

Title: Water and Sanitation in Dhaka Slums: Access, Quality, and Informality in Service Provision

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Abstract: Slum populations are commonly characterized to have poorly developed water and sanitation systems and speculated to access services through informal channels. However, there are limited representative profiles of water and sanitation services in slums, making it difficult to prioritize interventions that will make services safer for residents. This cross-sectional study examines quality and provision of access to water and sanitation services in government slums across Dhaka, Bangladesh. Access is overall high but is subject to quality issues related to safety, reliability, and liability. Services are often operated by informal middlemen at various stages of provision.

JEL Classification: P46, O17, D40, I31

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Introduction

Bangladesh's rapid urbanization has propelled the country to be among the five fastest economies in the world (World Bank 2019) but has also placed stress on housing, infrastructure, and overall quality of life in cities, particularly for the poorest. Low-income communities face unique challenges in accessing basic services, such as water, sanitation, and hygiene (WASH). Unsafe WASH remains a leading cause of mortality globally, estimated to account for over 1.6 million deaths and over 84 million disability-adjusted life years (DALYs) in 2017 alone (Stanaway et al. 2018). Poor WASH can cause repeated cases of diarrhea and asymptomatic enteric infections especially in early childhood, which in turn have been linked to environmental enteropathy, growth faltering, and impaired cognitive functioning (Guerrant et al. 2002; Humphrey 2009; Ngunjiri et al. 2014; Checkley et al. 2008; Walker et al. 2012). The WASH disease burden could be particularly significant in areas of high population density such as Bangladesh (Hathi et al. 2018).

Although changing, utilities traditionally have not been mandated to deliver services to slums due to their informal tenure. Instead, WASH services are often believed to be provided through informal markets operated by middlemen. On some accounts, residents have been observed to have illegal piped connections or private pumps (Hossain and Ahmed, 2015). Surface drainage and solid waste collection in slums are also neglected by city planners with garbage and waste commonly found in the periphery of communities (Ahmed, 2014).

The lack of formalized services may undermine accountability systems that allow monitoring and enforcement of a minimum quality of service (UNICEF 2010; Hanchett et al., 2003; Muhammad et al., 2016; Adams et al., 2015; Panday, 2017). Lack of regulation frameworks can also lead to poor cooperation and conflicts among different players across the service delivery channel (Banks, 2008). Further, underdeveloped WASH systems in slums ultimately contribute to widening intra-city housing disparities and may even weaken the “urban health advantage” generated from having relatively better access to jobs and services compared to in rural areas (Vlahov 2005). For example, Bangladesh’s slum population has the highest rates of child mortality and undernutrition in the country. Under-5 child mortality is 79% and 44% higher in slums areas compared to non-slum urban and rural areas, respectively (UNICEF 2010), while nearly half of all children living in slums of the country’s major cities are stunted (NIPORT et al., 2015; 2016).

Although slum communities are often characterized to have poor WASH, there are limited studies that measure a representative profile of WASH service delivery in slums. This is partly due to the difficulty of obtaining an accurate sampling frame of slum households. Though some surveys include slum households in sampling frames, many do not follow official government definitions of slum areas or offer disaggregated analysis of slum populations because they are not designed to be statistically representative of slum populations (Angeles et al., 2009, NIPORT et al., 2008, and NIPORT et al., 2015). The lack of representative data limits the ability to prioritize WASH issues unique to this vulnerable population.

This cross-sectional study attempts to respond to data gaps by quantifying and qualifying WASH access in government-defined slums across Dhaka, Bangladesh. It presents statistics on access to WASH services representative of small, medium, and large slums of Dhaka as defined by government’s 2014 Census of Slum Areas and Floating Population. The study additionally explores different dimensions related to the quality of and provision of WASH services.

Dimensions related to quality of water service include types of infrastructure, reliability, accessibility, reported issues, sharing status, and perceived quality. For sanitation, we examine types of infrastructure, sharing status, reliability, accessibility, fecal sludge management, and barriers to investing in sanitation. Finally, we examine some of the mechanisms of service provision, including measurements of service providers for installation, day-to-day management, accountability mechanisms, and payment collection schemes. These findings should inform opportunities for safe and sustainable interventions such as designing formalized mandates and clearer roles for utilities and non-state entities.

Methods

Cross-sectional data was collected in May 2016 and is representative of all slums in the Dhaka North and South City Corporationsⁱ. The Primary Sampling Units (PSU) were slum communities. The sampling frame used was the Census of Slum Areas and Floating Population 2014 collected by the Bangladesh Bureau of Statistics (BBS)ⁱⁱ. The Census defines slums as compact settlements of five or more households, which grow unsystematically and haphazardly in unhealthy conditions in either government or privately owned vacant land (BBS, 2014). To operationalize the definition, the government uses six criteria: (i) poor housing structure; (ii) high population density (one room for all household members; 3+ structures per one decimal of land); (iii) poor access to water and sanitation services (unsafe water; 15+ people sharing toilet); (iv) inadequate lighting and road facilities; and (v) low socio-economic status (informal non-agricultural jobs). The Census gave a sampling frame of a total of 3,360 slum communities with more than 5 households in Dhaka City Corporations. The Census categorizes community size: (i) small (5-10 households); (ii) medium (11-200 households); and (iii) large (more than 200 households).

PSUs were randomly selected and were equally allocated between strata 1 and 2 (small and medium size slums) and stratum 3 (large slums) using a combination of probability proportional to size (PPS) and practical allocation. PSUs were allocated across strata using PPS with the number of households used as the measure of size and rounding to account for the pre-determined cluster size of 10 households per PSU for medium size slums and 5 households per PSU for small slum communities. The final sample includes a total of 588 households, 2.3% from small slums, 41% from medium-sized slums, and 57% from large slums, which is closely aligned with the distribution of households from small, medium, and large sized slums in the original sampling

frame. In the second sampling stage, listings of households in selected communities were completed. Using these listings, 5-10 households were selected from each community using systematic equal probability sampling.

The administered survey measures basic demographic and housing characteristics and access to WASH following WHO/UNICEF Joint Monitoring Programme definitions for tracking targets under SDG-6ⁱⁱⁱ. The survey also asks questions on various dimensions of WASH service quality. For water services, this includes measures of reliability, accessibility, reported issues, and perceived quality, and for sanitation services, this includes sharing status, reliability, accessibility, fecal sludge management, and barriers to investing in sanitation. To understand the extent of informality of service providers, the survey additionally examines mechanisms of WASH service delivery, including household reported service providers for installation, day-to-day management, accountability mechanisms, and payment collection schemes.

The analysis provides representative estimates by these three strata of varying slum sizes and additionally disaggregates by land ownership and household welfare levels. The concept of land ownership in slums in Bangladesh is complex and prone to measurement error^{iv}. To construct a measure of land ownership, the survey has a self-reported question on land ownership asked to household heads and then creates a community-level land ownership variable based on the mode of that variable. To measure household per capita consumption, consumption aggregates are constructed and are fully consistent with the government's methodology for producing official poverty numbers using the HIES 2016/17.^v

Results

Profile of slum households and residents

Table 1 summarizes demographic and socio-economic characteristics of households by community size.^{vi} On average, households spend Bangladesh Taka BDT 4,410 per capita (around USD 53) to cover its expenditures on food, non-food, and housing per month. This corresponds to an average per capita consumption of USD 1.76 per day. A typical household has 4.3 members and 72% of its residents are dependents as measured by the age dependency ratio.^{vii} Household heads are predominantly male (85.9%), on average 40 years old, and on average have lived in their current residence for 10 years. About 47% of adult slum residents report knowing how to read and

write, but about 18% completed primary school. Among school-age children (7-12 years old), 82% attend school on a regular basis. Nearly 5% of households report having benefited from a relief program provided by government or a non-government organization (NGO).

Overcrowding, poor housing conditions, and fear of eviction are salient features faced by residents. One single room is normally shared by three people and rooms are on average 12 square meters. Housing structures are mainly constructed using low quality materials including tin-shed (59% of housing structures) and semi-permanent materials (29% of housing structures). About 12% of housing structures are constructed based on permanent materials. Over half of all residents report living in fear of being evicted from their housing structures. Slums have also dynamic rent housing markets with 71% of residents reporting renting their housing structure. On average, 61% of slums in Dhaka are in land reported to be government owned and 34% of slums are in land reported to be privately owned.

