

Burt, Z. and Ray, I. 2014. Storage and non-payment: Persistent informalities within the formal water supply of Hubli-Dharwad, India. *Water Alternatives* 7(1): 106-120



---

## **Storage and Non-Payment: Persistent Informalities within the Formal Water Supply of Hubli-Dharwad, India**

**Zachary Burt**

Energy and Resources Group, University of California at Berkeley, CA, USA; zzburt@gmail.com

**Isha Ray**

Energy and Resources Group, University of California at Berkeley, CA, USA; isharay@berkeley.edu

---

**ABSTRACT:** Urban water systems in Asia and Africa mostly provide intermittent rather than continuous water supplies; such systems compromise water quality and inconvenience the user. Starting in 2008, an upgrade to continuous (24/7) water services was provided for 10% of the twin cities of Hubli-Dharwad, India, through a process of privatisation and formalisation. The goals were to improve water quality, free consumers from collecting and storing water, and reduce non-revenue (i.e. unpaid for) water. Drawing on household surveys (n = 1986) conducted in 2010-2011 in the 24/7 zones, as well as on a range of interviews, we find that, even with 'formal' 24/7 water service, most consumers continue the supposedly 'informal' practices of in-home storage and water use without payment of bills. We argue that multiple unaccounted-for factors – including a history of distrust between the consumer and the utility, seemingly small infrastructural details, resistance to higher tariffs, and valuing convenience above water quality – have kept these informal practices embedded within the formalised delivery system. Our research contributes to understanding why formalisation may only partially supplant informal practices even when the formal system is functional and reliable.

**KEYWORDS:** Informality, water supply, drinking water storage, non-payment, quiet encroachment, continuous water supply, 24/7 water

---

### **INTRODUCTION**

Urban water supplies are commonly classified as formal versus informal. A formal system usually means piped delivery, at least partly treated, and regulated by a utility. An informal system usually implies a set of alternative water delivery mechanisms and practices largely unregulated by a state entity. In developed country cities, most consumers are served by the formal sector, but in the developing world, alternative means are the norm (UNDP, 2006). Historically, as piped and treated water systems have expanded to serve urban centres and their growing populations, the alternative mechanisms have gradually been supplanted. Developing country urban water supplies are being built or expanded with this same model in mind. The city planner's assumption seems to be that, as pipes get laid, water gets treated, services improve from intermittent to continuous supply, and billing and metering expand, fewer and fewer consumers will come to rely on neighbours' taps, vended water, street-corner hand pumps, storage containers and illicit connections.

In this paper, we examine the impacts of an expanding and increasingly formal piped water network on informal access practices. Our case study is a pilot project in Hubli-Dharwad, Karnataka, called the Karnataka Urban Water Services Improvement Project (KUWASIP). KUWASIP is a public-private partnership (PPP) with the stated goals of improving reliability, convenience, water quality and utility revenues. In common with most Indian cities, Hubli-Dharwad's piped system provides intermittent

rather than continuous water flows. The residents cope with intermittency using various means, including buying water from tankers, carrying water from public bore wells, storing water at home between supply periods, or constructing unauthorised connections for which they do not pay (see Bakker, 2003; Kumpel and Nelson, 2013). Since 2008, KUWASIP has regularised all household water connections and brought continuous water delivery to eight out of 67 wards in the twin cities of Hubli-Dharwad, covering 10% of all residents. Locally, this project is known as '24/7', since it provides water 24 hours a day, 7 days a week. KUWASIP's is a remarkable achievement; it marks one of India's first attempts to replicate the piped network standards typically found in developed countries.

We developed a survey instrument to understand the impact of KUWASIP's intervention at the household level. We conducted our survey in 2010-2011 with a random sample of households, all with children under five years of age ( $n = 1986$  households), from KUWASIP's eight demonstration wards. To compare the water use practices in the rest of the city with those of the 24/7 zones, we also surveyed households in the intermittent zones ( $n = 1951$ ). We wanted to know if increased water flows and regularization had indeed led to increased reliability and convenience, and had made the informal 'coping' practices of in-home storage and illicit piped water use redundant.<sup>1</sup> In other words, was the upgrade to 24/7 water supply living up to its *ex ante* expectations?

KUWASIP's project documentation argued that households that could access water from the formal 24/7 network would take full advantage of improved convenience, quality and reliability, and would be willing to pay for these amenities (World Bank, 2004). This does not match our observations in Hubli-Dharwad. We found that the informal (meaning, unregulated and outside the domain of the formal system) provision of convenience through in-home storage persists despite the improvements offered by the formal network. In fact, we saw the coexistence of the formal and informal not just at the neighbourhood scale, as described by Bakker (2003), but within the household itself. Multiple interacting factors – including distrust between the consumer and the utility, habits, valuing convenience above water quality and the seemingly small matter of where the household tap is located – have allowed storage to persist *even within a well-functioning piped system*.

We found that many households were happy with the continuous water service and willing to pay the increased rates that prevailed in the 24/7 zones. But we also found that a sizeable minority of households were not, in fact, paying, and were instead accruing rather large arrears. We suggest that non-payment for the recently regularized connections represents the "quiet encroachment of the ordinary" (Bayat, 2000: 545), whereby ordinary urban dwellers seek access to water and other resources through informal means. We argue that non-payment can be explained not only as resistance to higher tariffs, and as an (implicit) assertion of the right to water, but also by the unwillingness to let go of informal storage. To show how and why informal practices have remained embedded in Hubli-Dharwad's formalised and functioning water delivery system, we begin with a brief overview of the formal and the informal, in the urban studies literature more broadly, and in Hubli-Dharwad specifically.

### INFORMALITY AND URBAN WATER SUPPLY

The term 'informal' has eluded easy definition in the literature on urban politics and planning, as many of the papers in this volume confirm. Throughout the 1970s, when the concept of 'the informal sector' (see Hart, 1973) first emerged, it stood for unregulated urban activities, the boundary of the legal and the illegal, the unprotected, the makeshift, or simply casual economic activities undertaken by poor people. It generally implied the 'lack' of regulated activity or services with which the poor had to 'cope'

---

<sup>1</sup> We do not address the other major goal of the 24/7 upgrade in this paper, i.e. better water quality and thus improved child health. These impacts were studied by other members of our research team, and reported in Kumpel and Nelson (2013) and Ercumen (2014).

with. As early as 1978, Bromley argued that the dualism of formal/informal was inappropriate, but had gained traction because it seemed to offer safe policy choices for less-than-radical countries (Bromley, 1978). But the mainstream urban studies literature continued to treat 'the informal' as a catchall category that stood in opposition to a well-defined 'formal' (AlSayyad, 2004).

