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## **WATER AND SANITATION IN URBAN SLUM: A CASE FROM BANDUNG MUNICIPALITY, WEST JAVA, INDONESIA**

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**Abstract.** Providing equal access among urban quintiles is the main challenge in urban water and sanitation sector. This paper tries to depict the choice and behavior regarding drinking water and sanitation of 127 slum households in Bandung Municipality. Issues explored using close-ended questionnaires are socio-economic condition of households; existing condition and use of water and sanitation facilities and strategies in obtaining desired service level of water and sanitation. The results were analyzed using descriptive statistical method with distribution of percentage. It is suggested that households commonly use both improved and unimproved water sources, and low coverage of piped water results in reliance on decentralized drinking water sources in urban slum setting. Moreover, inadequate sanitation poses households to enteric contamination of water sources and health risks, but may be counterbalanced with high dependency on bottled water. The study also proposes the importance in securing technical norms and regulation for decentralized water and sanitation options and promoting household water treatment and safe storage practices.

**Keywords:** *drinking water, sanitation, slum household*

### **1 Introduction**

Indonesia is undergoing a steady urbanization; within 2005 to 2030, urban population in Indonesia is predicted to increase by 74% [1]. It is generally expected that urbanization will be concentrated in Indonesian mega-cities, such as Jakarta, Surabaya, Medan, and Bandung [2]. The rapid growing of cities is often faced with the flourish of densely populated area characterized by substandard settlements and disparities in basic service, e.g. water and sanitation which are often scarce or have a poor quality in urban slum dwellings.

Although Government's commitment to improve access of water and sanitation had advanced significantly, progresses are still low and challenges on providing equal access among urban quintiles are still unresolved. Even in the area with high access to improved drinking water, studies have found that drinking water accessed by the community often has low quality, inadequate quantity, cannot be accessed for 24 hours, or unaffordable [3]. Combination of low service quality by public institutions, limitation of resources in poor communities, and high demand of this vital infrastructure as the very basic need, has led to a flourishing informal service provision or needs-driven practices in urban areas [4], such as water vending and groundwater exploitation.

Meanwhile, in sanitation sector, the use of water toilets is well established and roughly three quarters of urban households have a typically pour-flush toilet but very few households dispose their wastewater safely [5]. As a result, many water sources are contaminated by enteric microorganism, reflecting poor sanitation facilities in Indonesia. For example, *E. coli* were isolated from most drinking water samples in Jakarta and was mainly caused by waste water discharges the rising of waste water infiltration into the water sources [6], and this is occurring in many surface and groundwater sources throughout areas with inadequate sanitation facilities.

To provide people living in slum area with proper drinking water and sanitation is in line with Target 7C and Target 7D of Millennium Development Goals. Target 7D strives, by 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers. This might be accomplished by also trying to meet the 7C target, by halving the population without improved water drinking water and sanitation. This may serve as a proxy endeavor to improve the state of health of urban slum dwellers. The efforts in doing so can only be achieved with the good understanding on real state and demand of slum households in water, sanitation, and hygiene. Therefore, this paper tries to depict the choices and behavior of slum households in Bandung Municipality, as a study case, regarding drinking water and sanitation. This paper also proposes some recommendations in improving access and service quality of water and sanitation in such area.

## **2 Instrument and Method**

Structured interviews were conducted to slum households distributed in 5 subdistricts in Bandung Municipality, namely Andir, Sumur Bandung, Rancasari, Bojongloa Kidul, and Cibeunying Kidul Subdistrict. There were 127 slum households selected based on Slovin formula [7], two-stage cluster method [8], and random walk and quota sampling [9]. Slum population was selected since it is particularly emphasized as national priority in the policy of Millennium Development Goals acceleration in Indonesia [10]. Issues explored are socio-

