is that realities do not precede knowledge; instead, they are enacted, or performed, in the process of knowing. In other words, there are not (only) many ways of *knowing* an object; but rather many ways of *practicing* it (Mol, 2014).

This shifts the attention from representation to materiality, that is, to the worlds – the practices – in which the social, the material and the semiotic are intertwined (Law and Mol, 2020). Semiotics refers to how words gain meaning in their discursive relationships; material semiotics, on the other hand, makes a slightly adjusted claim. In STS versions of practices, words are never just words; rather, they are embedded in, and part of, materialities and practices (cf. Abrahamsson et al., 2015; Yates-Doerr, 2020). Words need to be studied as part of, and not after or outside of, materialities and practices. "Keep talking I am interested!", writes Latour (2013), to show how the hierarchy of language versus practices serves as a Western entry point to approaching diversity. He suggests that language can be used to explore different modes of existence (ibid: 20). Studying language in practice shifts the concern from words 'themselves' to what linguistic repertoires *do* and *facilitate* in the worlds around them (Law and Mol, 2020; italics in original).

The various articles in this Special Issue use the term 'practices' in slightly different ways. The concept of 'moral-ecological rationalities' that is mobilised by Cleaver et al. (this Issue), for instance, suggests that it is possible to separate beliefs from actions/behaviours, methodologically as well as ontologically. The more practice-based theorisations of Mol and others that are mobilised by Verzijl et al. (this Issue) instead insist that beliefs (and rationalities) cannot be treated as existing in isolation from actions/behaviours; they emphasise that cultural beliefs and rationalities come into being or are performed 'in action', which is simultaneously a methodological and an ontological point (Mol, 2002).

In our conversations, we treated such differences with respect, among other things, we made sure to always situate them in the empirical contexts to which they refer or which they try to explain. We also treated them rather pragmatically, as we discovered that an empirical focus on practices – however theoretically defined – facilitated the sharing of stories across many differences (see Massuel et al., 2018). The reflections gathered in this Special Issue are, after all, the product of engagements and collaborations between university-based researchers and grassroots organisations such as SOPPECOM and ACWADAM, as well as between irrigators, social and natural scientists, engineers, activists and practitioners. In studying collaborations across disciplines, Barry et al. (2008) conclude that interdisciplinarity should be regarded in terms that capture both the processes of 'coordination' and the tensions between disciplinary and interdisciplinary practices. Our own reflection is that a focus on 'practices' can serve as an inspiration for joint theorising about transformative change; in its attempt to make sure that all voices, experiences and stories matter, it has also proved to be a joyful way to start practicing care and care-ful research (Law, 2021) in how it allows making sure that all voices, experiences and stories matter.

GROUNDWATER PRACTICES: ACCESSING, STORING, SHARING, PROTECTING AND KNOWING

The empirical anchor of many of the articles in this collection is a systematic documentation of the practices through which different groups engage with groundwater; these groups include irrigators, hydrogeologists, state administrators, and researchers (including ourselves). As we show, practices

involve work, knowledge, norms, and relations with groundwater, people and technologies. We roughly categorised groundwater practices into: 1) practices of accessing and storing; 2) practices of distribution, sharing and protection; and 3) practices of assessing, measuring and knowing. This categorisation proved to be an interesting starting point for our ethnographic practice-based work. In the cases that we studied, however, it was difficult and sometimes rather meaningless to divide practices up in this way as they are so connected and related. Irrigators and farmers, for instance, often get to know and understand groundwater through their everyday encounters with it or by accessing and storing it (see this Issue: Cleaver et al.; Saidani et al.; Leonardelli et al.). Technologies of accessing groundwater (wells and pumps) also importantly co-determine how it is shared. Collective practices to protect aquifers or store water for later use, in turn, tend to stimulate more explicit forms of caring for water (frugal use) and sharing it (see Saidani et al., this Issue). Below, we discuss some of our findings. We do so with the help of our original categorisation, however we use it loosely while always trying to indicate how one set of practices feeds into another.