This binary conceptualisation, suggesting that informal service is everything that the formal is not, has been repeatedly challenged, and from multiple standpoints. Urban informality has been conceptualised as a set of spontaneous and entrepreneurial survival strategies pursued by the poor (de Soto, 2000); as a particular 'mode of urbanisation' in the modern city rather than as the absence of regulation (Roy and AlSayyad, 2004); or as a way for the poor to seek services and recognition on their own terms as opposed to on the terms of the urban elite (Appadurai, 2004). Following Foucault's (1972) concept of power as circulating or decentralised, the informal – and potentially extra-legal – activities of the urban poor have recently been re-conceptualised as resistance to the rule of the urban elite. In these works (e.g. Innes et al., 2007; Grigorovich, 2008) urban informality is considered as a mode of urban living, and not necessarily in a dichotomous relationship to a well-defined formal.

Informal practices with respect to urban water specifically have also been explained as resistance to prevailing power structures. Loftus (2006) frames non-payment, protests against flow-restricting technologies at the tap, and night-time plumbers who reconnect the disconnected in Durban, as forms of resistance to the power of the water meter and, by extension, of those who control it. In Tijuana, Mexico, Meehan (2013) reports that households continue to use "ordinary infrastructures" such as rainwater harvesting and grey-water barrels, despite a functioning municipal supply, in part to save money, but in part because the resident feels in control of the water that she herself collects and manages.

Walking a line between the passive coping and the active resistance paradigms, Bayat's model of the informal is that of the "quiet encroachment of the ordinary" (Bayat, 2000), through which the urban poor, without noise and fury, go about the business of acquiring land, or bypassing regularised channels for urban services. He observes that "many poor people tap electricity and running water illegally from the municipality despite their awareness of their illegal behaviour" (ibid: 543). Kudva (2009), in a study of Delhi and Ahmedabad, builds on this concept to argue that such everyday resistance continues even when 'punctuated' by periodic expulsion from the system. Access through quiet encroachment may also be enabled – at a price – by the locally powerful or politically affiliated, resulting in the sort of 'informal formalisation' observed in Dhaka's slums (Hackenbroch and Hossain, 2012).

In this study of Hubli-Dharwad, we borrow Bayat's understanding of informality-as-encroachment to explain access to municipal water without payment. Many low- to middle-income residents with registered private taps rely on municipal water but do not pay their bills (Times of India, 2012b). Access to the municipal network itself may be illicit; pipes are hacked, and the resulting holes are connected to taps or simply plugged up using rags and tape. Non-registered connections are also an example of access by stealth (though they are stealthy only with respect to the utility: our study households made no attempt to obscure the holes hacked into the municipal pipes). Despite Bayat's claim that quiet encroachers take from powerful institutions and not from their fellow disenfranchised, a hole in a pipe will, in fact, reduce the neighbourhood's water pressure and cause the potential infiltration of polluted water. We therefore argue that, in the case of an urban water system, 'quiet encroachment' modes of access do impose direct costs on the poor, though the intent may be to take only from the state or private company.

These nuanced approaches to defining the informal and the work of informality have not been mainstreamed into urban water policy and planning. It is well known that most urban residents in developing countries are not served by piped and pressurised water systems, and these systems may not be feasible for all under current water policies (e.g. Bakker and Kooy, 2008). A hybrid mixture of vended, public, negotiated, illicit and self-provisioned sources remains the only option for the politically

and geographically marginalised (e.g. Crane, 1994; Kjéllen, 2000; Swyngedouw, 2004; Conan, 2005; Schaub-Jones, 2008; Ranganathan et al., 2009; Kacker and Joshi, 2012). Yet such systems are routinely considered prerequisites of modern urban life, as Bakker (2003) points out. The urban planning literature, while accepting the need for informal water suppliers where the utilities cannot (or, less openly admitted), do not want to go, treats these mechanisms as interim options, en route to, one day, piped water supply from a utility.

Bakker (2003) describes the reality of water provision in developing countries as a mix of overlapping strategies rather than as a linear transition from artisanal, community-based modes of provision (e.g. public wells or vendors) to more industrial and corporate forms (e.g. centralised, treated, piped water networks). A city develops 'archipelagos' of formal service; Bakker argues that the formal and the informal coexist because the formal system is spatially uneven, and that, where industrialisation levels are low, informal modes of water access will prevail. In this paper, 'formalisation' of water provision includes expanding the piped network, improving the network so that it allows for continuous water supply, enhancing water quality, registering new (or existing but unregistered) customers and fencing off artisanal sources.

In the twin cities of Hubli-Dharwad we find that, even where the water flows through the piped network into the customers' taps, the formal and the informal continue to coexist. Our household survey in the 24/7 KUWASIP-served zones showed that most residents continue to store water, a classically 'informal' practice common to neighbourhoods with no piped, or only intermittent piped, supply. Through our detailed study of in-home water storage and non-payment of water bills, we analyse how and why this particular formalisation project has succeeded, but has also remained incomplete.

