Water Hist (2017) 9:433–451
DOI 10.1007/s12685-017-0202-5

Waterscapes in transition: changing uses and perceptions of water in middle class homes in Kolkata, India

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Received: 26 September 2016 / Accepted: 17 June 2017 / Published online: 28 June 2017

Abstract This article uses practice theory to examine changes in middle class water tenure in Kolkata, India, at the household level from the 1960s to present. Surveys ($n = 34$) and focus group discussions ($n = 4$) reveal that the Kolkata urban middle class have transformed not only how they engage water, but their perceptions of water itself. Over the study period, households have: (1) shifted their sources of water; (2) introduced new end uses for water; (3) adopted new water-related technologies; and (4) changed their perceptions of water quality. More specific findings include movement away from public sources towards private sources of water, which are perceived to be of higher quality and greater convenience. Furthermore, all households draw upon multiple water sources and all employ technologies to further harness, process, or transform water (e.g., 100% both filter their water and have a cistern toilet). This influence on the social hydrology of Kolkata ultimately demonstrates their middle class social position and their ability to commodify water. A diversity of water sources, personally treated supplies, and the capital required to secure such a waterscape are increasingly being used to reinforce middle class status, both outwardly and inwardly. These results are distinguishable at the household and society scales, and they can be observed in everyday practices.

Keywords Middle class · Kolkata · India · Household water use · Practice theory · Embodied practice

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Introduction

The post-liberalization Indian middle class is experiencing sweeping changes in its way of life, negotiating the incongruencies arising from tradition and modernity while simultaneously inhabiting both imagined and actual worlds. Their consumption of resources—in this case, water—is still being used to participate in culture, but is increasingly utilized to embrace modernity and distinguish class. Within this context, this article investigates transformations in middle class waterscapes in urban Kolkata (formerly Calcutta), India, from the 1960s to present. Data from household surveys and focus group discussions reveal four salient transformations in middle class water tenure: (1) changes in water sources; (2) changes in water uses; (3) the adoption of water-related technologies; and (4) changes in what constitutes good quality water. We argue that such transformations are intricately linked to evolving perceptions and uses of water itself; for example, the increasing instrumentalization of water as a medium to project class.

The Indian middle class, or what Barbara Harriss-White (2015) terms 'middle India,' is a voracious consumer driving the engine of economic growth and prosperity of the country (Baviskar and Ray 2011; Donner 2011; Srivastava 2012). Further, the middle class is a highly visible and much debated group desperately trying to retain its identity (Appadurai 1996; Fernandes 2011), with the fluidities of their multiple social positions reflected on water and practices surrounding water. Ultimately, these complex spheres coalesce to determine what is perceived as 'good,' 'safe,' and convenient water for consumption in middle class Indian homes. As middle class households endeavor to find new ways of being global citizens, they expand consumption by accessing hitherto out-of-reach resources and by consuming old resources in new ways. In India, water is a unique resource due to its chronic scarcity, cultural symbolism, association with power, and thus its ability to reflect social dynamics (Mosse 2003; Gandy 2004; Mehta 2008). This unique social hydrology and political ecology are not only overlaid upon issues of class in India, but also issues of caste (Freed 1970; Swyngedouw 2009; Robbins 2012).

Consumption, as Inge Roepke (2009) points out, can be interpreted as a set of practices. Performing a practice usually requires the employment of material artifacts, technologies, or tools, and it is through this performance of practice that people draw upon resources such as water. Consumption and technologies are intimately linked to human perceptions of water, and we argue that rises in consumerism have stimulated marked changes in water sources and uses. These new sources and uses are driven by changes in middle class perceptions of what constitutes 'good,' 'safe,' convenient, and ultimately acceptable water. Furthermore, these transformations typically involve the adoption of new technologies and go on to affect water-related practices. In this context, this article explores how water assumes new meanings and materialities over time vis-à-vis new practices of water consumption, ultimately fashioning new waterscapes in urban India.

Practice theory and scale

Practice theory, also known as 'embodied practice,' is a growing domain of literature that encompasses a diverse, sometimes contradictory range of perspectives. However, the uniting ontological position is that the basic unit of analysis ought not be individuals, social structures, or discourses, but *practices*, which are often viewed merely as "inconsequential, inconspicuous and mundane" elements of everyday life (Strengers 2010, p. 7). Practice

theory came into its own in the late 1970s and early 1980s, and its origin can be traced to the works of Bourdieu (1984, 1990) and Giddens (1984, 1991), two stalwarts of practice theory in the social sciences.

Practice theory remained low-key in the social sciences before coming to the center in the works of Ortner (1984, 2006), Schatzki (1996, see also Schatzki et al. 2001), and Reckwitz (2002). Reckwitz defines practice as "a routinized type of behaviour which consists of several elements interconnected to one other: forms of bodily activities, forms of mental activities, things and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (2002, p. 249). This complex definition of practice—which can be simplified as an assemblage of material, competence, and meaning–was demonstrated in microsociological studies of water and energy consumption in routine practices of cleanliness, comfort, and convenience (Shove 2005). In such a construct, practices are conceived as elements of culture that bring together matter, action, and meaning, in contrast to technocrats' reductive understandings of consumer behavior as driven by individual attitudes. In fact, technology- and consumption-based practices penetrating and shaping culture has been conceptualized (somewhat linearly) within practice theory as links among: habits (in self-actuating a practice); routines (a series of practices); social relations (communication and replication of practices); material culture; socio-technical systems; and shared understandings of cultural and technical competence (Evans et al. 2012).

Practice theory has found use in understanding the nature of consumption. Theories of practice focus on the things that people do, with consumption perceived as practices necessarily embedded in the anthropic context in which they reside. The work of Warde (2005) and Roepke (2009) has been influential in this regard, departing from the bulk of work on consumption by focusing on common items used in a mundane manner. The emergence of a new practice, according to Roepke (2009), requires a process of innovation in which actors configure a set of new bodily-mental activities. This makes us, individuals, the vehicles of practices, diverting attention away from characteristics of the individual or object to instead focus on the characteristics of practices (e.g., consumption) in which the individual and object participate. Thus, practice theory can be used to examine the consumption of tangible materials, such as water, at the household level, which is where practices are employed, routinized, and eventually adopted (or rejected) at larger scales.

The geographical scale of inquiry assumes great significance in water practices. In this paper, we investigate the household scale. The household unit is often treated as a black box, an equipment with inner workings unknown or hidden from public view. Consequently, its functioning is largely taken for granted. Investigating water practices at this level allows one to understand how, in the microgeographical scale of the private home, perceptions of water are changing, which triggers changes in water-related practices and the deployment of new technologies. The household is neither a mere building block of some larger social system nor a convenient site for accessing individuals and their psychologies; rather, it is a functioning entity worth studying in its own right (Lahiri-Dutt and Harriden 2008; Truelove 2011; Juran et al. 2016). Household characteristics and dynamics are driven by logics of capital, class, culture, gender, and resource distribution that simultaneously operate at other sites and at larger social scales (Shove et al. 2012; Fam et al. 2015). Therefore, households are fertile sites for the transmission and reproduction—not to mention the innovation and transformation—of practices and, consequently, social, technical, and cultural norms.