1. Practices of *accessing and storing* groundwater. It is relatively well documented how accessing groundwater hinges on access to technologies, particularly pumps and wells. New drilling and pumping technologies often drastically change existing patterns of water distribution; this follows from the importance of the ability to invest in technology to the degree of water access (see Bhat et al., this Issue). In villages in Maharashtra, including Ravangaon and Randullabad, many farmers embraced new and easier methods of pumping water in order to intensify their agricultural activities; for instance, they shifted to new and more water-intensive crops, expanded their irrigated areas, or extended cultivation to additional seasons (see this Issue: Saidani et al., Bhat et al.). When combined with policies to promote the cultivation of high value, water-intensive crops – as is happening in many of the countries where we conducted research (see articles in this Issue: Bhat et al., Bossenbroek et al., Kuper et al., Saidani et al., and Underhill et al.) – the more widespread use of these drilling and pumping technologies indeed risks causing the irreversible depletion of aquifers, while also often widening existing class- and gender (and caste-, race-) based inequities in access to groundwater. This is more likely to happen when irrigators do not, or no longer, feel the need for collaboration and collective investment to ensure their access to water (which is what may be happening in the case of Ravangaon, as described by Bhat et al.). The cases of Randullabad, in Maharashtra, and the irrigation community in the M'Zab Valley in Algeria suggest that collective efforts to recharge aquifers help create or sustain a common basis for collective forms of caring for, and sharing of, groundwater (Saidani et al., this Issue). Joint investments of labour and sometimes of funds in the construction and maintenance of the infrastructure to capture and store 'difficult waters' (ibid) are important here in helping create a collective form of hydraulic property (Coward, 1980). The hard work of storing limited quantities of water, in turn, encourages frugal use of this water; for instance, it limits the number of wells and boreholes (even, in the case of India, forbidding borewells) and the "continuous challenging of irresponsible water use", especially when groundwater degradation "threatens domestic water supply" (Saidani et al., this Issue).

2. Practices of *distribution, sharing and protection*. In much mainstream scholarship on groundwater governance, a 'tragedy of the commons' reasoning prevails in which irrigators are portrayed as self-interested individuals whose main goal is to optimise profits per drop of water. It is not difficult to find empirical evidence for such a portrayal. The study of Ravangaon presented in this Special Issue, for instance, suggests that many farmers there look after themselves first and foremost, in a highly unsettling transition period from public surface to private groundwater; only after that do they look after each other or the aquifer. More intensive interactions with these farmers, however, revealed that many of them are deeply concerned about the longer-term sustainability of their farming and irrigation practices (Bhat et al., this Issue). In Ravangaon, what complicates the emergence or development of more sustainable and equitable rules for using, sharing and protecting groundwater is that the mixing of (public) canal water with (private) groundwater makes the clear attribution of rights and responsibilities difficult. This is different from what happens in Randullabad and the M'Zab Valley, where collective investments in

recharge (protection or storage) provide a good basis for devising rules for sharing water, while also encouraging frugality. In the Rufaro irrigation system in Zimbabwe, likewise, it may be that the collective and hard work of cleaning the tank is one way in which the right to access water is earned. In both places, however, sharing and caring for water is about more than a (calculable) return on investment. It is also about honouring and keeping alive relations – or moral-ecological rationalities (see Chitata et al., 2022) – with one another and with more-than-human others, even while also changing these relations; this includes relations with the aquifer itself as well as with the ancestors and spirits (see this Issue: Cleaver et al., Saidani et al.). The articles in this Special Issue that describe practices of distribution, sharing and protection underscore that belonging, community and attachment to place provide important motivations for irrigators and farmers to care for each other and for the aquifer. The article about the watermelon farmers in the Drâa Valley in Morocco perhaps shows this most clearly. Here, while many of the young farmers in the community actively exploited the aquifer for their new watermelon crops, the community was keen to protect it from outsiders by contesting its open-access regime. Their 'groundwater commoning' efforts, like most efforts to distribute and care for, hinge on the sometimes-arbitrary and never-innocent drawing of boundaries between those who do, and those who do not, belong (Bossenbroek et al., this Issue).