Main sources of drinking water

Overall, 97% of households have access to an improved water source as defined by JMP guidelines (Table 1). Access to piped water among households is nearly universal at 95%. However, piped connections that run directly into each of the slum dwelling structures are rare (8%) with most households accessing piped water through a system connected to the slum compound, yard or plot (68%) or through public standpipe (18%) (Table 2). Poorest households tend to share their water sources with a higher number of households (42 households on average) compared to richest households (23 households). Households are generally not located too far away from their main drinking water source (See figure S1 in the supplementary material), spending seven minutes, on average, to reach their main drinking water source. Richer households tend to live closer to water sources compared to poorer households.

Water treatment and testing

Columns 8 and 9 in table 2 show household water treatment practices and external testing for arsenic, iron, salinity, and bacteria. Close to 75% of households do not do anything to their water to make it safer to drink. Among those who treat water, common practices include boiling water

(68%), straining water using a cloth (17%), using a water filter (10%), and adding bleach or chlorine (3%). When asked about whether their main source of drinking water was ever tested by any parties for water quality issues, on average, 91% of households respond that water was not tested or that they do not know if the water has been tested. This pattern does not seem to change based on the size of the community, land ownership, or the welfare status level of households.

Water Quality Issues

Table 3 presents a summary of main quality issues identified by households. Although results are subject to interviewer and response bias, these provide interesting insights into main water quality concerns expressed by slum residents. Residents consistently report that the top issue is “funny smell/color/taste” (49.6%) and “bacterial contamination” (7.4%) of drinking water. Other less prevalent issues include availability (7.5%) and high price of water (1.7%).

Reliability of water sources

Households were asked about the reliability to access their main drinking water source. About 12% of households report a service interruption, with larger slums having significantly more service interruptions compared to small and medium slums (Table S3 in the supplementary material). Richer households seem to be impacted less frequently by service interruptions compared to poorer households. More than half of households report flooding in the past year, with an average flood lasting around 16 days (Columns 1 and 2, table 6). Almost a third of households are affected by limited supplies of drinking water during times of flooding (Column 3 in table 6). Among households that report being affected by flooding, they report being without access to a functional drinking water during flooding on average for 10 days (Column 4). Flooding affects larger slums more often than small and medium size slums. However, during flooding, the issues seem to be resolved more quickly in large slums compared to small and medium slums as measured by the number of days that slum households need to wait to have a functional drinking water source back again. Lastly, richer households report being affected by flooding and longer repair wait times more often than poorer households.

Main sources of sanitation used

On average, about 9% of households have access to an improved sanitation facility as defined by JMP guidelines (Table 1). If the definition is relaxed to allow for shared facilities as being considered as improved, this number increases to 86%. Access to flush toilets connected to a piped sewer system or septic tank is limited (Table 4). About 8% of households have access to a flush or piped sewer system or septic tank. Most households access on-site sanitation, with 78% using improved pit latrines. Slightly above 10% of households have access to hanging toilets, which is a form of unimproved sanitation. The use of open pits or hanging toilets for sanitation is much more common in large slums and in slums located in government owned land. Richer households are slightly more likely to have access to a flush toilet though the availability of those is quite limited.

Access to toilets exclusive to one household is rare. About 91% of households report sharing their sanitation facilities (Columns 9 and 10 from Table 4). On average, one toilet is shared with 16 households (around 70 people). Sharing toilet facilities is equally common across all slums independently of their size, though residents of smaller slums tend to share their sanitation facilities with fewer people as expected. Households located in publicly and privately-owned land share their toilet facilities with other households just as frequently, but those in privately owned land share their facilities with a larger number of household on average – 19 versus 13 households, respectively. Richer households also tend to share their sanitation facilities slightly less frequently (83.9% versus 95.4% among the poorest).

Households wait on average 7 minutes on line to use sanitation facilities. In small communities, households wait slightly less than in larger communities – 4.8 minutes in small slums on average compared to 7.2 and 6.7 minutes in medium and large slums, though there is quite a lot of variability in the waiting time across households (Figure S2). The waiting time is consistent across the household per capita distribution and across land ownership.

Perceived satisfaction, safety, and reliability

In terms of satisfaction with sanitation facilities, the majority of adult^{viii} male (89%) and female (84%) residents report feeling secure when using the facility at night (Table 5). Residents in smaller and privately-owned slums feel slightly more secure in terms of using sanitation facilities

at night and feel that they have good privacy compared to larger and government owned land slums, though the differences are not substantially large.

Sanitation facilities are reported to be reliable for the most part; however around 10% of households report that facilities were temporarily unusable for at least one full day in the past two weeks. This number is substantially higher in small slums where 28% of residents report this issue of reliability.

During times of flooding, 42% of households said that their sanitation facilities were inaccessible and reported an average of 9 days without access to sanitation (Table 6). Consumption quintiles report varying levels of in access (32-47%), but the lack of access to sanitation during flooding seems to affect disproportionately better-off households.

Fecal sludge management

Table 7 shows statistics on fecal sludge management and on where the sanitation facilities used by households empty to. Residents were asked to report where contents of their sanitation facilities emptied to. Responses were coded as “safe” and “unsafe,” where fecal sludge management was “safe” if contents emptied to either directly to a piped sewerage network, a septic tank with no outlet, or lined pit with no outlet. Overall, only 8% of households could be classified as practicing safe fecal sludge management. For those households with access to improved sanitation (unshared), only 2% practiced safe fecal sludge management. This number most closely represents access to “safely managed sanitation,” the new sanitation indicator developed by JMP for meeting SDG-6. The large majority report that contents are emptied to drains either through lined pits (42.9%) or septic tank connected to a drain (9.8%). Moreover, 13.7% of all households report that their sanitation facilities are emptied directly to a nearby lake, pond or river, and 6.1% to a septic tank connected to open ground. Among owners of pit latrines or sanitation facilities that link to septic tanks, about 68% report never having emptied their pit or septic tank. This does not necessarily tell us about safe fecal sludge management, but at least sheds light on pit and septic tank emptying practices.

Barriers to upgrading sanitation

Households reported that the main constraints to improving their sanitation facilities are lack of finance and lack of interest by landlords to invest (Figure S3). In large slums, lack of space to build the facilities is also frequently reported as an important issue. Even among richer households, lack of space is a reported constraint which suggests that households who might have the financial means to invest in improving sanitation merely do not have the space to do so.

Mechanisms of Water and Sanitation Service Delivery

Installation, management, and accountability

Tables S4, S5 and S6 summarize statistics on the ownership of drinking water sources, management structure, and the accountability mechanisms to escalate complaints. Water infrastructure is mainly installed by landlords (56.8%), D-WASA (17.3%) who is the local utility company responsible for water distribution in Dhaka, and NGOs (12.9%). Although landlords are the owners of virtually all drinking water sources in small and medium slums (100% and 81%, respectively), NGOs own a non-trivial share of water sources in large slums (21%). Landlords are reported to install a mix of tubewells and piped water sources, while D-WASA is reported to install a portion of only piped water sources. Landlords are the main owners of water sources used by slum residents located in privately owned land (90%) while in large slums D-WASA and NGOs own on average 27% and 21% of drinking water sources, respectively.

Sanitation facilities are mainly installed by landlords or middlemen (63%), NGOs (20%), and private companies or residents (15%) (Table S7). Although landlords are almost the exclusive providers of sanitation facilities in small and medium slums, NGOs have been supporting several of these investments in large slums. Compared to water services, there is a much larger role for household investments in sanitation infrastructure. NGOs and households themselves have been much more proactive to invest in sanitation infrastructure in government owned land compared to slums in privately owned land. On the contrary, in communities where land ownership is unclear or that is owned by a non-government agency, investments in sanitation facilities have mainly come from NGOs. Landlords rely heavily on community leaders for the day-to-day management of both water and sanitation facilities across all types of slums (Tables S6 and S9).

Payments for water and sanitation services

Landlords also seem to depend heavily on community leaders and private individuals to collect water payments from households (Table 8). On average, 46% of payments for water services in medium slums are channeled through community leaders, while in large slums NGOs take some of the payment collection responsibility (17%). The use of community leaders to collect water payment is slightly more prevalent in slums located in privately owned land (around 40.3%) compared to those located in government owned land (35%). Interestingly, community leaders are responsible for collecting the water services payments from the poorest households while richer households tend to pay directly to the landlords or NGOs operating in the slum.