In short, knowledge on everyday household practices helps illuminate lived sociotechnical realities, which are tempered by, among other things, dynamics of class,

gender, climate, space, and time. Given this backdrop, this article explores changes in water consumption from the 1960s to present among middle class Kolkata households through the lens of practice theory. Furthermore, we argue that such transformations are rooted in changing perceptions and uses of water, and that water is increasingly being leveraged as a semiotic device.

Context, data collection, and historiography

In India, many debates on water focus on the big picture. For example: raw population compared to water resource availability (Rao 1975; Vaidyanathan 2006); regional heterogeneity in precipitation and seasonal flows (Swain 1998; Kripalani and Kumar 2004); the problématique of supplying water to growing population centers (Briscoe and Malik 2006; McKenzie and Ray 2009); cooperation among states sharing water resources (D'Souza 2008; Rahaman 2006); and water laws and their implications (Reddy and Dev 2006; Shah and van Koppen 2006). Accompanying this big picture discourse is anxiety over looming (and already present) water crises in the urban and agricultural sectors (Macdonald et al. 1995; Folke 1998; Biswas et al. 2009), which has led successive governments to aggressively pursue what Gleick (2002, 2003), D'Souza (2006), and others term as supply-side or 'hard path' approaches for satisficing water demands. Such 'solutions' (see Tiesch 2011)—in contrast to demand-side or 'soft path' approaches that seek to increase water use efficiency, decrease wastage, and introduce decentralized and small scale infrastructure—focus on technocratic, centralized mega projects (e.g., dams, desalination) and the further appropriation of already stressed resources. However, we argue that supply-side approaches that aim to move from deficit to excess are futile in the long term, with Chaplin (2011) and Chhotray's (2011) respective critiques of watershed management and city service providers attempting to catch up with water supply and sanitation demonstrating dissent to such plans in the Indian context. Generally, both scholars (Gleick 2002; Shaban and Sharma 2007) and civil society (Moench et al. 1999; FICCI 2011) have stressed the need for demand-side management in thinking about water in India, rather than seeking endless (and non-existent) sources.

In India, water represents a number of things in various degrees and combinations that can all manifest simultaneously. Water is a multidimensional resource upon which cultural and religious beliefs find expression: it acts as an antiseptic that singlehandedly turns pollution into purity; represents a critical input for individual livelihoods and macroeconomies; assumes a geopolitically sensitive issue; and even rivers embody Hindu goddesses (e.g., Ganga, Saraswati, Yamuna). Thus, beyond its obvious value in the biophysical sphere (i.e., sustenance to flora, fauna, and the human corpus), water in India is pluralistic and represents both a matrix of culture and a medium through which social relations are practiced and structured. In short, traditions surrounding water are deeply embedded in broader societal constructs, so changing water practices necessarily changes culture.

Interestingly, water is included in both state and union lists, yet remains absent as a fundamental right in the Indian Constitution. For those who make and influence policy, water is typically situated in the economic domain, largely ignoring the cultural aspects of our everyday dealings with water or relegating them to one corner. Yet, as mentioned and as every Indian knows, the way social groups acquire, transport, store, process, serve, and conceptualize water is delineated by markers of class, religion, and cultural difference, and

this becomes evident when observing water tenure in practice. For example, in a recent study of water supply in Delhi, Roy (2015) unravels the complex, intertwining relationships among water markets, water technologies, the coexistence of water commodification and public utilities, and the private players that comprise the multilayered waterscape of the city—but this is done at a larger scale, leaving smaller scale perceptions, drivers, and ultimately practices unconsidered.

Class has entered the discourse on water in India. Commentators have argued about new market relationships emerging between the state and citizens in neoliberal India, an arrangement in which the state is no longer the provider of free services but rather a seller to different sets of consumers with different abilities to pay. For example, free water at public taps for the poor, but connection fees and flat or volumetric (metered) fees for those who can afford a private tap. Critiquing a water supply scheme activated by the Bangalore Water Supply and Sewerage Board under this pooled finance framework, Dasgupta (2012) argues that class divides become evident in 'participatory' meetings, serving to reveal the social location of water users. For example, while the middle class busied themselves in exchanging ideas, "the slum residents huddled together in small groups on the periphery of the field [the meeting]… From their hesitant steps, hushed voices and quick nervous glances, one could tell that they felt trivial and useless in that formal space and wholly out of depth" (Dasgupta 2012, pp. 532–533).

Data collection

This article uses original household data gathered via surveys and focus group discussions (Longhurst 2010; Rea and Parker 2014). Data are from middle class residents of the four inner zones of Kolkata (i.e., North, Central, East, and South), all of whom receive piped water from the Kolkata Metropolitan Corporation (KMC) (Fig. 1). Data collection took place in 2014 by the authors, who worked in collaboration with a small civil society organization to ensure longer, more candid engagement with research participants.

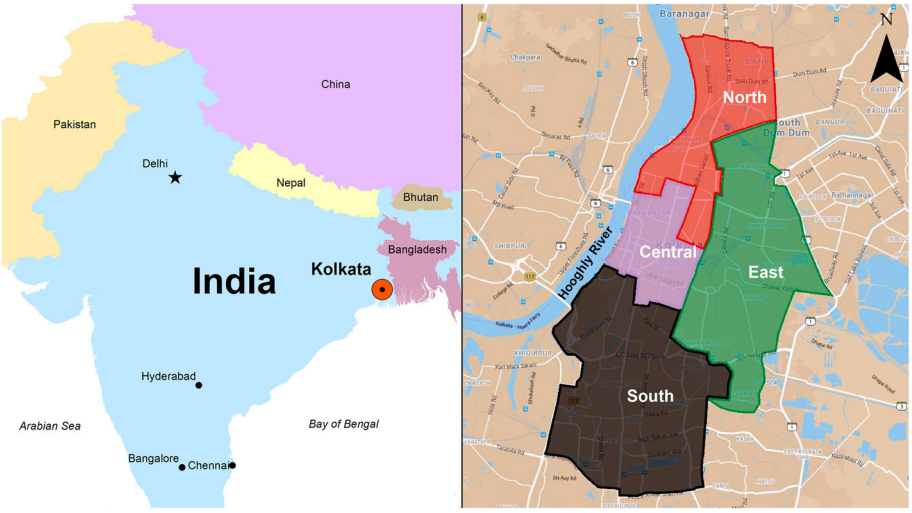

Fig. 1 Kolkata and the four study areas

The survey represents a follow-up of prior research on changing practices of household water use by one of the authors, Lahiri-Dutt (2014), which was founded on the Geertzian approach of establishing smaller scale narratives and lived experiences that can be extrapolated to better interpret the big picture (Geertz 1973). The survey sampled 34 individuals and their household units across North (10), East (8), South (10), and Central Kolkata (6). Surveys probed participant profiles in terms of: total household income (average of ₹233,000); number of incomes (68% of households have two or more); house/flat ownership (76% ownership); access to financial services (all household heads have both bank accounts and life insurance policies); and vehicle and smartphone ownership (24 and 72%, respectively). Finally, the average household size is three, and while all participants were alive in the 1960s, they have lived at their current residences for varied lengths of time (e.g., 32% for 1–10 years, 20% for 11–20 years, and 48% for >20 years).