#### **MUNICIPAL WATER IN HUBLI-DHARWAD: INCREASING FORMALISATION BUT CONTINUED INTERMITTENCY**

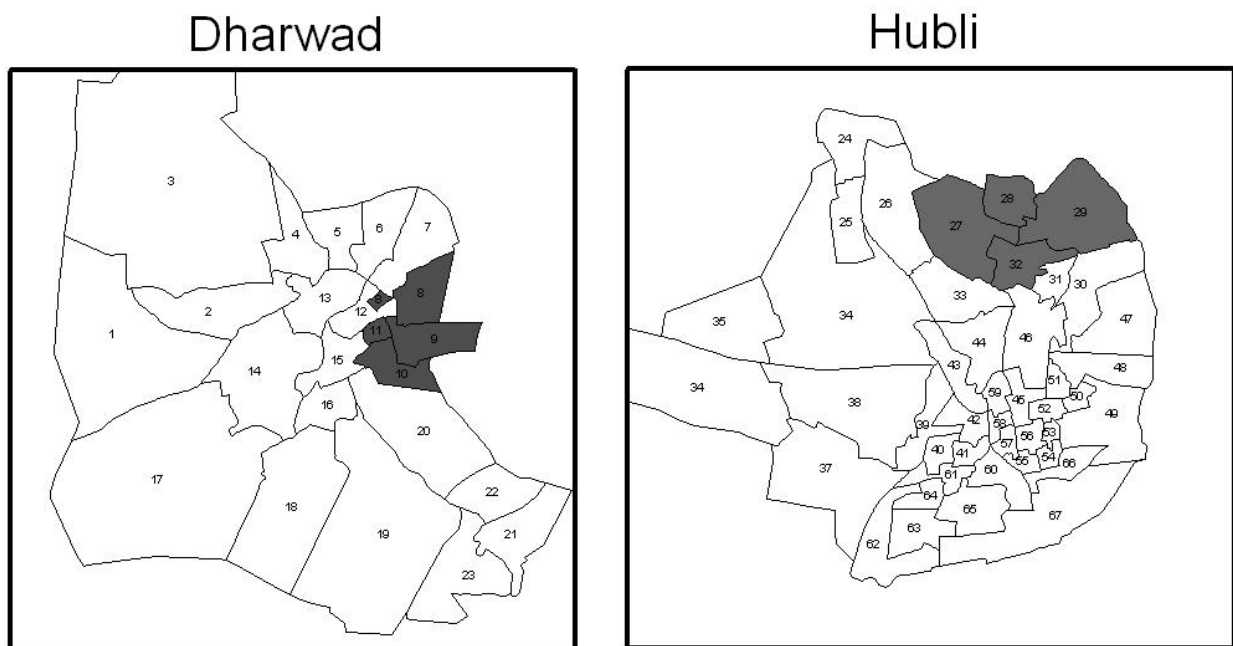
The city centres of Hubli and Dharwad are separated by a mere 20 kilometres. The twin cities have a combined population second only to Bangalore among cities in Karnataka; the 2011 census estimated that a population of nearly a million lives in Hubli-Dharwad. The cities source almost all their municipal piped water from the Malaprabha River and the Neer Sagar Lake. The water system has a design capacity of 130 MLD (million litres per day), but after leakages, supplies approximately 70 MLD to consumers (Wilbur Smith Associates Pvt., 2004). The current piped water network was initiated in 1956, and provided a continuous water supply for the urban population of that time (Wilbur Smith Associates Pvt, 2003). As urbanisation increased, the cities slowly outgrew their water system, resulting in intermittent water delivery. Tariffs did not cover the costs of operations and maintenance (O&M), nor allow for adequate expansion of the piped network. A volumetric rate was adopted in 1996 for the minority of houses that were metered, but all other registered connections continued to pay a monthly flat rate (World Bank, 2004). By 2001-02 collected revenues covered only 19% of O&M costs (World Bank, 2004), and illegitimate (i.e. informal) connections had become commonplace in low-income areas.

Daily deliveries eventually became weekly deliveries and, at the height of scarcity during the dry seasons of 2001 and 2002, regular deliveries occurred only once every 12-15 days (Times of India, 2002a; WSP, 2010). This fomented massive outrage among residents. Bayat's quiet encroachment is normally a series of individual acts, shunning collective demand-making in pursuit of shared goals. He argues, however, that these same quiet masses may take to the streets, if their hard-won gains are threatened, or as part of a "general expression of popular discontent" (ibid: 548). In this instance, not long before he was replaced, the Chief Executive Engineer of the Hubli-Dharwad Municipal Corporation (HDMC) was brought out of his office and tied to a pole as part of a public shaming executed by mobs of angry residents (personal correspondence). This reaction at the failure of the government-run utility established the power of the insurgent masses and has not been forgotten.

Figure 1. Map of India, indicating the location of Karnataka State and Hubli-Dharwad city (adapted from Wikipedia).



Figure 2. Maps of Hubli and Dharwad.



Note: Ward boundaries are shown; the 24/7 wards are shaded. Wards lying between the two city centres have been omitted.

In order to quell angry residents the Water Resources Minister announced on March 17, 2002, that the frequency of water delivery would be increased to once in five days by March 30 (Times of India, 2002a). By April of that year, HDMC officials admitted that once in five days would not be feasible but that once a week was "possible" (Times of India, 2002b). On April 1 2003, the HDMC had to hand over all O&M of the water system to the Karnataka Urban Water Supply and Sewerage Board (KUWSSB), a state-level rather than a city-level body (Times of India, 2003b). Almost immediately, the KUWSSB began investing in infrastructure, advocating for a tariff increase and crafting a programme for the regularisation of illicit connections. The HDMC still owned the water rights, was ultimately responsible

for all costs incurred, and had the right to approve or deny any changes in tariffs. But it was the KUWSSB that was charged with increasing revenues and improving services.

Change was gradual, but, as of 2005, water was being delivered once every six days, and tariffs, although still low, had been doubled. The flat residential rate per month went from Rs 45 (US\$ 0.82) to Rs 90 (US\$ 1.64) in 2007, which is where it stands today (The Hindu, 2005a; Sangameswaran et al., 2008). By 2011 approximately 70% of registered connections had been put on meters (The Hindu, 2005b, 2011b). The bill collection rate started to rise, and investments in infrastructure enabled improved water delivery frequencies (The Times of India, 2003b; World Bank, 2004; QualityTonnes, 2004). Overall, formalisation increased with the changes made by KUWSSB; as a result, water deliveries improved and tariffs went up, although the municipal water supply remained intermittent. Throughout the slow decline as well as the incremental improvements, households adapted to the shifting levels of service through a myriad ways.

Intermittent water deliveries mean that households have to collect, store and (possibly) treat their water, and these options vary greatly in terms of investment cost, time requirements, storage capacity and water quality. Informal methods of creating continuous, or at least more reliable, water access abound in Hubli-Dharwad. Following Woelfle-Erskine's (2012) typology of water access and coping mechanisms, our own research team found that water access could be roughly characterised into three types: 1) shared public taps, 2) private taps but no overhead storage tanks, and 3) both private taps and overhead tanks. The most inconvenient mechanisms, shared standpipes, used either by a small or a large number of families, are observed only in low-income neighbourhoods. Households with a private tap (legitimate or not) but no overhead tank correspond with the better-off low-income households, as well as some middle-income households. Overhead tanks allow for the most convenient forms of access, mimicking continuous piped water, and are available almost exclusively to upper income households. In all these cases, collection and storage for the sake of reliability and ease of access are informal services provided from within the household.

In 2004, the Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC) estimated that 45% of households had a registered private connection, and 25% of households accessed municipal water from a public standpipe (World Bank, 2004: 92). Figure 2 shows the number of households that we observed in the intermittent areas of our study in each of these three water access types, separated by wealth category. All three types span the median level of wealth found in Hubli-Dharwad, but a rough correlation exists between wealth and improved convenience of water access.