On average, 71% of households rent their housing structure. Among those households who rent, on average 89% have their water utilities included as part of the rent (Table S10, Column 2). Therefore, rent inclusive of water services are a quite common arrangement in slums.^{ix} In Column (3), the average payment for water services among slum households who report owning their housing structures is given. Although just a third of households report owning their homes, these estimates provide a broad approximation that can serve as a reference on how much slum households pay to access water services. Slums households owning their housing structure pay on average Taka 169 monthly for water services (around USD 2). Access to water services is on average cheaper in larger slums at around Taka 155 per month compared to medium slums where households pay on average Taka 308 monthly for these services – for small slums, no household reports owning their housing structure. These estimates should be interpreted with caution, however, as they are based on small sample sizes. Lastly, as a share of total per capita consumption (food, non-food, and housing Column 4), households spend around 1% of their expenditures in water services.

Figure S4 shows how frequently payments for water services are collected from households who own their housing structure or pay for water services separately from their rent. Most households are charged monthly or weekly. Poorest households tend to pay per use or be charged weekly while richer households are almost always charged monthly. Similarly, households located in private slums are billed for water services on a weekly basis exclusively. This suggests that landlords provide different payment frequencies to potential renters, perhaps based on their ability to pay.

Landlords also rely largely on community leaders to collect payments for the use of the sanitation facilities. On average, 77% of residents pay to community leaders for sanitation services (Table

8). While private companies act as collector agencies frequently for the provision of water services (25%), community leaders are almost exclusively responsible for collecting payments for using sanitation facilities. This trend does not vary across the different types of community size, land ownership, or socio-economic status of households

Unlike water services, 6% of residents who rent their dwelling report having the use of sanitation facilities included as part of their rent (Table S11). In small slums, 18% of renters report having the use of sanitation facilities included in the rent, which is consistent with the higher average rents paid by residents in these slums compared to large slums. In contrast, 8% of renters in large slums report having the use of sanitation facilities included as part of their rent.

Table S12 shows different measures of the magnitude of payments made by residents for sanitation services. Although sample sizes are generally small, these numbers suggest that residents pay on average 36 BDT per month for using the sanitation facilities available in slums. The amount spent in sanitation services is substantially lower than the amount spent on water services. Accessing water services costs households on average five times more than sanitation facilities. Access to sanitation facilities is almost two times higher in small slums compared to large slums and richer households tend to spend slightly more on average in accessing these services. Lastly, payments for using sanitation services are billed to households monthly as a fixed amount, though in some cases such as in large and publicly owned slums residents are offered the possibility of paying for accessing the sanitation facilities weekly (Figure S5).

Provision of water services to slums by D-WASA

Though middlemen are the predominant service provider, the local utility, D-WASA, is sometimes reported to play a role water service provision, whether it be in installation, accountability, management, or payment of services, particularly in large slums. This might suggest that D-WASA is providing water points at the border of slums or even in some cases inside the slums despite the lack of a formal mandate. To explore this hypothesis, we look at the location of the main drinking water source for households who report receiving their water services directly from D-WASA in large slums. Table S13 shows these statistics estimated separately for four groups of slum residents: (i) those who report that D-WASA installed their water source; (ii) those who report that

D-WASA manages their water source; (iii) those who report reporting issues with the water source to D-WASA; and (iv) those who report paying for water service to D-WASA.

Results suggest that between 50 to 65% of residents who report receiving water services from D-WASA, access this water source directly from their own dwelling, yard, or plot. Among those who pay for water services directly to D-WASA, more than 82% have the water source installed directly in their own yards or plots. Overall, these estimates suggest that D-WASA is not only installing water sources in the border of slums but might be providing direct services to some slum households, albeit the share benefiting from this direct service is very small (between 5.5 to 17.5 % of residents).

Discussion

This paper focuses on measuring access levels to water and sanitation and “informality” of service markets in slums of Dhaka, Bangladesh. Given the traditional lack of formal mandates of public utilities to serve slum areas (although this is changing in some areas of Bangladesh), overall access to water and sanitation infrastructure is high. Access to improved water is nearly universal at 97%, and 86% of households use shared or unshared improved sanitation technology. These results seem to be consistent with findings from other surveys with slum disaggregation in Bangladesh (NIPORT et al 208; 2015 and UNICEF 2015). However, indicators of improved infrastructural access may mask important dimensions of safety. This study is limited in that it could not measure updated JMP indicators on safely managed water, which include indicators on functionality and water quality (WHO/UNICEF 2019). We find that WASH services are mostly provided by non-regulated providers, with evidence to support claims of “informality” and strong presence of middlemen providers. The data suggests that local landlords or middlemen play a large role in installation and management, while the local utility seems to have a limited role in the overall spectrum of service delivery.

Informal service provision may reduce accountability to meet minimum standards of quality. For example, although nearly all households use piped water connections, many report issues of reliability, functionality, and accessibility, especially during monsoon seasons. Service interruption can indicate leakages and malfunctioning pipes that compromise water quality and

heighten risks to public health and safety (Shams et al., 2016; Ecrumen et al., 2015). Over half of study households reported issues related to water quality. Other studies have found that piped water supply is among one of the most heavily contaminated types of water sources in Bangladesh most likely due to leakages, intermittent supply, and unsafe handling (World Bank 2018; UNICEF 2014; Pickering et al., 2014; UNICEF 2019). Our study suggests that just a quarter of slum households reported treating their water. As middlemen such as landlords are the primary service providers, point-of-tap water treatment, such as the adoption of water filters or automated chlorination systems on taps, could be a viable short-term solution (Pickering et al., 2015) until formal capacity to monitor and enforce quality standards of piped water is developed.

On sanitation, open defecation and use of unimproved sanitation technology is minimal in Dhaka slums. However, there is a high dependence on shared or public toilets. Over 90% of households share sanitation facilities, and the average number of households to sanitation facility is 16 to 1. When adhering to JMP standards to exclude improved sanitation that is shared between two or more households, access is limited to 9%. These findings suggest that there is need to reduce shared sanitation or at least reduce the sharing ratio and improve management of public toilets. When considering fecal sludge management, we estimate that 2% have access to the JMP's conceptualization of "safely managed sanitation." The issue of safe fecal sludge management is not limited to only slum communities. One study estimates that 2% of the human excreta in Dhaka is safely managed, while the rest is discharged into open water. This is mostly due to the lack of regular maintenance of on-site sanitation facilities such as pit latrines and septic tanks (Blackett, Hawkins, and Heymans 2014). Policymakers have urged for better fecal sludge management by implementing city-wide sanitation initiatives that are inclusive to both on-site and off-site sanitation technologies. It is vital that slum communities are also included in these strategies and that formal, regulated fecal sludge management services are made available to residents.

Finally, this study responds to knowledge gaps on understanding basic characteristics of slum populations. Slums are not a transitory place for migrants, with household heads, on average, reporting about 11 years of residence in the community. There also seems to be a mix of consumption patterns, illustrating that not every household is living under the national poverty line and households are making conscious trade-offs between financial gains and living conditions. The findings additionally highlight inequalities across slums based on the characteristics of the

community itself, such as the size of the slum and whether the slum is located on private or public land. For instance, households living in larger slums are more likely to face threats of eviction and experience more crowding. On the other hand, residents living in larger slums are also more likely to be able to obtain services from NGOs and utilities compared to small and most medium slums. This heterogeneity demonstrates the need for interventions tailored to different types of slum contexts.

Given trends in rapid urbanization and growing urban poverty in Bangladesh, informal settlements will need to be a focal population in sustainable development strategies limited not only to poverty reduction, but also to improving health, equitable access to basic services, and economic, social, and environmental resilience. Doing this will require better monitoring and research efforts that can better describe the unique problems these communities face as well as the institutions and stakeholders that impact their communities.

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Declarations of interests

None.