Next, a focus group was organized in each of the four zones of Kolkata. The same 34 survey participants took part in 2–3 h discussions, and each discussion was organized in the home of one of the participants. The focus groups probed a number of topics, but concentrated on changes in water-related practices from the 1960s to present surrounding four broad domains: sources of water; modes and purposes of water use; water-related technologies; and perceptions of water quality.

Water supply in metropolitan Kolkata

Kolkata's urban history is intricately linked to its water resources. Located near the Bay of Bengal, Kolkata is situated on a low lying, deltaic terrain (only 6.4 masl), with its elongated shape reflecting the city's location on a natural levee. Before 1800, Calcutta, as it was known then, relied on the Hooghly River and a few tanks and wells.

From October to March, the Hooghly's seasonal low flow and associated incursion of seawater render the water unsuitable for consumption. Then, the Hooghly is flushed with monsoon rains, but heavy silt loads and turbidity prevail, again leaving the water unfit for drinking. This cycle leads Basu and Main (2001) to claim that water quality is more crucial than water quantity in Kolkata, which is unlike most other major Indian cities. Native households treated (i.e., decreased turbidity) their drinking water by adding alum or passing it through muslin strainers (Mukherjee 1977). However, that was not enough for the colonial British, who were not accustomed to turbid water. As a result, in 1869 the British constructed a sand filtration unit at Palta on the Hooghly to provide filtered and piped water (Samaddar 1978). By 1870, all principal streets of Kolkata were piped and over 500 standpipes were erected for public use. Meanwhile, capacity of the treatment unit at Palta was augmented incrementally, and by 1911 it could treat 209 ML/day (Datta 2012). A large overhead tank was also built at Tala in 1911 and, in 1936, some slow sand filtration systems were added.

The real pressure on Kolkata's water supply began after the Partition of India in 1947, when settlements along the Hooghly absorbed large numbers of people displaced from what would become East Pakistan. As a result, in the early 1950s piped water supply capacities increased from about 273 to 309 ML/day; however, per capita supply actually decreased from about 236 to 123 L/day (Samaddar 1978). To address the shortfall, additional supplies of untreated Hooghly water and untreated groundwater were exploited.

Population of the KMC grew from 2.5 million in 1951 to 4.2 million in 1981, flattening out at roughly 4.5 million thereafter, essentially 'full.' Meanwhile, the urban agglomeration (i.e., Kolkata Municipal Area, or KMA) grew from 4.8 to 9.2 million over the same 30-year period (Samaddar 1978), and now stands close to 15 million if the chain of

industrial settlements on the Hooghly's west bank are included. Population growth made it necessary for households to install deeper, greater capacity hand-pumps and deep tube wells (DTWs) to supplement the KMC water supply, particularly in southern Kolkata. Initially conceived as an emergency and stopgap measure, wells have become permanent fixtures among the middle class as most residential complexes, apartment buildings, and independent houses regularly withdraw groundwater for storage in overhead tanks. In turn, this generates decreased revenue for the KMC, often falling short of cost recovery (McKenzie and Ray 2009). A recent report on water access also highlights discrepancies in data from the KMC and Asian Development Bank (ADB): KMC claims that 94% of households are connected to a piped water supply, while the ADB claims the rate is only 74% (Engel et al. 2011). Further, even if households are connected, the average duration of daily water supply is only 8.3 h. In order to satisfy water needs, KMC residents are forced to exploit additional resources from the Hooghly as well as groundwater from hand-pumps and DTWs, the latter source accessible primarily to the middle and upper classes.

The major concerns surrounding Kolkata's municipally-supplied water are fecal and arsenic contamination combined with an antiquated delivery system (Engel et al. 2011). It is not surprising, then, that middle class households–those who are better able to afford water treatment technologies—have begun installing filtration devices and moving away from publicly supplied water for consumptive uses. Boiling is often resorted to as a method of water treatment among the relatively poorer classes. In fact, Juran and MacDonald (2014) observed that 10.4% of Indian households boil their drinking water, often inadequately, leaving an alarming 60% of households with a presence of fecal coliform post-boiling. To identify the cause, they investigated *actual household practices* surrounding boiling and uncovered that several factors determine these practices. For example, the duration of heating is limited (often precluding actual boiling) because the stove is required for other purposes, and the container in which water is boiled must be large enough to hold the requirements of the household, yet small enough to handle safely. However, such gendered practices are increasingly avoided in middle class homes, where many women participate in income-generating activities, both formal and informal (Lahiri-Dutt and Sil 2014). As a result, space has opened for the introduction of new water refining technologies. While prototypical in nature, these technologies are not adopted uniformly. Rather, water refining technologies interact with social, cultural, and economic fabrics and, consequently, they change cultures as much as cultures influence the practices of their use. As Misa (2003) notes, technologies interact deeply with society and culture, but the interactions involve mutual influence, substantial uncertainty, and historical ambiguity, ultimately eliciting fluid relations and co-construction of the subjects who use them and the technologies that are used.

Results and discussion

Survey and focus group data reveal four principal changes among middle class Kolkata residents from the 1960s to present: (1) changes in sources of water; (2) changes in water use; (3) the adoption of new water-related technologies; and (4) changes in perceptions of what characterizes good quality water. These changes—which are not mutually exclusive and in fact deeply entangled—are visible in the introduction of new practices or changes in existing practices. Furthermore, the consumption of water and waterscapes themselves are

increasingly being used by the middle class to portray social position, both outwardly and inwardly.

Changes in water sources

As outlined earlier, sources of water have changed for Kolkata residents since establishment of the KMC. These changes are reflected in the households that were studied. However, while all classified as middle class (in terms of assets, income, and stated identity), the households reveal wide diversity in the sourcing of water for domestic use. Over the study window, and as shown in Table 1, households have secured water from a total of five sources: treated piped water from KMC; untreated piped water from KMC; public roadside standpipes; private hand-pumps; and private DTWs (which arrived only in the 1980s). Furthermore, each household exploits water from a number of sources; no household relies on a single source. This diversity in water sources–both within and across households—could possibly be a matter of need due to the irregular availability of many sources, or it could be interpreted as a lack of trust in any single source. Additionally, such diversity signifies the ability to make choices and act on preferences and conveniences, which are privileges that can be perceived as status symbols. That is, by drawing water from several sources, middle class households differentiate themselves (hierarchically, in social hydrological terms, and in their practices) from slum dwellers, whose existence is dominated by a lack of basic water services, forcing them to rely on irregular public standpipes and surface water. As will become evident, changes in water sources reflect more than changes in the city's water delivery mechanisms–they also signal middle class desires to reduce labor, realize higher levels of convenience, and as a means to portray their socioeconomic position through the medium of water.