Table 1. Water access type by percentage of population and wealth category, Hubli-Dharwad (Intermittent Water Supply Zones).

	Shared standpipe	Private tap	Private tap with overhead tank	All access types
Below median wealth	9.8%	82.1%	8.1%	100%
Above median wealth	2.9%	37.6%	59.6%	100%

Adaptations to the decline of piped water services were not restricted to licit measures. Our survey data from the intermittent areas (i.e. areas of the city not in the 24/7 zones) indicated that approximately 10% of households had some form of private piped water access for which they did not pay a connection fee and do not pay any monthly charges. The use of these (mostly) illegitimate connections is also correlated with income; in our survey 16% of below median income households, but only 5% of above median households, used such connections.

In March 2003, the World Bank came to visit the HDMC to discuss large-scale water investments. The Initial Project Information Document for the Karnataka Urban Water Supply Improvement Project (KUWASIP) was approved the following January. The project was to provide 24/7 water in place of intermittent supply in demonstration zones, covering 5-10% of the population, in three cities of northern Karnataka: Gulbarga, Belgaum and Hubli-Dharwad. KUWASIP is a PPP, implemented in concert with the KUIDFC (a parastatal) and the KUWSSB, the state agency managing the local water utility. Based on its competitive bid, Veolia Water, a division of Veolia Environnement (France), was awarded the management and maintenance contract for two years (WSP, 2010).

The 24/7 zones were set up in four contiguous wards of Hubli and four more in Dharwad; the wards were chosen based on the ease with which they might be hydraulically isolated from the rest of the piped water network. According to the KUIDFC, these zones, when taken together, cut across all income groups (Wilbur Smith Associates Pvt., 2003). Our research team walked extensively in the 24/7 zone wards in order to create detailed maps of the areas to be sampled, and visually verified that low, middle and high-income neighbourhoods seemed to be well represented in the 24/7 zones.

In the official Project Appraisal Document, the World Bank stated that providing continuous (24/7), instead of intermittent, water was done with many goals in mind, including improved water quality, time-savings for residents who otherwise have to collect and store water, and cost recovery for the utility (World Bank, 2004). Local advocacy groups protested what they saw as a move towards privatisation, citing a lack of transparency and a loss of control over setting the tariff structure (Sangameswaran et al., 2008). Some residents worried that involving the private sector would reduce access for the poor who would not be able to afford the increased tariffs. Others argued that a private company might provide improved services, a highly desirable outcome. Sangameswaran et al. (2008: 63) report that:

there were people (usually those with adequate storage facilities and/or access to groundwater) who said that the board's supply (...) was more than enough; others welcomed 24/7 since it would eliminate the need to store water. Some slum-dwellers (...) felt that the implementation of 24/7 was in response to their demands for more regular water, since the poor stand to lose the most (in terms of time and wages foregone) when water is irregular and intermittent.

This observation shows the stress faced by low-income storers, who literally have to babysit their taps, versus the near-continuous supply that the higher-income storers can self-provide (see Woelfle-Erskine, 2012).

KUWASIP sought to change the terms of agreement between the municipal corporation and residents by promising "international standards", and by encouraging water users to treat their water as a commercial product and think of themselves as water consumers. The project aimed to make all connections within the 24/7 zones formal, improve reliability, and foster the development of "autonomous, customer responsive and commercially-oriented utilities, including effective public-private partnerships" (World Bank, 2004: 3). Stated goals of the pilot also included streamlined revenue collection, minimisation of leaks within the network and elimination of public, and hitherto free, standpipes. All of these efforts were ultimately aimed at decreased non-revenue water and therefore improvement in the utility's ability to cover the cost of service.

Protests against the municipal water system continued under KUWASIP. The original tariff structure proposed for the pilot project areas had to be revised due to public objections to the steep increase in rates. When the revised tariff structure was agreed upon, it was made retroactive, and those customers in the pilot zones that had bills in excess of Rs 200 between January 1 2008 and June 30 2009 received a refund (Times of India, 2009). The final domestic tariff structure had a minimum charge of Rs 48 for up to 8 kilolitres (kl) of water per household per month, rising at increasing volumetric rates to Rs 20/kl for each kilolitre per month above 25.

Our surveys in the 24/7 wards showed that service through the formal network has remained almost uninterrupted in the demonstration zones since the launch of operations. Nearly all households with formerly illegitimate connections have been regularised and given meters, and are now receiving monthly bills. At the same time, access to public water sources, which provided low-quality but free water in the 24/7 zones, has been greatly reduced. All 84 hand-pumps, an unspecified number of the 110 motorised bore wells, and all 115 public stand-posts are now closed. Unkal Lake, the largest surface water body within Hubli's city limits, once freely available for non-potable uses and for domestic buffalos, has been fenced off. Access to this 'recreational area' now requires a nominal fee.

Overall, KUWASIP has achieved significant successes with respect to the goals of the 24/7 project. Yet formalisation remains incomplete: our study finds that the creation of continuous, reliable water access for all has not ended informal storage practices, and that regular metering and billing have not led to all customers paying the utility. Informal practices remain tenaciously entrenched, despite 24/7's "international standards".

## **METHODS**

We surveyed 1986 households located in the eight wards of Hubli-Dharwad receiving 24/7 water service in 2010-2012. This household survey was part of a larger project aiming to make a comprehensive assessment of the impacts of KUWASIP in Hubli-Dharwad, evaluating health, water quality as well as household finances and willingness-to-pay for improved water services. We extensively piloted the survey instrument in order to ensure that it reflected the specific ways in which people used water in Hubli-Dharwad. We also collected information on the socio-economic status (SES) and demographic characteristics of all households. In this paper, we extracted our observations concerning SES, storage and non-payment from that larger, comprehensive data set.

We divided each of the eight wards into clusters, i.e. zones within the ward that displayed homogeneous economic and demographic make-up (determined qualitatively by visual inspection), and separated from other zones through roads, fields or other physical barriers. We attempted to enroll 250 participants from each ward; the number of participants enrolled in each cluster was determined based on the population density of the cluster in order to obtain a representative sample of the ward. We took GPS coordinates for all houses and checked to make sure that the participating households were spatially spread throughout the study wards. A subset of these houses ( $n = 350$ ), sampled systematically, participated in a longer survey that included measurement of the height and diameter of all of their storage containers. We conducted this container survey in order to estimate the types and volumes of containers that were in regular use. We used these volume data in our analysis of storage in 24/7 households.