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Tables

Table 1. Summary statistics by slum size

	Small	Medium	Large	All	t-test small-medium	t-test medium-large
Monetary poverty						
Distribution of slum households (%)	2.3	40.8	57.0	100	-	-
Monthly per capita expenditure (in Taka)	3,956	4,723	4,208	4,410		
Demographics and human capital						
Household size	4.3	4.2	4.3	4.3		
Dependency ratio (%)	80.8	76.1	68.9	72.1		
Age of household head (in years)	39.2	40.2	40.3	40.2		
Female household head (%)	10.3	12.9	15.2	14.1		
Duration of residence hhold head (years)	7.8	8.3	12.6	10.7		*
Literacy rate for adults (%)	65.3	46.9	46.6	47.2	*	
Completed primary school for adults (%)	29.3	16.5	17.8	17.5	*	
School attendance children 7-12 years (%)	94.1	81.4	82.1	82	*	
Household received relief program (%)	3.4	3.8	5	4.5		
Labor markets						
Share of male adults who are earners (%)	94.4	89.9	88.2	89.0		
Share of female adults who are earners (%)	40.9	52.8	48.7	50.1		
Main source of income from industry (%)	6.9	4.2	15.1	10.5		***
Main source of income from services (%)	93.1	95.8	84.9	89.5		***
Housing						
Per capita rooms	0.32	0.32	0.33	0.33		
Room size (in sq. meters)	12.1	11.8	11.7	11.8		
Share of renters (%)	96.6	82.2	61.2	70.6	**	***
Monthly rent (in Taka)	2,849	2,692	2,390	2,548		**
Has separate kitchen (%)	55.2	87.9	63.4	73.2		***
Government owned land (%)	17.2	27.1	86.6	60.8		***

Non-government and private owned land (%)	82.8	72.9	3.3	33.5		***
Others and do not know who owns land (%)	0.0	0.0	10.0	5.7		*
Fear of eviction (%)	17.2	21.8	71.6	50.1		***
Permanent dwelling structure (%)	24.1	12	11.4	11.9		
Semi-permanent dwelling structure (%)	37.9	36.7	22.8	28.8		
Tin-shed dwelling structure (%)	34.5	51.2	65.8	59.2		
Jhupri dwelling structure (%)	3.4	0	0	0.1		
Access to basic services						
Improved drinking water (%)	100	95.4	98.3	97.2		
Improved sanitation, JMP definition (%)	6.9	9.2	8.2	8.6		
Improved sanitation, including shared (%)	100	93.9	80.5	86.4		*
Electricity is main source of light (%)	100	99.2	93.6	96.1		

Notes: Bangladesh Urban Informal Settlements Survey 2016. All summary statistics were computed using household weights except for mean monthly per capita expenditure (in Taka), age, literacy rate for adults, completed primary school for adults, school attendance for children 7-12 years, %age of male adults who are earners, %age of female and male adults who are earners, which were computed using population weights. The t-test columns show the results from Wald tests testing whether the difference in means/proportions between small and medium size slums and medium and large slums are significant at * p<0.1, ** p<0.05, *** p<0.01. The JMP defines access to improved sanitation as unshared facilities that are flushed to piped sewage systems, flushed to septic tanks, pit latrines with slabs, and ventilated improved pit latrines. Sanitation definition follows the same criteria as the JMP but includes as improved sanitation shared or unshared facilities that are flushed to piped sewage systems, flushed to septic tanks, pit latrines with slabs, and ventilated improved pit latrines.

Table 2. Main source of drinking water, treatment and testing

	Piped into dwelling (%)	Piped into compound, yard or plot (%)	Public tap / standpipe (%)	Tubewell, Borehole (%)	Others (%)	Households who share water source (%)	Average number of households who share water source	Water treated (%)	Water tested (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All	8.1	68.4	18.3	1.8	3.5	93.8	33.2	25.7	9.2
By size of the slum									
Small slums	6.9	62.1	24.1	6.9	0.0	93.1	13.2	48.3	15.8
Medium size slums	4.2	72.6	13.5	3.5	6.1	91.1	28.8	35.4	5.5
Large size slums	10.8	65.7	21.4	0.4	1.7	95.8	37.0	17.9	11.4
t-test small-medium							**		
t-test medium-large	*							**	
By land ownership									
Public	9.0	66.5	22.2	0.6	1.6	95.3	36.7	17.2	11.9
Private	5.4	77.9	5.0	4.3	7.5	92.3	21.3	45.5	4.8
Others	13.3	33.4	53.3	0.0	0.0	86.7	66.7	0.0	3.7
t-test public-private			***					***	
By per capita consumption expenditure									
Poorest	4.6	69.6	13.3	5.7	6.8	98.9	42.4	18.1	8.3
Second quintile	4.9	65.5	21.9	2.1	5.6	94.6	40.8	17.1	12.3
Third quintile	7.3	67.3	22.2	0.8	2.4	98.0	33.3	19.8	10.1
Fourth quintile	8.1	68.2	21.0	0.4	2.4	94.2	29.7	29.4	8.4
Richest	13.5	71.1	13.2	1	1.3	86.1	23.0	39.1	7.3
t-test poorest - richest	*					***		***	

Notes: Bangladesh Urban Informal Settlements Survey 2016. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Category others includes bottle water and other categories not specified.

Table 3. Top issues reported related to water services

	Bacterial contamination (%)	Funny smell, taste, or color (%)	Not enough water to all the demand (%)	Too expensive (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)
All	7.4	49.6	7.5	1.7	33.8
By size of the slum					
Small slums	3.4	72.4	0.0	0.0	24.1
Medium size slums	7.7	56.7	3.8	0.4	31.4
Large size slums	7.4	43.6	10.4	2.7	36.0
t-test small-medium					
t-test medium-large					
By land ownership					
Public	7.6	46.7	7.2	2.8	35.6
Private	7.7	54.7	4.7	0.0	32.9
Others	3.3	50.0	26.7	0.0	20.0
t-test public-private					
By per capita consumption expenditure					
Poorest	6.5	38.2	6.7	4.6	44.1
Second quintile	5.6	49.4	7.8	2.0	35.1
Third quintile	5.2	49.6	9.5	0.0	35.7
Fourth quintile	10.8	54.4	7.9	0.9	26.0
Richest	8.2	53.4	5.8	1.5	31.2
t-test poorest - richest		*			

Notes: Bangladesh Urban Informal Settlements Survey 2016. The t-tests show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Category others includes arsenic or heavy metal contamination, salinity contamination, no challenges, do not know and other categories not specified.

Table 4. Access to sanitation facilities and households who share toilet

	Flush to piped sewer system, septic tank, (%)	Flush to somewhere else (%)	Pit latrine Ventilated (%)	Pit latrine with slab (%)	Pit latrine without slab/ open pit (%)	Hanging toilet/ hanging latrine (%)	Improved sanitation, JMP definition (excluding share) (%)	Improved sanitation (including shared) (%)	Households who share toilet (%)	Average number of households who share toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
All	8.0	0.2	20.3	58.1	3.2	10.2	8.6	86.4	91.1	16.2
By size of the slum										
Small slums	0	0	31	69	0	0	6.9	100	93.1	12.3
Medium size slums	10.4	0.4	13.8	69.7	0	5.8	9.2	93.9	90.8	17.7
Large size slums	6.7	0	24.5	49.4	5.7	13.8	8.2	80.5	91.2	15.2
t-test small-medium	**									*
t-test medium-large				*				*		
By land ownership										
Public	6	0	20.1	54.6	5.3	14	8.7	80.7	90.7	12.4
Private	12.6	0.5	24	62.9	0	0	8.2	99.5	91.8	19.0
Others	3.3	0	0	66.6	0	30	10	70	90.0	39.3
t-test public-private						***		***		**
By per capita consumption expenditure										
Poorest	5.3	0.0	16.9	61	2.3	14.5	4.6	83.2	95.4	19.4
Second quintile	8.6	0.0	11.8	71.5	2	6.1	7.3	91.9	92.7	14.6
Third quintile	7.6	0.0	24.9	50	4	13.6	6	82.5	94	16.1
Fourth quintile	4.7	0.7	23.4	55.6	4.5	11	6.7	83.8	91.5	15.7
Richest	12.8	0.0	22.8	54.3	3.2	7	16.1	89.8	83.9	15.6
t-test poorest - richest	*						**		**	

Notes: Bangladesh Urban Informal Settlements Survey 2016. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table 5. Satisfaction with sanitation facilities available