In the days before the provision of piped municipal water, most households sourced water from dug wells; buckets tied to strings were used to physically lift groundwater that

Table 1 Sources and end uses of water among middle class Kolkata households, 1960s–1980s

	Drinking	Cooking	Bathing	Cleaning and laundry	Toilet flushing	Ablutions	Vehicle washing and other
1960s							
KMC-T	26	32	30	30	12	13	2
KMC-U	0	2	3	2	12	12	0
Roadside	0	0	1	2	1	2	9
Hand-pump	8	0	0	0	0	0	0
1980s							
KMC-T	19	28	28	27	14	18	2
KMC-U	0	0	0	0	2	2	0
Roadside	0	0	1	2	1	2	8
Hand-pump	13	0	0	0	0	0	0
DTW[a]	6	5	5	5	3	5	2

KMC-T piped water from Kolkata Municipal Corporation that is treated, *KMC-U* piped water from Kolkata Municipal Corporation that is untreated, *DTW* deep tube well

$n\max = 34$

[a] DTWs were not introduced until the 1980s

infiltrated into wells. Such wells occupied a considerable footprint on urban land use as they required a clearance of up to 100 m^2. Since wells were located on the premises of each household lot, pressures of population density and urban expansion led to their eventual abandonment in favor of roadside standpipes and hand-pumps, with all participants in the study having access to piped KMC water (treated and/or untreated) in the 1960s. It is important to note that the major burden of water retrieval fell upon women given their culturally defined 'duty' of performing domestic chores. When women of the household were not fetching water, as was common in this investigation of middle class households, domestic servants fetched water in buckets or earthen containers, and some hired porters to transport water in leather bags hung from bamboo rods.

While all study households were provided piped KMC water in the 1960s, the rate of urban expansion coupled with the (dis)ability of the KMC to provide adequate quantities meant that many could not rely on piped water alone. Thus, middle class households were compelled to introduce private hand-pumps and DTWs to appropriate more plentiful (and unregulated) groundwater resources. Interestingly, an epidemic of gastroenteritis in the 1980s, directly linked to piped KMC water from the Hooghly, situated KMC water unsafe for those who could afford the luxury of alternative sources. As a result, the 1980s ushered an era when many middle class households introduced DTWs, which extract groundwater perceived to be of higher quality at the time. Furthermore, water filtration devices were introduced in order to treat water in the household, whether from the KMC, DTWs, or other sources. Then, just as the enteric hazard subsided, the threat of arsenic contamination arose, further fueling the impetus of households to introduce water treatment technologies. As will be discussed later, several other water-related technologies, such as cistern toilets, geysers, and dishwashers, would eventually proliferate across the middle class Kolkata landscape.

Observing changes in water sources, the distinctive trend, beyond the utilization of a multiplicity of sources, is a continued and increased dependence on groundwater in order to acquire supplemental resources beyond what is provided by the government. Early supplemental sources were dug wells that allowed groundwater to infiltrate, which were eventually deserted by the middle class in favor of groundwater from hand-pumps, which are now being replaced with DTWs. Contradictorily, this middle class shift toward hand-pumps and DTWs occurred in parallel with the establishment and expansion of piped water supplies by the KMC. However, while households shied away from piped surface water from the Hooghly, groundwater too became no longer trusted as a source of potable water due to issues of arsenic contamination. This deficit in trust by middle class water consumers, as intimated in focus groups, will be reflected later when discussing the uptake of technologies to further process and purify water.

Changes in water use

Changes in water sources among middle class Kolkata households have been accompanied, and partially driven, by marked changes in water use (i.e., the end or beneficial use of water from particular sources). We just explored how sources of water have shifted, and with these shifts have emerged changes in *how* and *where* such water is used and not used. The expectation that treated piped water from the KMC would be used for consumptive purposes, such as drinking and cooking, has largely borne out. However, the use of hand-pump water for drinking and cooking also increased over time, and the advent of DTWs in the 1980s further stimulated changes in household water use, particularly for consumptive ends (Table 1). While the use of untreated water from both the KMC and roadside

standpipes has been directed primarily towards non-consumptive purposes (e.g., toilet flushing, ablutions, vehicle washing), the use of untreated KMC water fell precipitously while the use of roadside water remained steady. In this case of middle class Kolkata, what arose was the increased use of water from hand-pumps and DTWs, both sources private and both made possible through relatively larger disposable incomes. Further, rises in these private sources served to both displace the use of untreated KMC water and relegate the use of public and perceived lesser quality water for non-consumptive ends.

Treated KMC water is perceived to be of high quality and has remained the number one water source among study households from the 1960s through the 1980s and onward. However, the gap between treated KMC water use and other sources has narrowed over time. While 100% of households used and continue to use treated KMC water for some purpose, the proportion of that water compared to total water use has decreased, particularly in the domain of consumptive use. For example, in the 1960s, 76% of households used treated KMC water for drinking and 94% used it for cooking. In the 1980s, however, only 56% and 82% of households used treated KMC water for drinking and cooking, respectively. Moreover, from the 1960s to 1980s, households using treated KMC water as their sole source of consumptive water decreased from 71 to 35% for drinking and from 94 to 82% for cooking. What transpired is that private hand-pumps and DTWs emerged as more convenient and reliable sources, and that too for both consumptive and non-consumptive uses. In the 1960s, only 24% of households used water from private hand-pumps; all were located in South and Central Kolkata, and all used such water solely for drinking. In the 1980s, however, and also owing to the introduction of DTWs, 56% of households (compared to 24%) used water from hand-pumps and/or DTWs. Furthermore, hand-pumps and DTWs had permeated all four zones of Kolkata–not just the South and Central–and the number of households using such water as their sole drinking source climbed to 29%. Further still, water from private hand-pumps and DTWs was no longer reserved solely for drinking, but was also being exploited for non-consumptive uses such as bathing, cleaning/laundry, flushing toilets, ablutions, and washing vehicles.

Changes in water use for non-consumptive ends also surfaced over time. Broadly, the most salient shift was away from public KMC untreated water towards private water from DTWs. For example, while 6% of households used KMC untreated water each for bathing and cleaning/laundry in the 1960s, usage dropped to zero for both purposes from the 1980s onward. Analogous changes were observed for toilet flushing and ablutions; the use of KMC untreated water for these purposes plummeted from 35% in the 1960s to just 6% from the 1980s onward. This shift away from KMC untreated water coincides with the introduction of private DTWs. Nonexistent until the 1980s, DTWs emerged as additional means for hydrating middle class homes. While the non-consumptive use of DTWs may appear insignificant (i.e., used by only 15% of households each for bathing, cleaning/laundry, and ablutions; 9% for toilet flushing; and 6% for vehicle washing/other), such use almost directly displaced the use of KMC untreated water. Therefore, the net effects should not be underestimated.