In order to compare the impacts of KUWASIP's intervention, we conducted a very similar household survey in the intermittent areas of Hubli-Dharwad ( $n = 1951$ ). These households were selected in order to control for known confounders using a quasi-experimental approach called genetic matching (Sekhon and Grieve, 2009). In this paper, our analysis focuses on storage and non-payment within the 24/7 areas; we use information from the intermittent zone survey to contextualise water access in Hubli-Dharwad more generally. We followed up the survey data with open-ended interviews with a small subset of 24/7 households, in order to understand the reasons for the behaviours reported in the household survey.

## **THE PERSISTENCE OF THE INFORMAL IN 'FORMAL' HUBLI-DHARWAD**

Registering water connections, removing free standpipes, shutting down public bore wells, metering, and the timely issuance of monthly water bills were all part of the 24/7 process and they each contributed to the increase in revenues collected by the utility. But in Hubli-Dharwad, "overlapping



strategies" (Bakker, 2003) and "quiet encroachment" (Bayat, 2000) persist, in the form of storage and non-payment, even *within* the service areas of the functional and reliable formal water delivery system.

### The continuation of storage

Other than price, the four significant aspects of water supply that determine a customer's satisfaction, and possibly willingness to pay, are quantity, quality, convenience and reliability. 'Convenience' means a reasonable hour of delivery (for example, 7 a.m. was a good time for many of our survey respondents), low effort expended during collection, and water easily within reach when the household needs it. 'Reliability' means both knowing when the water will arrive and knowing that the household will not run out between arrivals. Formalisation often aims to improve water services along all four dimensions but may or may not do so. When KUWSSB took over operations in Hubli-Dharwad, it increased the quantity available and decreased the time it took to collect water. But it did not improve the convenience of the hour of delivery – water users had no choice. Nor did it improve the reliability of delivery: people sometimes had to wait hours for the water to arrive, and were unsure of when it would arrive next. In this situation, all households stored water. At the point of delivery, therefore, water access crossed over from a service provided by a formal network to a service created through what the literature calls a 'coping mechanism'. Although in many cases formal services did enter the home by way of a private tap, until KUWASIP began its 24/7 pilot those services did not include the reliability of water.

Our household survey shows that, with 24/7, the quantity, convenience and reliability of water supplies have measurably improved. The quality of water at the tap has also improved (Kumpel and Nelson, 2013). But the vast majority of our survey respondents in the pilot zones – over 90% – continued to collect and store water almost two years after the upgrade to continuous water service. On average, they spent just over 7 hours per month collecting this water; we observed that households collected and stored their drinking and cooking water on average once every 1.5 days. Our research team measured stored volumes in a systematic sample (n = 350) of the households surveyed in the 24/7 zone. The volumes of actively used storage capacity varied tremendously. The median total volume stored was over 100 litres. Discounting the water stored in overhead and underground tanks, the median volume in containers was still above 50 litres per household (see Table 2).

Table 2. Storage volume in regular use; 24/7 water supply zone, Hubli-Dharwad.

	Total (litres)	Overhead and underground tanks (litres)	Smaller containers (litres)
Mean storage volume	425	968	203
Median storage volume	133	667	74
n =	350	80	350

The continuation of storage within a continuous pressure supply zone surprised us; storage is supposed to fill a 'gap' in an intermittent or unreliable water supply mechanism. In-home storage also increases the risk of re-contamination in the home (Clasen and Bastable, 2003), a problem that continuous water supply seeks to overcome. We initially hypothesised that KUWASIP's implementation was imperfect, and that the allegedly 24/7 zones were, in fact, not so. But our interviews of customers did not bear this out. That they invested any time at all in collecting water was itself an indication that they valued stored water. Those who continued to store produced a range of reasons, including "it is a habit"; "this is how we use water"; and "it is a back-up, just in case". Discussions with household members revealed that people have grown accustomed to collecting and storing water. Those with rooftop tanks saw no

reason to change their overhead storage practices; they had, in effect, provided themselves with 24/7 water. Those with buckets and pots suggested that as long as water is delivered punctually every day, or even every other day, they do not mind storing. In effect, these consumers choose this informal practice over the formal alternative.

In addition to user habits, we posit that user convenience is also a partial explanation for continued storage practices. In the course of our many household visits, we observed that the household tap is most often not inside the kitchen, but just outside the home or a few feet away from the home. Even a very short walk to water, no more than a few seconds long, was inconvenient relative to storage vessels in the kitchen. Behavioural economists have argued for some years that "small hassle factors" (Bertrand et al., 2006: 16) routinely dissuade people from programme take-up, and that economists often consider these factors to be "too minor to be taken seriously" (ibid: 16). Storing in the home is itself a hassle, but the World Bank and KUWASIP, in arguing that "24/7 supply converts household coping costs into resources for the service provider" (WSP, 2010: 4), may not have foreseen that stepping outside the front door for water could be seen as an even bigger hassle by a majority of its customers. What our respondents cared about was that the water be delivered on time so they did not have to wait, and to have water right at the point of use so they did not have to walk.

Finally, the image of an incompetent utility was still vivid in people's minds. Several respondents told the lead author that they stored because they feared that one day they would turn on the tap and no water would come out. When pushed to recall an incident of tap failure, they readily admitted that the 24/7 tap had never, in fact, failed to yield water. They agreed that they could not complain about water deliveries in the two years since KUWASIP began operations, but those years had not eclipsed their memory of decades of intermittent water supply.

We conclude that the informal provision, not of access but of convenient and reliable access, within an otherwise formalised (and, by all accounts, smoothly functioning) water network persists for three reasons: the utility has yet to build up enough trust between itself and its customers; consumers are habituated to storing water and, at least for now, are not motivated to change; and the utility failed to see 'convenience' through its users' eyes, implicitly assuming that a continuously yielding outside tap was less of a hassle than an intermittent tap with storage containers in the kitchen. We thus find that formal and informal processes coexist, not only just across spatially differentiated delivery mechanisms but also within a single water delivery mechanism. In this sense, Bakker's archipelago is extended into the home: it reaches between the pipe and the storage vessel and climbs into the upper reaches of the roof tank.

### **The continuation of non-payment**

KUWASIP has, in the main, eliminated illicit connections within the demonstration zones, metered all connections, billed water users for 83% of all water produced and issued charges for 96% of all water supplied (World Bank, Completion and Results Report, 2011: 33). KUWASIP had set an objective of billing 70% of all water produced; its performance represents an instance where the pre-project objectives were met and exceeded. But not all those receiving bills are paying them, and issuing charges is not the same as collecting them. Although Gulbarga 'decoupled' old arrears and started their KUWASIP tariff collections by zeroing out all past due amounts, Hubli-Dharwad has chosen to carry old arrears forward. According to an article in the Times of India (2012a), as of May 2012, more than 1500 households in Hubli-Dharwad have received bills for arrears of Rs15,000 – Rs20,000 each (US\$273-455). Such large amounts owed in arrears could only have been accrued over a period of several years.