	Feels safe using facility at night, adult male (%)	Feels safe using facility at night, adult female (%)	Feels satisfied with privacy, adult male (%)	Feels satisfied with privacy, adult female (%)	Unusable facility for full day in past two weeks (%)
	(1)	(2)	(3)	(4)	(5)
All	89	84.4	73.9	68.9	9.2
By size of the slum					
Small slums	96.6	96.6	82.8	82.8	27.6
Medium size slums	87.3	83.1	65.8	59.1	8.9
Large size slums	89.8	84.8	79.2	75.2	8.7
t-test small-medium		**			
t-test medium-large			*	**	
By land ownership					
Public	87.1	84.5	78.2	74.3	9.6
Private	92.1	88.3	67.8	61.2	8.4
Others	90.0	60.0	63.3	56.7	10.0
t-test public-private					
By per capita consumption expenditure					
Poorest	86.8	86.8	67.6	68.2	11.1
Second quintile	85.7	80.2	65.7	62.2	4.4
Third quintile	87.4	82.6	73.1	68.3	11.0
Fourth quintile	88.4	86.2	76.0	68.3	10.7
Fifth quintile	94.7	85.7	83.0	75.2	8.8
t-test poorest - richest	**		**		

Notes: Bangladesh Urban Informal Settlements Survey 2016. Feels satisfied with privacy of sanitation facilities corresponds to 'very satisfied' and 'satisfied' responses reported by households. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table 6. Accessibility of water and sanitation facilities during times of flooding

	Households who experienced flooding (%)	Number of days of flooding	Households with limited water availability during flooding (%)	Number of days with a non-functional water source during flooding	Households with a non-functional toilet facility during flooding (%)	Number of days with a non-functional toilet facility during flooding
	(1)	(2)	(3)	(4)	(5)	(6)
All	52.2	15.6	28.9	10.4	42.1	9.4
By size of the slum						
Small slums	44	5.0	45.5	3	45.5	4.4
Medium size slums	47.7	11.4	30.8	16.7	41.7	14.6
Large size slums	55.7	18.4	27.3	6.4	42.2	6.5
t-test small-medium		*		**		**
t-test medium-large				*		**
By land ownership						
Public	58.2	19.0	36.8	11.4	50.7	10.1
Private	39.5	8.4	16.2	4.4	31.1	6.3
Others	62.0	9.3	0.0	-	-	-
t-test public-private		*	**	**		
By per capita consumption expenditure						
Poorest	43.6	13.0	26.4	4.2	31.8	5.4
Second quintile	47.3	21.5	25.4	10.5	46.1	11.0
Third quintile	53.4	12.8	32.3	11.5	46.0	9.0
Fourth quintile	54.9	17.1	37.9	10.9	47.0	9.1
Fifth quintile	58.3	14.0	22.4	12.1	37.7	10.7
t-test poorest - richest				**		**

Notes: Bangladesh Urban Informal Settlements Survey 2016. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table 7. Fecal sludge management

	Lined pit with overflow to drain elsewhere (%)	Directly to drain/ditch (%)	Directly to lake/pond/river (%)	Septic tank connected to drain (%)	Septic tank connected to opened ground (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)	(6)
All	42.9	13.9	13.7	9.8	6.1	13.6
By size of the slum						
Small slums	44.8	0.0	13.8	37.9	0.0	3.4
Medium size	48.4	11.9	3.1	12.7	8.0	15.8
Large size	38.8	15.9	21.2	6.7	5.0	12.4
t-test small-		**				*
t-test medium-			***			
By land ownership						
Public	35.8	19.8	18.6	6.3	5.0	14.6
Private	51.6	5.6	1.4	18.0	9.3	14.1
Others	66.6	0.0	33.4	0.0	0.0	0.0
t-test public-		**	***			
By per capita consumption expenditure						
Poorest	36.5	11.6	15.6	13.8	9.8	12.7
Second quintile	40.2	14.2	10.8	11.5	10.3	13.0
Third quintile	40.0	16.5	14.3	11.0	5.4	12.8
Fourth quintile	48.6	13.9	12.8	7.8	3.4	13.6
Richest	46.6	13.2	14.8	6.8	3.4	15.2
t-test poorest -						

Notes: Bangladesh Urban Informal Settlements Survey 2016. The t-tests show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Category Others includes directly to piped sewer system, septic tank connected to piped sewer system, septic tank with no outlet, lined pit with no outlet, unlined pit, and other categories not specified.

Table 8. Water and Sanitation Payments: To whom do you pay?

	Landlord/middlemen (%)		D-WASA (Central Government) (%)		Private company/person (%)		NGO (%)		Community leaders (%)		Others (%)	
	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
All	13.3	17.9	5.5	-	24.5	2.0	13.6	1.6	35.0	77.0	8.2	1.5
By size of the slum												
Small slums	-	0.0	-	-	-	75.0	-	0.0	-	25.0	-	0.0
Medium size slums	12.5	32.2	8.3	-	16.7	0.0	0.0	0.0	46.0	64.4	16.5	3.3
Large size slums	13.5	6.2	4.8	-	26.3	0.0	16.8	3.1	32.3	90.6	6.2	0.0
t-test small-medium	-		-	-	-		-		-		-	
t-test medium-large				-			**					
By land ownership												
Public	14.4	4.5	4.2	-	26.6	0.0	14.8	4.5	34.5	86.9	5.5	4.1
Private	0.0	40.6	19.9	-	0.0	5.5	0.0	0.0	40.3	53.8	39.8	0.0
Others	-	5.9	-	-	-	0.0	-	0.0	-	94.1	-	0.0
t-test public-private	***			-	**		**					
By per capita consumption expenditure												
Poorest	0.0	25.8	0.0	-	37.2	4.3	0.0	5.3	56.4	64.6	6.4	0.0
Second quintile	17.5	25.3	4.4	-	30.6	0.0	9.6	0.0	37.9	74.7	0.0	0.0
Third quintile	15.0	8.9	16.0	-	20.8	0.0	5.7	0.0	26.4	81.1	16.1	10.0
Fourth quintile	14.8	11.5	0.0	-	24.6	2.9	27.7	0.0	22.9	85.6	10.0	0.0
Richest	15.1	15.8	6.8	-	14.2	0.0	19.5	0.0	34.6	84.2	9.8	0.0
t-test poorest - richest	*		**	-								

Notes: Bangladesh Urban Informal Settlements Survey 2016. The t-tests show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Category Others for water includes tanker truck manager, water vendor, and other categories not specified, for sanitation includes only tan

ⁱ The micro data from the Bangladesh Urban Informal Settlements 2016 is publicly available at:
<http://microdata.worldbank.org/index.php/catalog/2864/>

ⁱⁱ The sampling frame included a total of 3,360 urban slums. There were 34 slums originally included in the Census of Slums and Floating Population 2014 that we excluded from the sampling frame because they had less than five households as required by the official definition of slums used by the government.

ⁱⁱⁱ Unlike the JMP, we do not include chemical or microbial testing of priority water contaminants.

^{iv} There are multiple official agencies in charge of land records in Bangladesh so it is quite complex to find out information on land tenure for many records, even for those located in privately owned land.

^v For details on how the official poverty numbers are produced in Bangladesh see Ahmed et al. (2017).

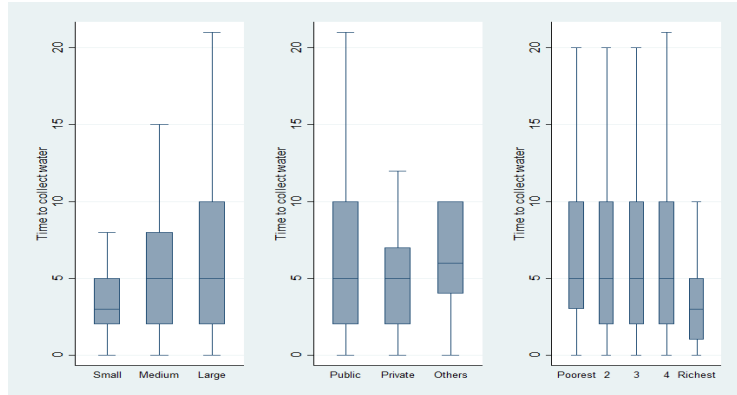
^{vi} Tables S1 and S2 in the supplementary material, present similar statistics by slum land ownership and quintiles of per capita household expenditure.

^{vii} The dependency ratio is defined as the number of household members aged zero to 14 and above the age of 55 divided by the number of household members aged 15 to 55.