The introduction of DTWs generated two major outcomes, the cascade of which triggered a decline in the use of KMC untreated water. First, since DTWs are used for consumptive purposes (i.e., drinking, cooking), they replaced some households' use of KMC treated water for consumption. As a result, DTWs caused some houses to reserve KMC treated water only for non-consumptive uses. Second, with some KMC treated resources downgraded to non-consumption coupled with some DTW water simultaneously being used for non-consumption, an associated decline in KMC untreated water use arose. In short, DTWs and KMC treated water are preferred over KMC untreated water (this

holds for both consumption and non-consumption), and over time these preferences led to a decline in the use of KMC untreated water for all purposes. Furthermore, it is important to stress that changes in non-consumptive water use mirror changes outlined earlier: just as was the case for consumptive use, households shifted away from public sources towards private sources of water to meet non-consumptive ends. Moreover, the use of KMC untreated water is withering as DTW and KMC treated water are preferred and becoming more available (technologically and monetarily) to satisfy middle class 'needs.'

The transition from public to private water use is rooted in the coalescence of several factors. First, the change was contingent upon the joint combination of the introduction of DTW technology on one hand, along with rises in income, consumption levels, and standards of living on the other. Next, once DTW technology permeated India (and the same argument can be made for preexisting hand-pump technology), middle class households could afford to consume the technology and thereafter capitalize on its conveniences while simultaneously reaffirming their social location. Furthermore, and as articulated by study participants, these conveniences carried over to affect actual household practices surrounding water.

Compared to public water, privately sourced water is more abundant and more convenient to use once the infrastructure is laid. Further, private infrastructure is easier to fix if problems arise, and the water is essentially free once infrastructure is configured. While initial capital costs are considerable—essentially prohibitive to the relatively poor–once in place, water flows from hand-pumps for free and from DTWs virtually for free, the only cost being electricity charges. Additionally, access to water from private sources is essentially uninterrupted (i.e., continuous supply) and comes with no trappings of limitations in quantity. Owing to poor infrastructure and constraints in resource treatment and delivery, KMC water arrives intermittently or in predetermined availability windows (e.g., 6–10 am, 4–6 pm), meaning that both the duration of access and volume of water that can be obtained are capped. Alternatively, private sources are able to dispense water at any time, and that too in unlimited quantities. Note our recognition that DTWs cannot operate during electrical outages (although this is increasingly circumvented with electrical generation and storage technologies, such as generators and invertors), and we likewise acknowledge that extraction is limited by groundwater availability. However, these are minor caveats in the short to medium time-scale *vis-à-vis* the availability and quantities that can be secured through public sources. From a public works standpoint, what is interesting is that the Kolkata middle class (as well as the wealthy), who exhibit disproportionate influence and agency compared to the relatively poor, may actually be weakening political will for improved piped water services due to their increased reliance on private supplies.

Private water sources are less burdensome/restrictive and more productive (economically and socially) due to advantages in quantity secured and near-continuous service coverage, and this influences the rate and manner in which practices manifest. For example, and as shared across the focus groups: the practice of water collection is deemed less taxing; the practice of storing water in anticipation of scarce supplies or service interruption is mitigated; domestic practices must not conform to predetermined water availability windows; and water-related practices can be completed more quickly, thoroughly, and with more certitude given confidence that private water is readily available. Additionally, many of these practices are actually performed by domestic servants who work in middle class homes, meaning that practices beyond those of the middle class are being impacted. Thus, from where domestic servants retrieve water, where they complete tasks, how they complete tasks, when they complete tasks, the length of time required to

complete tasks, and so forth were all modified by the introduction and expansion of private water use. However, we caution that these changes did not necessarily simplify the lives of domestic servants. In fact, the net 'conveniences' afforded by private water supplies likely serve to increase the expectations employers have of domestic servants regarding the quality, rate, and thoroughness of work performed. Interestingly, on the other side, interacting with private water sources may too influence the expectations and views of modernity of domestic servants themselves.

The adoption of water-related technologies

Over the window of study, all households adopted technologies in order to further control, process, and transform water. The proliferation of water-related technologies among middle class Kolkata arose from the confluence of a set of factors: the diffusion of such technologies to India; relatively large household incomes and the desire to portray this affluence; and anticipated benefits from adopting water-related technologies. These (real and perceived) benefits include enhanced water quality and the ability to perform tasks more easily and quickly. Moreover, the adoption of water-related technologies also altered human practices surrounding water.

The practice of water treatment inside the home embodies the most marked change in technological adoption. The use of filtration devices (e.g., reverse osmosis systems, charcoal and multimedia filters) now takes place in 100% of study households; that is, every household drinks water that has been treated at the point-of-use. The use of filtration technologies stood at 0% in the 1960s and just 4% in the 1980s, although mechanical filtration with ceramic pots, muslin, and sari fabric was practiced by some. Furthermore, when outside the home (i.e., at work, restaurants, homes of friends and family), 92% drink filtered water and 88% drink bottled water (categories not mutually exclusive). While first qualified by participants as 'not preferable' and a 'last resort,' only 8% reported the consumption of untreated or 'raw' water outside of the home.

Beyond filtration technologies, all households have, in the past decade or so, introduced a variety of water-related appliances, not to mention that more and varied types of taps have been added both inside and outside of homes to facilitate practices that rely on water (e.g., new taps inside to hook up washing machines, new taps outside to wash vehicles and water gardens). A particularly evident technological introduction is the cistern or western style toilet to replace the pour-flush or Indian style toilet (Srinivas 2002; Doron and Raja 2015). While there were no cistern toilets among study households in the 1960s and few in the 1980s (less than 6%), there now exists a cistern toilet in 100% of households. In terms of practice theory, the cistern toilet not only changed the plumbing of middle class households, but the very practice of relieving oneself. In the past, individuals squatted over the pan of pour-flush toilets and physically flushed by pouring a small bucket of water into the pan. Water for flushing came from a tap inside the bathroom, but sometimes had to be transported from outside in buckets. Now, individuals sit on the toilet and flush by pushing a lever that dispenses a fixed quantity of concealed, already stored water. As for why households introduced cistern toilets, the most common response was convenience (40%), followed by hygiene (32%) and better engineering (12%). When asked if cistern toilets are superior to their pour-flush counterparts, 80% responded affirmatively, with rationale ranging from functionality (no need to store water and water is dispensed in a fixed quantity) to personal perceptions (more convenient, clean, and 'odor free') to the sociological (cistern toilets are 'more fashionable,' pour-flush toilets are 'obsolete,' and 'it's embarrassing to carry buckets of water from outside to flush the toilet'). Still others argued

that cistern toilets use less water and are thus more environmentally friendly, although this contention is variable and depends on how the two toilets are used in practice.