Our survey in the 24/7 zones confirmed the Times of India report that many households owed the utility significant sums of money. Of the 1986 households that completed the survey, 86% reported receiving a water bill in the past month and 59% of them showed us their bills. Of the bills we were allowed to see, the median arrears amount was Rs213 (US\$3.74), about equivalent to the average

monthly bill. But 34% had arrears above Rs1000 (US\$18) and 5% owed over Rs10,000 (US\$180). We labelled arrears that had accumulated over a period of six months or more as 'large'. The households who owed more than six months' worth of arrears came from all income groups, but low-income households dominated. Since reported income is notoriously unreliable, and the variation for this parameter in our survey data was large, following Ercumen (2013), we also categorised our respondents by wealth. In households that showed us their bill and owed less than six months in arrears ( $n = 618$ ), the average per capita monthly reported income was Rs1621, while in households that owed more than six months in arrears ( $n = 373$ ) this amount dropped to Rs1091. Likewise, asset ownership is markedly different across these two groups: those with low arrears were significantly more likely to own tables (which require dedicated floor space and thus indicate a minimum floor size), refrigerators, and motorcycles as compared to the households with high arrears. Table 3 shows that large amounts of arrears occurred disproportionately in households with below median wealth.

Table 3. Number of households with large arrears (24/7 areas only).

	Number of observed water bills		Reported income per capita	
	Below median wealth	Above median wealth	Median	Mean
Arrears < 6 months of charges	849	1191	1000	1621
Arrears > 6 months of charges	724	524	755	1091

Our data may underestimate the actual numbers who owed money because 40% of our respondents refused to show us their water bills. Many lower-income household members said that 24/7 was a clear benefit over water that arrived once every few days, but that the high water tariffs were burdensome. When the monthly bill went from Rs90 to over Rs300, it was too much, said one respondent by way of explanation. She did not need 24/7 water at that high price, she argued; water for 4 hours every other day and at a lower cost was fine for her family's needs. She did not want a tap that would yield water even at midnight because why would anyone wish to turn on the tap at midnight? In effect, she argued, she was 'stuck' with 24/7, unable to control children and non-earning family members from running the tap for trivial reasons and wasting water, for which she, one of only two members earning an income, was then forced to pay the bill.

Such narratives, in effect a form of justification for being unwilling to pay, are completely consistent with Bayat's analysis of quiet encroachment within a formal service system. They are also consistent with our previous observation that many 24/7 customers are willing to self-provide convenience, at least up to a point. While KUWASIP is focused on continuous access, citing quantity, quality, reliability and convenience, some their customers value the frequency and reliability of delivery over quality and continuousness per se. If, for reasons of habit or trust or convenience or some combination of these, households plan to store water anyway, they would understandably not wish to pay the full charge for 24/7 service. The World Bank's Project Appraisal Document (World Bank, 2004: 50), arguing for the benefits of continuous service to consumers, says: "[a]ssuming that coping costs to supplement water needs will be *fully offset* by the introduction of 24/7 service, the NPV<sup>2</sup> would be Rs25.7 million and the IRR 14%" (emphasis added). But we find that consumers may not value fully offsetting their 'coping costs'.

<sup>2</sup> NPV stands for net present value.

On April 30 2012 KUWSSB declared that it would start to shut off connections for accounts in Hubli that owed excessive arrears (Webindia, 12/3/2012; Times of India, 2012a). In response, as Bayat would have predicted, a massive protest in Dharwad was held on May 14 2012 (Times of India, 2012a). Despite connections having been formalised, or more accurately, perhaps, because of it, the quiet encroachment of the individual suddenly needed to be collectively defended. While many water users who previously had illicit connections were now paying customers, well integrated into an upgraded water distribution system, and other previously informal users simply became non-paying customers within the demonstration zones. As long as the formal system did not distinguish between an illicit water user and a non-paying customer, there was no need for insurgency. But the threat of losing water access or having to pay substantial sums of money to the utility moved many to noisy action. We find that the quiet encroachment of the past continues in this regime of increased formalisation, despite streamlined metering, billing and payment options, and that public outcry remains a constant threat.

The negotiation about what to do with customers who have large outstanding arrears is still ongoing. If non-paying customers remain connected to the system, the utility may not be able to recover its operating costs, and currently paying customers may be tempted to stop paying. But, given the polarisation caused by private sector participation in the 24/7 project, KUWSSB cannot simply cut people off without political fallout. These households would now be worse off than they were before KUWASIP came, given that free public water access has been all but eliminated.

Bayat (2000: 549) notes that the poor may make efforts to stay outside of the formal network simply because formalisation can require them to conform to more rigid requirements:

modernity is a costly affair (...) it requires the capacity to conform to the types of behavior and mode of life (adherence to the strict disciplines of time, space, contracts and so on) which most vulnerable people simply cannot afford. (...) In their quest for security, the poor then are in constant negotiation and vacillation between autonomy and integration.

Our work in Hubli-Dharwad does not suggest that the poor are deliberately trying to stay outside of the formal water system. We find that many would prefer to conform to a mode of life in which water supplies are regular, predictable and 'modern'. No respondent in the 24/7 zone preferred the autonomy of fetching water from a public bore well to the integration of a municipal tap in the yard. But 24/7, with both its predictability and higher tariffs, has fragmented its customers, low-income or otherwise. Some respondents told us that having 24/7 water is like an addiction and that they can no longer go without its convenience. Those were not among the non-payers in our survey. But the specific mode of formalisation has made the 'last mile' provision of reliability, convenience and affordability an in-house step for others – reliability and convenience through continued storage, and affordability through quiet encroachment punctuated by mass protest when the right to affordable water is under threat.