^{viii} Defined as over 15 years of age.

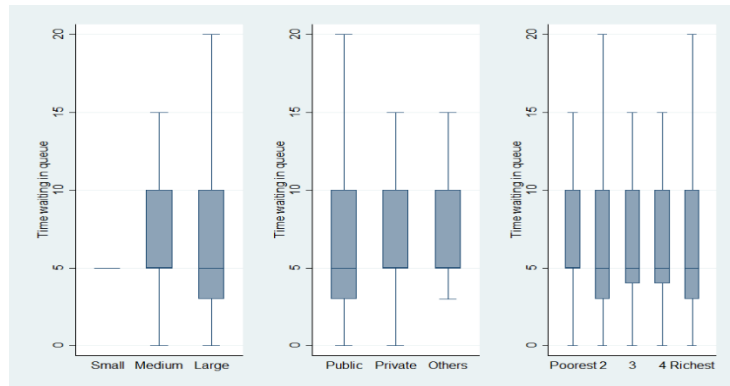
^{ix} Table S12 in the supplementary material presents a summary of the utilities that are reported to be included as part of the housing rent payment by slum households who are renters. Results suggest that almost all renters have their water and electricity utilities automatically included in their rents as a fixed payment. In small slums and medium size slums, almost without exception water is always included while within larger slums some renters pay for their water services separately.

Figure S1. Time to collect water from main drinking water source (in minutes)



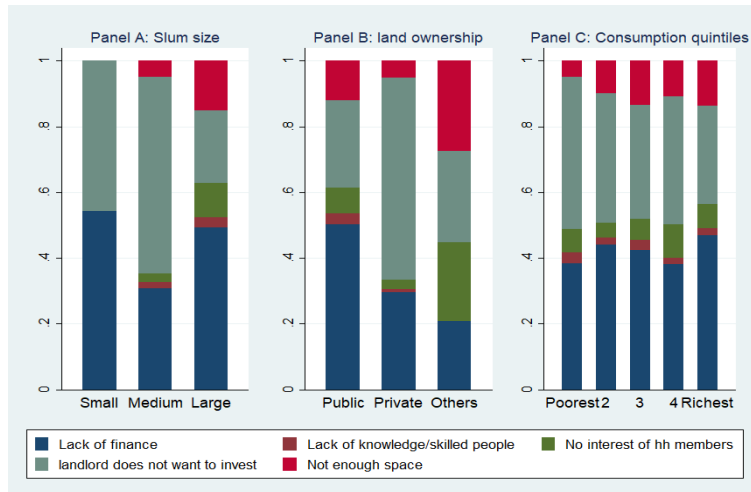
Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption.

Figure S2. Time waiting to get access to sanitation facility (in minutes)



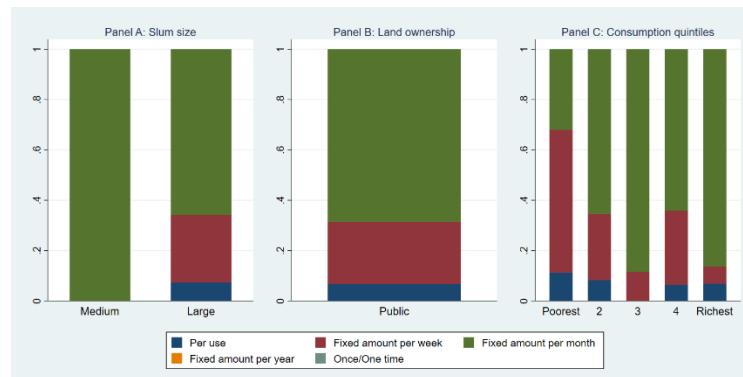
Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption.

Figure S3. Main challenges for upgrading sanitation facilities



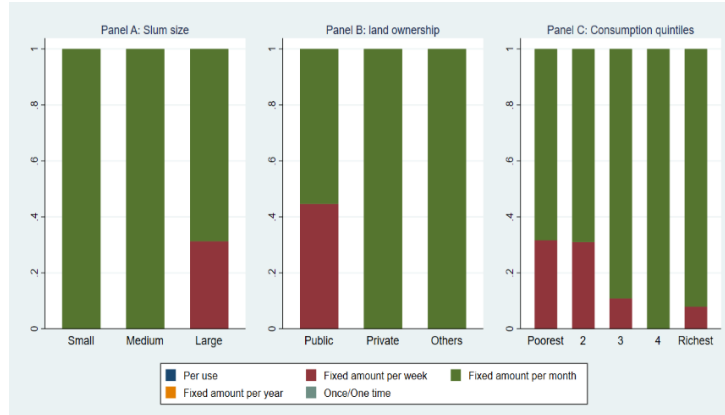
Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption.

Figure S4. Frequency of water payments



Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. These statistics were computed using owners and renters who do not have the use of sanitation facilities included as part of their rents.

Figure S5. Frequency of sanitation payments



Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. These statistics were computed using owners and renters who do not have the use of sanitation facilities included as part of their rents.

Table S1. Summary statistics by land ownership

	Public	Private	Public, Others, Do not know	All	t-test	t-test
	(1)	(2)	(3)	(4)	(1)-(2)	(2)-(3)
Monetary poverty						
Distribution of slum households (%)	60.8	33.5	5.7	100	-	-
Monthly per capita expenditure (in	4,165	4,772	5,125	4,410		
Demographics and human capital						
Household size	4.3	4.2	4.0	4.3		
Dependency ratio (%)	73.6	74.0	45.5	72.1		***
Age of household head	39.9	40.7	40.9	40.2		
Female household head (%)	13.7	13.9	20.0	14.1		
Duration of residence hhold head	11.9	7.1	19.8	10.7	**	*
Literacy rate for adults (%)	48	44.6	53.5	47.2		
Completed primary school for adults	18.0	17.3	18.6	17.5		
School attendance children 7-12 years	83.1	81.2	66.7	82.0		**
Household received relief program (%)	6.1	2.4	0	4.5		
Labor markets						
Share of male adults who are earners	87.6	91.4	90.2	89.0		
Share of female adults who are earners	49.0	54.9	37.8	50.1		
Main source of income from industry	14.0	3.6	13.3	10.5	***	
Main source of income from services	86.0	96.4	86.7	89.5	***	
Housing						
Per capita rooms	0.3	0.3	0.4	0.3		***
Room size (in sq. meters)	12.0	11.9	8.5	11.8		***
Share of renters (%)	60.4	93.0	47.0	70.6	***	**
Monthly rent (in Taka)	2,198	2,932	2,879	2,548	***	
Has separate kitchen (%)	66.2	92.1	36.7	73.2	***	**
Fear of eviction (%)	68.6	14.1	63.3	50.1	***	***
Permanent dwelling structure (%)	5.6	14.7	63.3	11.9	*	*
Semi-permanent dwelling structure (%)	23.8	42.4	3.3	28.8	*	***
Tin-shed dwelling structure (%)	70.5	42.9	33.4	59.2	**	
Jhupri dwelling structure (%)	0.1	0.0	0.0	0.1		
Small size slum (%)	0.6	5.6	0.0	2.3	***	***
Medium size slum (%)	18.2	88.8	0.0	40.8	***	***
Large size slum (%)	81.2	5.7	100.0	57.0	***	***
Access to basic services						
Improved drinking water (%)	98.7	94.7	95.2	97.2		
Improved sanitation, JMP definition	8.7	8.2	10.0	8.6		
Improved sanitation, including shared	80.7	99.5	70.0	86.4	***	
Electricity is main source of light (%)	93.8	99.5	100	96.1	*	

Notes: Bangladesh Urban Informal Settlements Survey 2016. All summary statistics were computed using household weights except for mean monthly per capita expenditure (in Taka), age, literacy rate for adults, completed primary school for adults, school attendance for children 7-12 years, %age of male adults who are earners, %age of female and male adults who are earners, which were computed using population weights. The t-test columns show the results from Wald tests testing whether the difference in means/proportions between slums in public and privately-owned land are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table S2. Summary statistics by quintiles of per capita household expenditure