Several other technologies have penetrated middle class Kolkata. Of study households, 84% have an electric water heater or geyser (device with metal rods that heat water when immersed) and 72% have a washing machine; both technologies stood at zero in the 1960s and 1980s. Interestingly, dishwashers are owned by only 8% of households, and stand-up or western style showers are slowly becoming more common (both were non-existent in the 1960s and 1980s). In fact, the introduction of stand-up showers signifies the most recent, currently unfolding transformation among middle class homes.

While at face value stand-up showers merely change the point of water dispersal, in actuality they fundamentally alter the practice of bathing and serve to change the bathroom space writ large (Srinivas 2002; Doron and Raja 2015). Indians have, for centuries, engaged in 'bucket showers,' or the act of filling a large bucket and using a smaller 'mug' (filled with water from the larger bucket) to rinse. In traditional practice, women have sat on a short stool while bathing and men would also bucket shower, but stand. Additionally, men have traditionally shaved outside the bathroom (sometimes outdoors), and brushing of hair and teeth also took place outside the bathroom, usually in a basin meant for washing hands before and after eating, but sometimes outdoors. Now, homes with stand-up showers are incrementally altering practices that have historically been conducted in other spaces. Beyond women abandoning the shower stool (although some still use it out of habit), bathing space is now more strictly delineated within the bathroom since the entire bathroom floor is no longer wet after someone showers—and this newly opened space is slowly being used for other practices, such as shaving and brushing hair and teeth. Thus, while the introduction of stand-up showers seems innocuous and culturally insignificant, the introduction of such technology has profoundly changed not only the practice of bathing, but also ancillary hygienic and aesthetic practices that were previously reserved for other functional spaces.

The adoption of water-related technologies has altered middle class views of water. In fact, 88% of surveyed households reported that technologies have changed their perceptions of water. Of these households, Table 2 breaks down changes in perceptions on water availability, quality, and how technologies have changed or eliminated water-related practices deemed undesirable (e.g., boiling, chlorination, carrying water in buckets). Interestingly, although technologies were partly deployed to make life 'simpler' and 'easier,' only 48% of study participants perceive water-related practices as actually being

Table 2 Impacts of water-related technologies on middle class Kolkata households

Top open-ended responses to "How have water-related technologies impacted daily life?"	Percent who generated response (%)
Life is 'simpler' and 'easier'	48
Drinking water is 'safer'	40
More cost effective	32
No need to boil water and wait for it to cool	28
No need to use chlorine tablets	24
Do not need help doing laundry	24
Water is more readily available	12

$n = 34$

simpler and easier as a result of the technologies. Similarly, only 12% perceive water as being more readily available as a result of technologies. This is counterintuitive given that the households can and do obtain more water through DTW technology compared to when they relied solely on public sources. In fact, all households surpass the widely accepted standard of 50 L per capita per day, the minimum quantity to maintain an adequate level of health, hygiene, and sanitation (Gleick 1996; Chenoweth 2008). This standard is unmet by many in Kolkata, and if achieved it is often through considerably more burdensome and unpredictable water arrangements.

Changes in what characterizes good quality water

Changes in water sources, uses, and technologies have far-reaching implications, with some arguing that changes in water tenure necessarily engender changes in society and culture (Mosse 1999; Strang 2004; Fagan 2011). Thus, it should come as no surprise that transformations in middle class waterscapes are accompanied by concomitant changes in perceptions of water quality.

In the 1960s, all study participants considered themselves habituated to the taste and quality of drinking water. However, only 50% regarded their drinking water as 'safe,' and participants stressed that turbidity was a problem, especially in Central and South Kolkata. Roadside and KMC untreated water were perceived as lowest quality, with participants referencing their turbidity and general impurity, while the quality of KMC treated water was perceived as relatively high. When perceptions confronted practice, though, confidence in KMC treated water was only moderate, with many households operationalizing additional precautions such as boiling or straining with cloth; these procedures were common across all four zones of Kolkata. Private hand-pumps—which merely draw untreated groundwater from shallow to medium depths—were perceived as the highest quality source in the 1960s. Study participants emphasized the safety, 'naturalness,' and 'sweetness' of hand-pump water. In many parts of India (even in the distant southern states of Kerala and Tamil Nadu), it is common for untreated groundwater perceived as safe to be described as 'sweet.' In practice, sweetness correlates with the absence of a chemical (e.g., chlorine) taste, and such water is typically derived from rural or lesser populated areas that are hilly, vegetated, and receive relatively high amounts of precipitation, although some of these attributes are less in play in this case of low lying, urban Kolkata.

From the 1980s to present, only 40% (compared to 50% in the 1960s) of households perceive their water supply as 'safe.' However, while less confident in initial quality (i.e., what is initially supplied by the KMC or obtained directly from the ground), 96% of households perceive their water as safe at the point-of-use. The virtually unanimous perception of safe water is a product of treatment devices, that is, the ubiquitous installation of reverse osmosis and multimedia filtration systems across the households. As for source hierarchy, the biggest change was the introduction of DTWs in the 1980s, which participants now perceive dispense the highest quality and therefore safest water. While DTWs did not exist in the 1960s, thus making direct comparisons difficult, they quickly outpaced hand-pumps as the preferred source in middle class homes. Private, untreated DTW water is now considered the safest just as private, untreated hand-pump water was considered safest in the 1960s. This lack of faith in piped and treated public water exemplifies well-established binary notions of private versus public wherein the private automatically outperforms the public, whether founded or unfounded. Again, from a public works standpoint, what is interesting is that the Kolkata middle class (as well as the wealthy) may

actually be undermining demand for higher quality piped water, thus subverting desires of relatively lower classes.

The concept of 'safe' water is undeniably subjective. Study participants were asked what constitutes good quality water, with results presented in Table 3. Water quality was well represented across the three basic parameters: biological (free of bacteria and pathogens); chemical (free of iron, arsenic, and salt); and physical-aesthetic (appears 'clean,' 'crystal clear,' and tastes 'natural'). However, such perceptions do not necessarily match actual levels of risk (e.g., risk of consuming iron vs. arsenic), not to mention that 'crystal clear' water that tastes 'natural' may very well harbor biological or chemical constituents harmful to human health. Furthermore, it appears that past concerns about fecal and arsenic contamination have been attenuated among the middle class due to practices of household water treatment and confidence held in water treatment technologies.

The relevance of practice theory lies in the fact that while a minority of households (i.e., 40%) perceive their water as safe, all (i.e., 100%) participate in routines of water treatment. This universal practice of point-of-use treatment can be interpreted differently. It may be that households who already perceive their water as safe are simply seeking additional assurance. However, based on dialogues with study participants, we argue that the practice of treatment is also being activated as a class marker. Through water technologies and their embedded practices, households are able to further distinguish and reinforce their middle class position both within the urban milieu and the household unit. For example, many participants shared that they would feel 'embarrassed' to serve untreated water to visitors in their home, and they would likewise feel 'out of place' and 'somewhat offended' if served the same water in others' homes. Here, participants are underlining the new waterscapes in which they reside, and these waterscapes are constituted as much of new technologies as they are new water-related practices that such technologies embed.