## CONCLUSIONS

The formalisation process in Hubli-Dharwad during KUWASIP's 24/7 implementation improved water quantity, water quality, and reliability for the consumer, and the balance sheet for the utility – all positive outcomes in this case. As predicted by the World Bank and KUWASIP, many consumers have been willing to pay higher water charges to be freed from the drudgery of waiting for and collecting water. But the 24/7 effort has not accomplished the degree of formalisation envisioned at the start. Home-storing is still a widespread practice and quiet encroachment continues through non-payment of bills. Storing water and accessing water without paying are classical forms of urban informality. We argue that the persistence of these informal forms of water access suggests that

- a) convenience is defined by the experience of the water user; understanding that household-level infrastructure may lead to 'small hassles' is a key part of the project's cost-benefit analysis;

- b) water users place a high value on convenience and affordability relative to other dimensions of water service such as water quality or continuous availability; and
- c) developing trust between water users and providers is necessary, although perhaps not sufficient, for the reduction of 'overlapping strategies' and, relatedly, of non-payment.

We find that storage in Hubli-Dharwad continues for the same reasons it always did: to create reliability and convenience. The persistence of storage within a formal, well-performing water delivery system shows that industrialised and corporatised water (cf. Bakker, 2003) need not supplant informal processes. We find that non-payment continues for the same reasons it always did: lower-income customers find it difficult to pay, especially when in default, and stealthily protect their access to water. Additionally, if people are going to store water anyway, they may not value, and thus not wish to pay for, all the features of 24/7 delivery.

We conclude that there may be limits to the extent of formalisation – i.e. there may be some 'slack' for a considerable period of time – in a city transitioning from intermittent to continuous water supply. These limits depend on consumer habits, consumer values, the history of a city's water supply and accidents of infrastructure. Two years from the launch of 24/7 water supply, informal methods for creating convenient access persist, and many non-paying customers remain in Hubli-Dharwad. Despite formalisation, capital upgrades, the introduction of international actors, and the aspiration to international standards, many residents are quietly accessing water outside formal channels.

#### ACKNOWLEDGEMENTS

We are grateful to Ayşe Ercumen and Emily Kumpel, who, along with Zachary Burt, led the survey data collection in Hubli-Dharwad; Narayan Billava and Madhu Reddy for excellent research assistance during the data collection period; Kara Nelson, the ERG Water Group, and the participants at the 'Informal Space in the Urban Waterscape' Conference at the UNESCO-IHE, Delft, for useful discussions; and the guest editors and anonymous reviewers for their clarifying comments and suggestions.

#### REFERENCES

- AlSayyad, N. 2004. Urban informality as a 'new' way of life. In Roy, A. and AlSayyad, N. (Eds), *Urban informality: Transnational perspectives from the Middle East, Latin America, and South Asia*, pp. 7-30. Lanham, MD: Lexington Books.
- Appadurai, A. 2001. Deep democracy: Urban governmentality and the horizon of politics. *Environment & Urbanization* 13(2): 123-43.
- Bakker, K. 2003. Archipelagos and networks: Urbanization and water privatization in the South. *The Geographical Journal* 169(4): 328-341.
- Bakker, K.; Kooy, M.; Shofiani, N.E. and Martijn, E.-J. 2008. Governance failure: Rethinking the institutional dimensions of urban water supply to poor households. *World Development* 36(10): 1891-1915.
- Bayat, A. 2000. From 'dangerous classes' to 'quiet rebels': The politics of the urban subaltern in the Global South. *International Sociology* 15(3): 533-57.
- Bertrand, M.; Mullainathan, S. and Shafir, E. 2006. Behavioral economics and marketing in aid of decision making among the poor. *Journal of Public Policy & Marketing* 25(1): 8-23.
- Bromley, R. 1978. The urban informal sector: Why is it worth discussing? *World Development* 6(9): 1033-1039.
- Centre for Monitoring Indian Economy Pvt Ltd. 2012. *Karnataka GSDP*. <http://statesofindia.cmie.com> (accessed 25 January 2013)
- Clasen, T. and Bastable, A. 2003. Faecal contamination of drinking water during collection. *Journal of Water and Health* 1(3): 109-115.
- CMDR (Center for Multi-Disciplinary Development Research). 2006. *Socio economic survey of Hubli Dharwad city*. Technical Report. Dharwad.

- Conan, H. 2005. *Small piped water networks: Helping local entrepreneurs to invest*. Manila: The Asian Development Bank.
- Crane, R. 1994. Water markets, market reform and the urban poor: Results from Jakarta, Indonesia. *World Development* 22(1): 71-83.
- De Soto, H. 2000. *The mystery of capital. Why capitalism triumphs in the West and fails everywhere else*. New York: Basic Books.
- Ercumen, A. 2014. Drinking water quality and child health in south Asia: The role of secondary contamination. PhD thesis. UC Berkeley: Department of Public Health.
- Foucault, M. 1972. *Knowledge/Power*. New York: Pantheon Books.
- Government of India Planning Commission. 2012. *Press note on poverty estimates 2009-2010*. New Delhi.
- Grigorovich, J. 2008. Informality and autonomy in the slums of the developing world. *Undercurrent Journal* 5(3): 20-29.
- Hackenbroch, K. and Hossain, S. 2012. The organised encroachment of the powerful: Everyday practices of public space and water supply in Dhaka, Bangladesh. *Planning Theory and Practice* 13(3): 397-420.
- Hart, K. 1973. Informal income opportunities and urban employment in Ghana. *Modern African Studies* 11(1): 61-89.
- Hubli-Dharwad Municipal Corporation. 2012. Hubli-Dharwad One Homepage: [www.karnatakaone.gov.in/HubliDharwad/HubliDharwadOneHome.aspx](http://www.karnatakaone.gov.in/HubliDharwad/HubliDharwadOneHome.aspx) (accessed 10 November 2012)
- Innes, J.; Connick, S. and Booher, D. 2007. Informality as a planning strategy. *Journal of the American Planning Association* 73(2): 195-210.
- Kacker, S. and Joshi, A. 2012. In the pipeline: From clientelism to customer service the governance of urban water supply in informal settlements. Paper presented at the Sixth Urban Research and Knowledge Symposium 2012, Barcelona.
- Kjéllen, M. 2000. Complementary water systems in Dar es Salaam, Tanzania: The case of water vending. *International Journal of Water Resources Development* 16(1): 143-154.
- Kudva, N. 2009. The everyday and the episodic: The spatial and political impacts of urban informality. *Environment and Planning A* 41(7): 1614-1628.
- Kumpel, E. and Nelson, K.L. 2013. Comparing microbial water quality in an intermittent and continuous piped water supply. *Water Research* 47(14): 5176-5188.
- Loftus, A. 2006. Reification and the dictatorship of the water meter. *Antipode*. 38(5): 1023-1044.
- Meehan, K. 2013. Tool-power: Water infrastructures as wellsprings of state power. *Geoforum* <http://dx.doi.org/10.1016/j.geoforum.2013.08.005> (accessed 22 December 2013) (in press).
- QualityTonnes. 2004. *Energy efficiency improvements in municipal water utilities in Karnataka, India*. [http://cdm.unfccc.int/filestorage/P/C/O/PCOM\\_177688515670180466/PDD%20Resubmission%2021.05.04.pdf?t=SWV8bXpzNG81fDCnKyD-Q\\_4S0SNv4mTWMhDo](http://cdm.unfccc.int/filestorage/P/C/O/PCOM_177688515670180466/PDD%20Resubmission%2021.05.04.pdf?t=SWV8bXpzNG81fDCnKyD-Q_4S0SNv4mTWMhDo) (accessed 22 December 2013)
- Ranganathan, M.; Kamath, L. and Baindur, V. 2009. Piped water supply to greater Bangalore: Putting the cart before the horse? *Economic and Political Weekly* XLIV(33): 53-62.
- Roy, A. and AlSayyad, N. (Eds). 2004. *Urban informality: Transnational perspectives from the Middle East, Latin America, and South Asia*. Lanham, MD: Lexington Books.
- Sangameswaran, P.; Madhav, R. and D'Rozario, C. 2008. 24/7, 'privatisation' and water reform: Insights from Hubli-Dharwad. *Economic and Political Weekly* April XLIII(5): 60-67.
- Schaub-Jones, D. 2008. Harnessing entrepreneurship in the water sector: Expanding water services through independent network operators. *Waterlines* 27(4).
- Sekhon, J. and Grieve, R. 2009. A nonparametric matching method for covariate adjustment with application to economic evaluation. Working Paper. [http://sekhon.berkeley.edu/papers/GeneticMatching\\_SekhonGrieve.pdf](http://sekhon.berkeley.edu/papers/GeneticMatching_SekhonGrieve.pdf) (accessed 22 December 2013)
- Solo, T.M. 1999. Small-scale entrepreneurs in the urban water and sanitation market. *Environment and Urbanization* 11(1): 117-131.