3. Practices of *assessing, measuring and knowing*. The 2022 Global Water Development Report, which focuses on groundwater, emphasises better knowledge about aquifer dynamics as being important in helping solve groundwater problems. Global groundwater visualisation projects proliferate. These mobilise advanced remote-sensing and modelling tools to produce ever more accurate global groundwater maps and databases. The ideal is to generate a single coherent, universally applicable, set of descriptors, parameters, taxonomy, set of scales and concepts to describe groundwater dynamics. While important to the alerting of global governance bodies to the severity of groundwater problems, such global maps and databases are much less useful for improving actual groundwater use and management practices. This is because they miss out on the specific characteristics of often complex local groundwater dynamics and they fail to shed light on how and why different people engage with (use, store and manage) groundwater. Several articles in this Special Issue draw attention to, and discuss, how people in different places have developed local ways of knowing groundwater as part of practical attempts to sustain their present and future livelihoods; these people include farmers, engineers, hydrogeologists and others who are involved in using or managing groundwater on a day-to-day basis. We already discussed how farmers in the oases of Algeria have devised intricate technical and institutional means to capture, store and share water from sporadic flash floods. Part of the derived water is routed to wells, which allows for recharge of the aquifer; this water can then be pumped up during drier periods to be used for irrigation (Saidani et al., this Issue). Cleaver et al. (this Issue) analyse the embodied encounters of dowers with groundwater which enable them to successfully 'find water' through enormous human investment. The article documents that, as community members and 'knowers' of water, dowers also play a role in helping protect it by limiting (and standardising) the depth of wells. This helps avoid competition and prevents the well-documented rat race of installing ever-deeper wells and boreholes (Moench, 2007). Both Leonardelli et al. (2023, this Issue) and Verzijl et al. (this Issue) compare more scientific or managerial ways of knowing groundwater with more local or traditional understandings of it. Leonardelli et al.'s analysis shows that the managerial version of water treats it as if irrigation water is distinct and separate from domestic water. In Pravah, however, the newly introduced irrigation water overflows this categorisation, with the untreated wastewater that is earmarked for irrigation polluting and contaminating the water that is used for domestic purposes. Women were the first to notice this. They have developed multiple ways of assessing the water quality of the various wells and water sources, "storing them in different containers for different uses". Ironically, it is through their work of separating water that women help make the techno-managerial version (or enactment) of groundwater real. Verzijl et al. (this Issue) engage in what they call a care-ful and symmetrical comparison of dowsing and modelling, as two ways of knowing groundwater. They show

that scientists, in this case modellers, "indubitably make use of the wisdom of dowsers", while also noting that the two ways of knowing have much more in common than they may appear to have at first sight. Appreciating, acknowledging, and learning from other than accepted scientific ways of knowing groundwater is important; the situated wisdoms contained in these other ways of knowing can provide a significant complement to a more-global water knowledge, while also sometimes challenging it.

CONCLUSIONS: TRANSFORMATIONS TO GROUNDWATER SUSTAINABILITY

The articles in this Special Issue offer ways to learn if and how everyday practices and assemblages are, or can become, part of patterns and patchworks of change and potential transformations in such different places as Algeria, California, India, Morocco, Peru, Palestine, Tanzania and Zimbabwe. Each of the articles offers an analytical and reflective effort to document the *specificities* of these complex practices. While interested in identifying some more-generic lessons or conclusions, we tried to slow down comparison for the sake of better recognising the creativity and tenacity of each individual case. Attention to details is important here, also because ways of doing groundwater otherwise may be unfolding outside of, or only be partially connected to, the powerful social imaginaries promoting global intensive groundwater-based agriculture (Kuper et al., this Issue: 20; Underhill et al., this Issue). In fact, this Special Issue shows that a promising place to start looking for alternatives may be the stories that destabilise – or, as we termed it, 'unsettle' – (predictions based on) current patterns and structures of abstractive forms of irrigated agriculture.

While remaining cautious about how generalisation and comparison involve translations that are never innocent, we would like to end this introduction with presenting and discussing three sensitising concepts that have proved useful in not just challenging, but also expanding, existing ways of making sense of, and doing, groundwater. Faithful to our own insistence that transformative change is always an ongoing process, one that is never finite, we discuss them as verbs: situating, caring and tinkering. As we show below, these are intimately connected. All three refer as much to a mode of doing research, or a way of knowing, as they refer to a mode of 'doing' groundwater.