A middle class culture has emerged in which point-of-use water treatment is a unifying fixture. However, beyond the generation of 'safer' water, the practice of water treatment is being instrumentalized to project class. The ability to visibly demonstrate (i.e., practice) higher social status is itself a luxury, and this luxury is an etiology of the introduction of

Table 3 Perceptions of good quality water among middle class Kolkata households

Top open-ended responses to "What are characteristics of good quality water?"	Percent who generated response (%)
Free of iron	52
Free of bacteria and pathogens	44
Free of 'impurities'	44
Tastes 'natural' (i.e., no chemical/chlorine taste)	40
Appears 'clean'	28
Appears 'crystal clear'	20
Water has been filtered	16
Free of arsenic	12
Free of salt	8
Bottled water	8

$n = 34$

new technologies coupled with disposable income for their purchase. While water-related practices are common across space and humanity, many of those practices are privileges and many are deployed for reasons other than comfort, convenience, and health.

Conclusions

This article investigated changes in middle class Kolkata waterscapes from the 1960s to present. The scale of inquiry was the household, and the lens was practice theory. Over the study window, households have: (1) shifted water sources; (2) changed and introduced new end uses; (3) adopted new water-related technologies; and (4) altered their perceptions of water quality. Moreover, these transformations were accompanied by changes in existing water-related practices and the development of new practices. Specific findings include an evident shift away from public sources (i.e., treated and untreated KMC water) towards private sources (i.e., hand-pumps and DTWs), which are perceived to be of higher quality and greater convenience. Furthermore, all households draw upon multiple sources and all employ technologies to process or transform water (e.g., 100% both filter water at the point-of-use and have a cistern toilet)—these privileges made feasible by disposable incomes that their middle class social locations permit.

Water is increasingly, or at least more visibly, being harnessed as a medium to demonstrate social position. A diversity of water sources, personally treated supplies, the adoption of technologies to transform and use water in new ways, and the funds to secure this waterscape are being instrumentalized to portray class and reinforce status both outwardly and inwardly. The instrumentalization of water speaks to debates on the commodification of water and public pressure for improving water supply services. Middle class residents perceive public supplies as unreliable and low quality, but their response has been to exploit groundwater on an individual basis and make that water 'pure' through in-home treatment mechanisms. Consequently, the middle class is transforming the urban waterscape based on their ability to pay the price of privately-sourced and privately purified water, and this may erode political will for improvements in the public water sector. The middle class, adapting their water practices to suit their propensity for consumption, set trends for the poor and neoliberal state alike with regard to how to manage issues surrounding water. Behavioral changes in water practices therefore lie at the heart of the wider picture of water supply in Kolkata and urban India more broadly.

Small picture studies tend to investigate and inform the microscopic domain, while big picture studies tend to investigate and inform the macroscopic domain. Alternatively, this article seeks to understand what is driving the big picture by critically examining *practices* that originate and propagate in the small picture. This approach is constructive, because only at finer resolutions can one accurately articulate place- and systems-based dynamics. The small picture scale allows one to identify issues, formulate nuanced understandings of the issues, and ultimately address those issues at larger scales. Thus, there is utility in using practice theory at a small scale, with applications for policy and decision makers as well as researchers who espouse both humanistic and positivistic leanings. A clearer understanding of contemporary water issues in urban India can only be accessed when the small and the big pictures are combined, and practice theory can help in this endeavor.

Acknowledgements We thank Sanam Aksha for his assistance in manuscript preparation, and we are especially thankful to the study participants in Kolkata.

References

Appadurai A (1996) Modernity at large: cultural dimensions of globalization. University of Minnesota Press, Minneapolis

Basu SR, Main HAC (2001) Calcutta's water supply: demand, governance and environmental change. Appl Geogr 21:23–44

Baviskar A, Ray R (2011) Introduction. In: Baviskar A, Ray R (eds) Elite and everyman: the cultural politics of the Indian middle classes. Routledge, New Delhi, pp 1–26

Biswas AK, Rangachari R, Tortajada C (2009) Water resources of the Indian subcontinent. Oxford University Press, New Delhi

Bourdieu P (1984) Distinction: a social critique of the judgement of taste. Routledge, London

Bourdieu P (1990) The logic of practice. Polity Press, Oxford

Briscoe J, Malik RPS (2006) The water economy of India: bracing for turbulence. Oxford University Press, New Delhi

Chaplin SE (2011) The politics of sanitation in India: cities, services and the state. Orient BlackSwan, New Delhi

Chenoweth J (2008) Minimum water requirement for social and economic development. Desalination 229:245–256

Chhotray V (2011) The anti-politics machine in India: state, decentralization and participatory watershed development. Anthem Press, London

D'Souza Radha (2006) Interstate disputes over Krishna waters: law, science and imperialism. Orient Longman, Hyderabad

D'Souza Rohan (2008) River-linking and its discontents: the final plunge for supply-side hydrology in India. In: Lahiri-Dutt K, Wasson R (eds) Water First: issues and challenges for nations and communities in South Asia. SAGE Publications, New Delhi, pp 99–121

Dasgupta S (2012) Rethinking participation: water, development and democracy in neo-liberal Bangalore. South Asia 35(3):520–545

Datta P (2012) Planning the city: urbanization and reform in Calcutta, c. 1800-c. 1940. Tulika Press, New Delhi

Donner H (ed) (2011) Being middle-class in India: a way of life. Routledge, New York

Doron A, Raja I (2015) The cultural politics of shit: class, gender and public space in India. Postcolonial Stud 18(2):189–207

Engel K, Jokiel D, Kraljevic A, Geiger M, Smith K (2011) Big cities, big water, big challenges: water in an urbanizing world. World Water Forum, Berlin

Evans D, McMeekin A, Southerton D (2012) Sustainable consumption, behaviour change policies and theories of practice. Collegium 12:113–129

Fagan B (2011) Elixir: a history of water and humankind. Bloomsbury Press, New York

Fam D, Lahiri-Dutt K, Sofoulis Z (2015) Scaling down: researching household water practices. ACME 14 (3):639–651

Fernandes L (2011) Hegemony and inequality: theoretical reflections on India's 'new' middle class. In: Baviskar A, Ray R (eds) Elite and everyman: the cultural politics of the Indian middle classes. Routledge, New Delhi, pp 58–82

FICCI (Federation of Indian Chambers of Commerce and Industry) (2011) Water use in India industry survey. FICCI Water Mission, New Delhi

Folke S (1998) Conflicts over water and land in South Indian agriculture: a political economy perspective. Econ Political Wkly 33(7):341–349