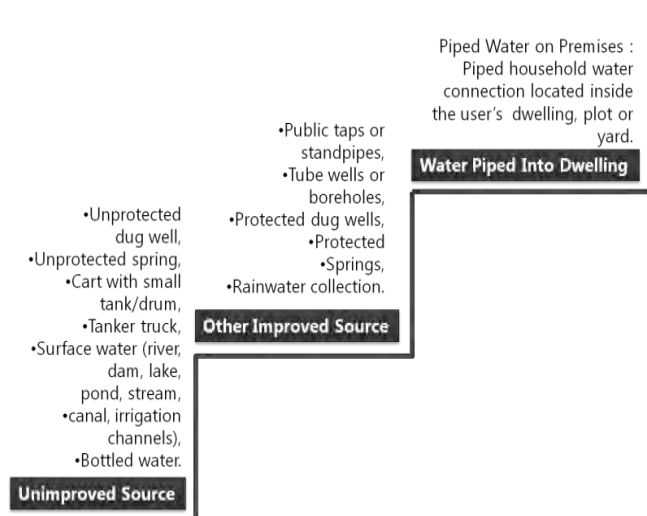
economic condition of households; existing condition and pattern of use of water and sanitation facilities and strategy in obtaining desired service level of water and sanitation. The results were analyzed using descriptive statistical method with distribution of percentage.

### 3 Data and Analysis

#### 3.1 Socio-economic aspect of respondents and households

The majority of respondents are housewives or work at home in which 88.19 % are women and 87.40% are married. Moreover, 38.58% are primary school graduates; 27.56% are junior high school graduates and 25.98% are high school graduates. Meanwhile, within the household, in average there are two families living in the same roof. It is not unusual that the grown and married daughters or sons are still living together with their parents due to social and economic reason. Majority of the families interviewed were not recently immigrated from other cities or districts since they have been living in Bandung for 37 years, in average. Based on interview, 53.54 % of respondents stated to have household income under Minimum Regional Salary Year 2012. Nevertheless, 73.2 % respondents own a permanent house; this could be a motivation to invest in installation of adequate drinking water and sanitation facilities.

#### 3.2 Drinking water and sanitation in slum households



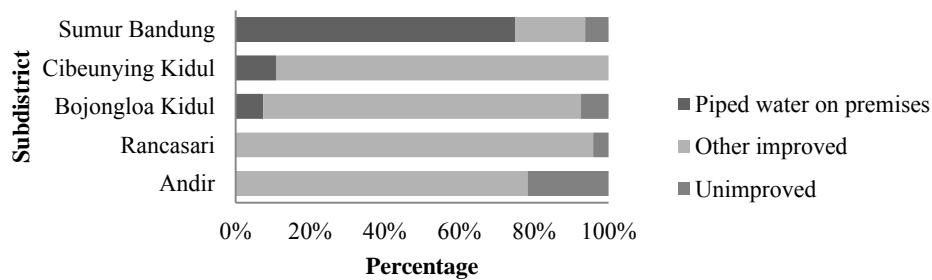
In this study, drinking water is classified according to the three-step ladder used by WHO/UNICEF Joint Monitoring Program (JMP), which consists of piped water in premises – in which water is piped into dwelling, plot, or yard; other improved source and unimproved source (see Figure 1).

**Figure 1** Classification of three-step ladder of drinking water based on JMP classification [11].

Table 1 below elaborates sources of drinking water available in slum households while Figure 2 below shows drinking water sources in study area based on JMP classification.

**Table 1** Drinking water sources in slum households.

<i>Household Water Source</i>	<i>Andir</i>	<i>Rancasari</i>	<i>Bojongloa Kidul</i>	<i>Cibeunying Kidul</i>	<i>Sumur Bandung</i>
Piped water on premises	-	-	1	5	12
Public tap	-	1	-	4	6
Borehole	16	22	21	28	2
Protected dug well	3	2	4	11	2
Protected spring	-	-	-	1	-
Unprotected dug well	-	-	-	-	1
Water from vendors	9	-	4	1	-
Bottled/re-filled water	13	20	10	15	4
Other source	1	1	1	-	-