	Poorest	Q2	Q3	Q4	Richest	All	t-test poorest - richest
Monetary poverty							
Distribution of slum households (%)	16.7	18.7	19.3	21.3	24.0	100	-
Mean monthly per capita expenditure (in Taka)	2,290	3,091	3,831	4,779	8,108	4,410	***
Demographics and human capital							
Household size	5.3	4.6	4.4	4.1	3.6	4.3	***
Dependency ratio (%)	120.4	75.9	75.7	63.4	48.8	72.1	***
Age of household head	41.8	40.6	39.7	40.9	39.1	40.2	
Female household head (%)	16.7	14.9	13.3	15.7	11.6	14.1	
Duration of residence hhold head (years)	9.4	9.7	9.5	11.1	12.6	10.7	
Literacy rate for adults (%)	33.7	37.5	45.1	47.2	61.8	47.2	***
Completed primary school for adults (%)	10.0	13.7	16.8	19.8	22.5	17.5	***
School attendance for children 7-12 years (%)	69.0	78.7	87.6	89.7	90.6	82.0	***
Household received relief program (%)	5.2	7.5	3.6	4.0	3.2	4.5	
Labor markets							
Share of male adults who are earners (%)	90.5	87.9	92.2	86.9	88.6	89.0	
Share of female adults who are earners (%)	55.2	57.0	50.9	51.9	39.3	50.1	***
Main source of income from industry (%)	11.7	17.1	13.7	9.2	4.3	10.5	
Main source of income from services (%)	88.3	82.9	86.3	90.8	95.7	89.5	
Housing							
Per capita rooms	0.2	0.3	0.3	0.4	0.4	0.3	***
Room size (in sq. meters)	11.1	11.6	11.7	12.4	11.8	11.8	
Share of renters (%)	86.6	75.4	73.3	68.6	58.8	70.6	***
Monthly rent (in Taka)	1920	2425	2722	2774	2877	2548	***
Has separate kitchen (%)	72.3	72.1	67.3	71.1	80.2	73.2	
Government owned land (%)	58.0	62.3	72.1	61.6	52.7	60.8	
Non-government and private owned land (%)	37.9	34.5	25.0	30.4	39.0	33.5	
Others and do not know who owns land (%)	4.1	3.2	3.0	8.0	8.3	5.7	
Fear of eviction (%)	37.7	49.7	59.3	47.4	52.1	50.1	*
Permanent dwelling structure (%)	4.9	4.3	9.8	14.9	19.7	11.9	**
Semi-permanent dwelling structure (%)	26.2	26.5	29.9	32.0	28.5	28.8	
Tin-shed dwelling structure (%)	68.8	69.2	60.4	52.8	51.8	59.2	*
Jhupri dwelling structure (%)	0.0	0.0	0.0	0.4	0.0	0.1	
Small size slum (%)	4.4	3.0	0.8	1.1	2.6	2.3	
Medium size slum (%)	42.6	41.2	37.0	40.3	42.6	40.8	
Large size slum (%)	53.0	55.8	62.2	58.6	54.8	57.0	
Access to basic services							
Access to improved drinking water (%)	93.1	94.4	98.2	97.6	100.0	97.2	
Improved sanitation, JMP definition (%)	4.6	7.3	6.0	6.7	16.1	8.6	**
Improved sanitation, including shared (%)	83.2	91.9	82.5	83.8	89.8	86.4	
Electricity is main source of light (%)	93.2	93.6	97.4	96.4	97.9	96.1	

Notes: Bangladesh Urban Informal Settlements Survey 2016. All summary statistics were computed using household weights except for mean monthly per capita expenditure (in Taka), age, literacy rate for adults, completed primary school for adults, school attendance for children 7-12 years, %age of male adults who are earners, %age of female and male adults who are earners, which were computed using population weights. The t-test columns show the results from Wald tests testing whether the difference in means/proportions between slum households in the quintiles 1 and 5 of the per capita household consumption distribution are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table S3. Accessibility of water sources in the previous two weeks

Water source was unusable in the last two weeks for at least one full day	
	(1)
All	12.2
By size of the slum	
Small slums	6.9
Medium size slums	8.1
Large size slums	15.4
t-test small-medium	
t-test medium-large	
By land ownership	
Public	10.2
Private	9.9
Others	-
t-test public-private	
By per capita consumption expenditure	
Poorest	18.4
Second quintile	7.4
Third quintile	10.2
Fourth quintile	15.7
Fifth quintile	10.2
t-test poorest - richest	

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table S4. Who installed the drinking water source?

	Landlord/Middlemen (%)	D-WASA/ DPHE (Central Government) (%)	Private (%)	Mosque/ school/ clinic (%)	NGO (%)	Community leaders (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All	56.8	17.3	3.4	2.6	12.9	3.9	3.0
By size of the slum							
Small slums	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Medium size slums	80.6	5.0	2.3	0.4	3.0	6.3	2.3
Large size slums	38.0	26.8	4.3	4.3	20.5	2.3	3.7
t-test small-medium	***					**	
t-test medium-large	***	***			***		
By land ownership							
Public	39.5	26.9	5.6	0.6	20.6	3.6	3.1
Private	89.7	2.3	0.0	0.5	0.0	5.2	2.3
Others	46.7	3.3	0.0	36.6	6.7	0.0	6.7
t-test public-private	***	***			***		
By per capita consumption expenditure							
Poorest	63.1	11.4	4.4	1.1	12.5	4.0	3.4
Second quintile	56.0	18.8	3.1	2.0	16.5	2.7	0.8
Third quintile	51.9	25.0	4.4	3.0	8.8	3.4	3.6
Fourth quintile	55.7	13.2	2.7	2.7	16.5	4.9	4.3
Richest	57.8	17.7	2.9	3.8	10.6	4.3	2.9
t-test poorest - richest							

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Others include not applicable, use surface water, and do not know.

Table S5. Who manages the main drinking water source?

	Landlord/ Middleme n (%)	D-WASA/ DPHE (Central Government) (%)	Private (%)	Mosque/ school/ clinic (%)	NGO (%)	Community leaders (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All	59.0	9.5	6.6	2.3	2.3	19.3	1.0
By size of the slum							
Small slums	51.7	17.2	0.0	0.0	0.0	31.0	0.0
Medium size slums	62.9	7.4	2.7	0.4	0.0	25.5	1.2
Large size slums	56.5	10.8	9.7	3.7	4.0	14.4	1.0
t-test small-medium							
t-test medium-large					*		
By land ownership							
Public	55.6	12.7	10.4	0.0	3.8	16.7	0.9
Private	67.2	4.9	0.9	0.5	0.0	25.1	1.4
Others	46.7	3.3	0.0	36.6	0.0	13.3	0.0
t-test public-private			**				
By per capita consumption expenditure							
Poorest	58.4	5.5	10.1	0.0	0.0	26.0	0.0
Second quintile	60.5	9.7	9.2	1.0	2.2	17.3	0.0
Third quintile	53.0	12.3	8.2	3.0	2.0	19.8	1.8
Fourth quintile	58.2	10.2	3.6	2.7	5.0	18.7	1.6
Richest	63.7	9.3	3.7	3.8	1.7	16.3	1.4
t-test poorest - richest							

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Others include not applicable, use surface water, and do not know.

Table S6. Who would you report issues with water services to?

	Landlord/Middlemen (%)	D-WASA/ DPHE (Central Government) (%)	Private (%)	Mosque/school/clinic (%)	NGO (%)	Community leaders (%)	No one (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All	54.2	4.2	4.5	1.0	2.1	20.6	11.1	2.3
By size of the slum								
Small	65.5	0.0	0.0	0.0	0.0	31.0	3.4	0.0
Medium	55.2	2.3	2.7	0.0	0.0	23.5	11.7	4.6
Large	53.1	5.7	6.0	1.7	3.7	18.1	11.0	0.7
t-test					*			
t-test								
By land ownership								
Public	52.5	5.4	6.9	0.0	3.5	19.4	12.0	0.3
Private	60.4	2.8	0.9	0.0	0.0	22.7	7.5	5.6
Others	36.7	0.0	0.0	16.7	0.0	20.0	23.3	3.3
t-test			*		*			
By per capita consumption expenditure								
Poorest	60.3	3.4	6.7	0.0	0.0	23.2	6.5	0.0
Second	58.4	7.6	4.1	1.0	1.2	17.5	9.3	0.8
Third	54.7	6.6	4.2	0.0	0.0	26.7	6.2	1.6
Fourth	52.6	3.6	4.5	1.8	6.8	19.4	9.9	1.5
Richest	47.9	0.8	3.7	1.6	1.8	17.3	20.8	6.1
t-test poorest - richest							***	*

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Others include not applicable, use surface water, and do not know.