- Swyngedouw, E. 2004. *Flows of power: The political ecology of water and urbanisation in Ecuador*. Oxford: Oxford University Press.
- The Hindu. 2004. *Hubli-Dharwad to get water once in five days*. 3 August 2004.
- The Hindu. 2005a. *Water cess likely to go up*. 5 June 2005.
- The Hindu. 2005b. *Water meters compulsory*. 19 October 2005.
- The Hindu. 2011a. *State's economic growth poised at 8.2 per cent*. 11 February 2011.
- The Hindu. 2011b. *Now, Dharwad too will get water supply once in three days*. 28 September 2011.
- The Times of India. 2001. *Drinking water crisis grips Hubli-Dharwad*. 23 July 2001.
- The Times of India. 2002a. *Hubli relieved over Patil's assurance on water*. 20 March 2002.
- The Times of India. 2002b. *No unanimity on water supply at the Hubli-Dharwad*. 5 April, 2002.
- The Times of India. 2003a. *Twin cities to Rs 150 cr water scheme soon*. 10 August 2003.
- The Times of India. 2003b. *Water daily by next year*. 29 April 2003.
- The Times of India. 2009. *Govt. approves revised tariff for water*. 3 November 2009.
- The Times of India. 2012a. *Dharwad residents to protest against water board*. 14 May 2012.
- The Times of India. 2012b. *Water Board asks erring consumers to pay up*. 16 December 2012.
- United Nations Development Programme. 2006. *Beyond scarcity: Power, poverty and the global water crisis*. Human Development Report. New York: UNDP.
- Water and Sanitation Program (WSP). 2010. *The Karnataka Urban Water Sector Improvement Project: 24x7 water supply is achievable*. Field Note.
- Webindia123. 2012. *KUWSSB to launch disconnection drive to recover arrears*. <http://news.webindia123.com/news/articles/India/20120413/1964757.html> (accessed 26 October 2012)
- Wikipedia. *India Karnataka locator map*. [http://en.wikipedia.org/wiki/File: India Karnataka locator map.svg](http://en.wikipedia.org/wiki/File:India_Karnataka_locator_map.svg) (accessed 22 January 2014)
- Wilbur Smith Associates Pvt. Ltd. 2003. *Environmental assessment of demonstration projects & priority investments in Hubli-Dharwad, Belgaum and Gulbarga*. Report No. E-799. Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC), Karnataka Water Supply and Sanitation Sector Improvement Project. [www-wds.worldbank.org/external/default/wdscontentserver/wdsp/IB/2003/10/10/000094946\\_03092704005582/Rendered/PDF/multi0page.pdf](http://www-wds.worldbank.org/external/default/wdscontentserver/wdsp/IB/2003/10/10/000094946_03092704005582/Rendered/PDF/multi0page.pdf) (accessed 22 December 2013)
- Woelfle-Erskine, C. 2012. *The 'how much' and 'why' of household water use: Investigating waste during a transition from intermittent to continuous water service in Hubli-Dharwad, India*. MS Paper. UC Berkeley: Energy & Resources Group.
- World Bank. 2004. *Project appraisal document on a proposed loan in the amount of US\$39.5 million to the Republic of India for the Karnataka Urban Water Sector Improvement Project*. Report No. 27180-IN. Energy and Infrastructure Sector Unit. South Asia Regional Office.
- World Bank. 2011. *Implementation completion and results report (IBRD-47300) on a loan in the amount of US\$39.5 million to the Government of India for the Karnataka Urban Water Sector Improvement Project*. Report No. ICR00001950. Sustainable Development Department, Urban, Water and Disaster Risk Management Unit, India Country Management Unit, South Asia Region. [www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2011/12/21/000356161\\_20111221235043/Rendered/PDF/ICR19500P0825100disclosed0120200110.pdf](http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2011/12/21/000356161_20111221235043/Rendered/PDF/ICR19500P0825100disclosed0120200110.pdf) (accessed 22 December 2013)

THIS ARTICLE IS DISTRIBUTED UNDER THE TERMS OF THE CREATIVE COMMONS *ATTRIBUTION-NONCOMMERCIAL-SHAREALIKE* LICENSE WHICH PERMITS ANY NON COMMERCIAL USE, DISTRIBUTION, AND REPRODUCTION IN ANY MEDIUM, PROVIDED THE ORIGINAL AUTHOR(S) AND SOURCE ARE CREDITED. SEE [HTTP://CREATIVECOMMONS.ORG/LICENSES/BY-NC-SA/3.0/LEGALCODE](http://creativecommons.org/licenses/by-nc-sa/3.0/legalcode)