Situating: Situating is a term that takes inspiration from Haraway (1988). It refers, first of all, to a form of 'particularising' existing groundwater knowledge, situating it in the specific contexts and networks in which it arose or is arising. It is a 'de-universalising' move, one that is necessary to create space for other groundwater knowledges, as well as appreciation for other ways of doing groundwater. It is a critique of detached, abstracted and disembodied modes of knowing, of the kind of knowing that makes the knower disappear from the knowledge process and insulates her from groundwater realities as experienced by those who live them. Situating, then, also means a (re-)turn to the field, with researchers being 'there', in place, connected to what they study and accountable for their results. In this sense, situating entails a re-articulation of the relationship between researcher and that which is researched. It acknowledges that the two are related or 'intra-acting', to use the term of Karen Barad (2007). The hope is that bringing groundwater research closer to lived problems and people and to (ground)water itself in its many versions will make it not just more accurate, but also more effective as a source of knowledge that can support positive water transformations. Situating also refers to the slowing down of comparison and generalisation that we mentioned earlier. It is a reluctance and refusal to join the trend of much groundwater research to 'go global'; instead, it calls for staying with specificities and contingencies. Specificities originate, for instance, in aquifer types, which can range from huge alluvial aquifers used by thousands or even millions of farmers to smaller localised hard-rock aquifers (Kulkarni et al., 2015). Specificities also originate in the (political) economies that are dependent on groundwater (Shah, 2008); they are found, as well, in the many different ways in which people interact with, relate to, and make sense of groundwater, which are often linked to the use of different pumping and storage techniques. All of these matter to how groundwater is, or can be, done and to how transformation happens or can happen; they therefore need to be attended to with seriousness and care.

Caring: The predominant language used in scientific understandings and policy texts about groundwater seems to be one of control and innovation. It is a distinctly techno-managerial language, one that is mobilised by those tasked with, or hoping to advise, planning and management. The articles in this Special Issue suggest that there is merit in complementing, or perhaps sometimes replacing, prevailing languages of control with languages that allow for the recognition that interacting with groundwater is also a matter of caring. There is a long tradition of often feminist thinking about care (see van Dooren, 2014; Mol and Hardon, 2021; de la Bellacasa, 2017; Tronto, 2017). Where control foregrounds concern with management, power and discipline and where the verb 'to care', "draws together the emotional engagement of being concerned and the practical engagement of contributing to restoring, sustaining, or improving something" (Mol and Hardon, 2021). Foregrounding care and caring may help recognising that people's groundwater behaviours are not motivated only by greed and competition, but can also be inspired by solidarity, compassion and concern or by the desire to share and live well together. As the different contributions to this Special Issue also show, however, caring is seldom innocent or intrinsically good; rather, it entails messiness and difficult compromises (Ureta, 2016). Mobilising languages of care may positively inspire ways of using, managing and governing groundwater in more relational, connected, intimate and grounded ways; it may also inspire more care-ful research and comparison (Law, 2021, see also Verzijl, this Issue). Engaging languages of care may also help create the space for critical social scientists to move beyond critique. After all, caring requires more than well wishing; it requires getting involved in some concrete way (van Dooren, 2014; de la Bellacasa, 2017).

Tinkering: The term bricolage (or tinkering; we here use these terms interchangeably) is a last useful sensitising concept that we offer in the Special Issue, one that we found useful to help push thinking and doing groundwater in new directions. 'Tinkering' conveys that actual practices of engaging with groundwater often consist of technologies, knowledges and institutions that are patched together and always in-the-making, rather than being fixed and rationally or scientifically designed. Caring for and sharing groundwater always involves more than employing forms of control and optimisation that can be accounted for and managed. It also consists of much less predictable and often contingent adaptations, and it entails negotiation, diplomacy and compromise. By opening up the range of activities, skills and knowledges needed for using, sharing and caring for water (or for the environment more broadly), tinkering has the useful effect of decentering the scientist or the engineer; it thereby also prompts a reconsideration of what is, and who has, power and it invites more serious appreciation of other forms of expertise and skill (for recent explorations of tinkering in the study of irrigation, see Kemerink-Seyoum et al., 2019; Kuper et al., 2017; Naouri et al., 2020). Perhaps the metaphor of tinkering is also better than that of 'masterful knowing' for denoting the work that researchers do to discover and understand groundwater realities. After all, weaving empirical specificities into larger (theoretical) patterns often has a rather tentative, speculative and craft-like character in which grounded – and always partial – narratives evolve in conversation with already existing theoretical understandings (see also Bonelli et al., 2016; Domínguez-Guzmán, 2019).

As the different contributions to this Special Issue show, these sensitizing concepts help push thinking about transformation beyond known structures to identify less predictable and sometimes surprising ways of caring for and sharing groundwater. Assessing whether these indeed (can) form part of longer-term or wider transformations to sustainability would require much-longer engagements with the people and places involved.

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