Table S7. Who installed this toilet facility?

	Landlord/Middlemen (%)	D-WASH D-PHE (%)	Private (%)	NGO (%)	Community leaders (%)	Households (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All	62.6	1.0	0.5	20.0	0.5	14.5	0.9
By size of the slum							
Small	96.6	0.0	0.0	0.0	0.0	3.4	0.0
Medium	83.0	0.0	0.8	4.3	0.8	10.8	0.4
Large	46.7	1.7	0.3	31.9	0.3	17.6	1.3
t-test	**						
t-test	***	**		***			
By land ownership							
Public	48.6	1.6	0.8	27.8	0.3	19.9	0.9
Private	93.0	0.0	0.0	0.0	0.9	5.6	0.5
Others	33.4	0.0	0.0	53.3	0.0	10.0	3.3
t-test	***	**		***		***	
By per capita consumption expenditure							
Poorest	74.0	0.0	0.0	19.4	0.0	5.5	1.1
Second	67.9	2.2	1.9	16.5	1.0	9.5	1.0
Third	66.5	1.0	0.0	19.6	0.0	12.0	1.0
Fourth	51.4	0.9	0.7	30.3	0.0	16.0	0.7
Richest	57.5	0.8	0.0	14.2	1.3	25.4	0.8
t-test	*					***	

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table S8. Who manages this toilet?

	Landlord/Middlemen (%)	D-WASA/ DPHE (Central Government) (%)	Private (%)	NGO (%)	Community leaders (%)	Household (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All	51.3	0.2	0.5	1.5	19.8	24.5	2.1
By size of the slum							
Small slums	48.3	0.0	0.0	0.0	31.0	20.7	0.0
Medium size slums	55.6	0.4	0.4	0.0	25.9	13.1	4.6
Large size slums	48.4	0.0	0.7	2.7	15.0	32.9	0.3
t-test small-medium				**		***	
t-test medium-large							
By land ownership							
Public	48.6	0.0	0.9	2.5	13.0	34.1	0.8
Private	59.3	0.5	0.0	0.0	26.0	9.6	4.7
Others	33.4	0.0	0.0	0.0	56.6	10.0	0.0
t-test public-private			*	**		***	
By per capita consumption expenditure							
Poorest	60.4	0.0	1.1	1.1	23.9	13.4	0.0
Second quintile	59.1	0.0	1.9	1.0	17.3	19.0	1.7
Third quintile	49.4	0.8	0.0	1.0	20.6	26.6	1.6
Fourth quintile	48.1	0.0	0.0	4.5	21.9	24.0	1.5
Richest	43.4	0.0	0.0	0.0	16.6	35.3	4.7

t-test poorest -

*

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Others include mosque/school/clinic, and other categories not specified.

Table S9. Who you report issues related to your toilet facility?

	Landlord/Middlemen (%)	Private (%)	NGO (%)	Community leaders (%)	No one (%)	Others (%)
	(1)	(2)	(3)	(4)	(5)	(6)
All	55.9	0.6	1.9	21.7	15.4	4.5
By size of the slum						
Small slums	65.5	0.0	0.0	31.0	3.4	0.0
Medium size slums	57.9	0.0	0.0	25.9	11.2	5.0
Large size slums	54.1	1.0	3.4	18.4	18.8	4.4
t-test small-medium						
t-test medium-large		*	*			
By land ownership						
Public	54.0	0.9	3.1	16.4	21.5	4.1
Private	63.3	0.0	0.0	25.6	5.1	6.1
Others	33.4	0.0	0.0	56.6	10.0	0.0
t-test public-private		*	*		***	
By per capita consumption expenditure						
Poorest	64.7	1.1	1.1	24.1	8.9	0.0
Second quintile	62.1	1.0	2.0	17.3	12.4	5.1
Third quintile	57.0	0.0	3.0	25.5	11.0	3.6
Fourth quintile	52.4	0.9	2.7	22.8	15.4	5.7
Richest	47.2	0.0	0.8	19.6	25.6	6.8
t-test poorest - richest	*				***	*

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table S10. Payments for water services

	Share of households who are renters (%)	Share of renters whose rent includes water utilities (%)	By dwelling owners (in Taka per month)	Budget shares for dwelling owners (%)
	(1)	(2)	(3)	(4)
All	70.6	89.2	168.9	1.00
By size of the slum				
Small slums	96.6	100	-	-
Medium size slums	82.2	96.2	308.3	1.9
Large size slums	61.2	81.9	155.3	0.9
t-test small-medium	**	**		
t-test medium-large	***	**	**	
By land ownership slum				
Government	60.4	83.5	168.9	1.0
Private	93.0	97.5	-	-
Others	46.7	71.5	-	-
t-test public-private	***	**		
By per capita consumption expenditure				
Poorest	82.1	91.7	108.2	1.0
Second quintile	76.3	92.0	152.7	1.3
Third quintile	74.5	86.1	211.8	1.3
Fourth quintile	67.3	89.9	179.4	0.9
Fifth quintile	57.8	86.5	178.4	0.7
t-test poorest - richest	***			

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01. Budget shares are based on total household consumption (food, non-food, and housing).

Table S11. Share of renters whose rent payments includes utilities (%)

	Water	Sanitation	Electricity	Gas
	(1)	(2)	(3)	(4)
All	89.2	5.7	85.7	66.1
By size of the slum				
Small slums	100.00	17.9	82.1	85.7
Medium size slums	96.2	2.8	91.1	75.6
Large size slums	81.9	7.7	80.8	55.8
t-test small-medium	**			
t-test medium-large	**			*
By land ownership				
Government	83.5	7.4	82.9	49.4
Private	97.5	3.5	89.7	85.4
Others	71.5	7.1	78.6	71.5
t-test public-private	**			***
By per capita consumption expenditure				
Poorest	91.7	7.0	89.0	62.1
Second quintile	92.0	6.2	83.3	60.4
Third quintile	86.1	6.7	84.9	63.8
Fourth quintile	89.9	4.5	86.9	71.6
Fifth quintile	86.5	3.9	84.5	72.8
t-test poorest - richest				

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * p<0.1, ** p<0.05, *** p<0.01.

Table S12. Payments for use of sanitation facilities

	By renters who do not have service included in rent (in Taka per month)	By owners (in Taka per month)	Budget shares for renters who do not have service included in rent (%)	Budget shares for owners (%)
	(1)	(2)	(3)	(4)
All	48.2	36.3	0.4	0.2
By size of the slum				
Small slums	90	-	0.86	-
Medium size slums	47.4	48.3	0.39	0.2
Large size slums	43.6	33	0.25	0.2
t-test small-medium				
t-test medium-large				
By land ownership				
Public	48.7	32.7	0.4	0.2
Private	50.4	50.0	0.4	0.2
Others	35.0	40.0	0.2	0.3
t-test public-private				
By per capita consumption expenditure				
Poorest	44.2	20.0	0.45	0.2
Second quintile	41.5	30.0	0.39	0.2
Third quintile	55.3	37.8	0.28	0.3
Fourth quintile	52.5	47.1	0.29	0.2
Fifth quintile	53.8	38.4	0.3	0.2
t-test poorest - richest		**		

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. The t-tests rows show the results from Wald tests testing whether the difference in means/proportions are significant at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Budget shares are based on total household consumption (food, non-food, and housing).

Table S13. Location of water sources reported by D-WASA clients

	D-WASA			
	installed water source (%)	manages water source (%)	is accountable for water source (%)	collects payment (%)
	(1)	(2)	(3)	(4)
In own dwelling	14.6	7.9	8.3	-
In own yard/plot	50.7	38.2	42.0	82.3
Elsewhere - outside slum	10.9	19.0	27.1	17.7
Elsewhere - somewhere inside slum	23.8	34.9	22.7	-
Share of slums households (%)	17.5	9.3	4.2	5.5

Notes: Bangladesh Urban Informal Settlements Survey 2016. Small size slums include 5-10 households, medium size slums include 11-200 households, and large size slums include more than 200 households. Quintiles are estimated based on per capita household consumption. Accountable for water sources refers to if your water source is not functioning and you or any of your neighbors cannot fix it, who would you report the problem to.