Freed SA (1970) Caste ranking and the exchange of food and water in a north Indian village. Anthropol Q 43 (1):1–13

Gandy M (2004) Rethinking urban metabolism: water, space, and the modern city. Cities 3:363–379

Geertz C (1973) Thick description: toward an interpretive theory of culture. In: Geertz C (ed) The interpretation of cultures: selected essays. Basic Books, New York, pp 3–32

Giddens A (1984) The Constitution of society: outline of the theory of structuration. Polity Press, Cambridge

Giddens A (1991) Modernity and self-identity. Polity Press, Cambridge

Gleick PH (1996) Basic water requirements for human activities: meeting basic needs. Water Int 21(2):83–92

Gleick PH (2002) Water management: soft water paths. Nature 418:373

Gleick PH (2003) Global freshwater resources: soft-path solutions for the 21st century. Science 302:1524–1528

Harriss-White B (2015) Middle India and urban-rural development: four decades of change. Springer, New Delhi
Juran L, MacDonald MC (2014) An assessment of boiling as a method of household water treatment in South India. J Water Health 12(4):791–802
Juran L, MacDonald MC, Basu NB, Rajagopal R, Rajagopalan P, Philip L (2016) Development and application of a multiscalar, participant-driven water poverty index in post-tsunami India. Int J Water Resour Dev. doi:10.1080/07900627.2016.1253543
Kripalani RH, Kumar P (2004) Northeast monsoon rainfall variability over south peninsular India vis-à-vis the Indian Ocean dipole mode. Int J Climatol 24:1267–1282
Lahiri-Dutt K (2014) Researching world class watering in metropolitan Calcutta. ACME 14(3):688–699
Lahiri-Dutt K, Harriden K (2008) Act on gender: a peep into intra-household water use in the Australian Capital Territory (ACT) Region. J Rural Soc 17(3):230–242
Lahiri-Dutt K, Sil P (2014) Women's 'double day' in middle-class homes in urban India. Contemp South Asia 22(4):389–405
Longhurst R (2010) Semi-structured interviews and focus groups. In: Clifford N, French S, Valentine G (eds) Key methods in geography. SAGE Publications, Thousand Oaks, pp 103–115
Macdonald DMJ, Kulkarni HC, Lawrence AR, Deolankar SB, Barker JA, Lalwani AB (1995) Sustainable groundwater development of hard-rock aquifers: the conflict between irrigation and drinking water supplies from the Deccan basalts of India. British Geological Survey, Nottingham
McKenzie D, Ray I (2009) Urban water supply in India: status, reform options and possible lessons. Water Policy 11:442–460
Mehta L (2008) Contexts and constructions of scarcity. In: Baviskar A (ed) Contested grounds: essays on nature, culture, and power". Oxford University Press, New Delhi, pp 38–58
Misa TJ (2003) The compelling tangle of modernity and technology. MIT Press, Cambridge
Moench M, Caspari E, Dixit A (1999) Rethinking the Mosaic: investigations into local water management. Nepal Water Conservation Foundation, Kathmandu
Mosse D (1999) Colonial and contemporary ideologies of 'community management': the case of tank irrigation development in South India. Mod Asian Stud 33(2):303–338
Mosse D (2003) The rule of water: statecraft, ecology and collective action in South India. Oxford University Press, New Delhi
Mukherjee SN (1977) Calcutta: myths and history. Subarnarekha, Kolkata
Ortner SB (1984) Theory in anthropology since the sixties. Comp Stud Soc Hist 26(1):126–166
Ortner SB (2006) Anthropology and social theory: culture, power, and the acting subject. Duke University Press, Durham
Rahaman MM (2006) The Ganges water conflict: a comparative analysis of 1977 agreement and 1996 treaty. Asteriskos 1(2):195–208
Rao KL (1975) India's water wealth: its assessment, uses and projections. Orient Longman, New Delhi
Rea LM, Parker RA (2014) Designing and conducting survey research: a comprehensive guide. Jossey-Bass Publishers, San Francisco
Reckwitz A (2002) Toward a theory of social practices: a development in culturalist theorizing. Eur J Soc Theory 5(2):243–263
Reddy VR, Dev SM (2006) The canvas: policies, institutions, and technologies. In: Reddy VR, Dev SM (eds) Managing water resources: policies, institutions, and technologies. Oxford University Press, New Delhi, pp 1–22
Robbins P (2012) Political ecology: a critical introduction. Wiley, Chichester
Roepke I (2009) Theories of practice: new inspiration for ecological economic studies on consumption. Ecol Econ 68(10):2490–2497
Roy D (2015) Understanding the Delhi urban waterscape through the actor network theory. Public Works Manag Policy 20(4):322–336
Samaddar SP (1978) Calcutta. The Corporation of Kolkata, Kolkata
Schatzki T (1996) Social practices: a Wittgensteinian approach to human activity and the social. Cambridge University Press, Cambridge
Schatzki T, Cetina KK, von Savigny E (eds) (2001) The practice turn in contemporary theory. Routledge, London
Shaban A, Sharma RN (2007) Water consumption patterns in domestic households in major cities. Econ Political Wkly 42(23):2190–2197
Shah T, van Koppen B (2006) Is India ripe for integrated water resources management? Fitting water policy to national development context. Econ Political Wkly 41(31):3413–3421
Shove E (2005) Stuff, image and skill: towards an integrative theory of practice. Presented at the designing and consuming: objects, practices and processes workshop, Durham University, Durham, 11 Jan 2005

Shove E, Pantzar M, Watson M (2012) The dynamics of social practice: everyday life and how it changes. Sage Publications, London
Srinivas T (2002) Flush with success: bathing, defecation, worship, and social change in South India. Space Cult 5(4):368–386
Srivastava S (2012) National identity, bedrooms, and kitchens: gated communities and new narratives of space in India. In: Heiman R, Freeman C, Liechty M (eds) The global middle classes: theorizing through ethnography. School for Advanced Research Press, Santa Fe, pp 57–85
Strang V (2004) The meaning of water. Berg, New York
Strengers Y (2010) Conceptualising everyday practices: composition, reproduction and change. RMIT, Melbourne
Swain A (1998) Reconciling disputes and treaties: water development and management in Ganga basin. Water Nepal 6(1):43–65
Swyngedouw E (2009) The political economy and political ecology of the hydro-social cycle. J Contemp Water Res Educ 142(1):56–60
Tiesch JB (2011) Engineering nature: water, development, and the global spread of American Environmental Expertise. The University of North Carolina Press, Chapel Hill
Truelove Y (2011) (Re-)Conceptualizing water inequality in Delhi, India through a feminist political ecology framework. Geoforum 42(2):143–152
Vaidyanathan A (2006) India's water resources: contemporary issues on irrigation. Oxford University Press, New Delhi
Warde A (2005) Consumption and theories of practice. J Consum Cult 5(2):131–153

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