**Figure 2** Drinking water sources in slum households based on JMP three-ladder classification (n=127).

According to Table 1 and Figure 2, piped water supplied by local PDAM (Municipal Drinking Water Supplier) were only found in 3 out of 5 subdistrict surveyed, which are Bojongloa Kidul, Cibeunying Kidul, and Sumur Bandung. In total, piped water in premises only covers 14% of the respondents. Meanwhile, Figure 2 indicates that from 127 households surveyed, 94% of them have access to piped water or other improved drinking water sources, and only a small percentage that relies on unimproved water sources (6%). But, it was found that 66% of households are using multiple water sources, especially water from vendors and

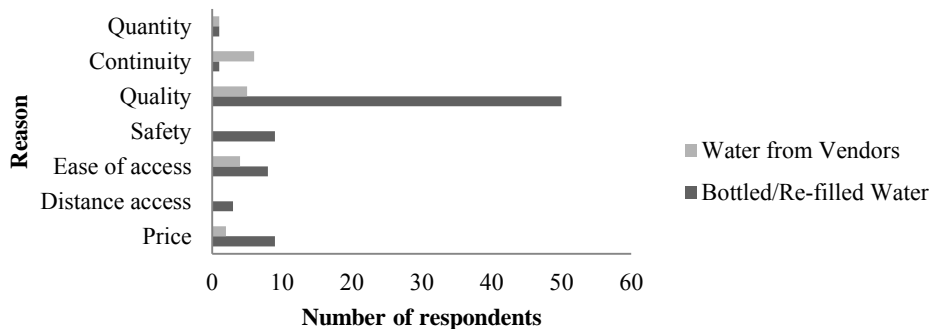
bottled water as two unimproved water sources commonly used with piped water or other improved water sources.

Table 2 below shows the pattern of water use in slum households to six water sources daily used by households.

**Table 2** Water uses in slum households (%).

<i>Water Use</i>	Piped water on premise (n=18)	Public tap (n=11)	Borehole (n=89)	Protected dugwell (n=22)	Water from vendors (n=14)	Bottled water (n=62)
Drinking	88.89	18.18	41.11	25.00	57.14	98.41
Cooking	88.89	45.45	73.33	45.83	92.86	31.75
Bathing	16.67	54.55	95.56	83.33	64.29	0
Handwashing	27.78	27.27	94.44	83.33	64.29	0
Toilet flushing	72.22	36.36	95.56	83.33	64.29	0
Laundry	61.11	54.55	95.56	83.33	64.29	0
Others	0	9.09	3.33	0	0	0

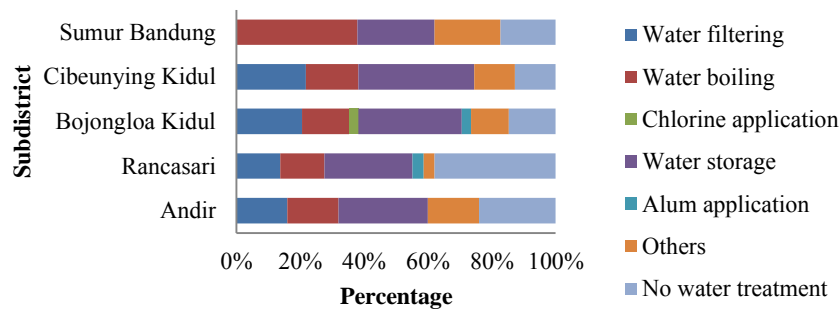
Table 2 above indicates that majority of households who have access to piped water are willing to use the water for drinking and cooking, but households who have access to other improved water sources, such as tap water, borehole, and protected dugwell are not willing to use the water for such purposes. Meanwhile, water from vendors and, particularly, bottled water, are two very popular choices for water for drinking purpose despite their higher price compared with water from improved sources. Figure 3 below shows the reason for using unimproved water sources among respondents.



**Figure 3** Number of respondents' answers on reason for using unimproved water sources.

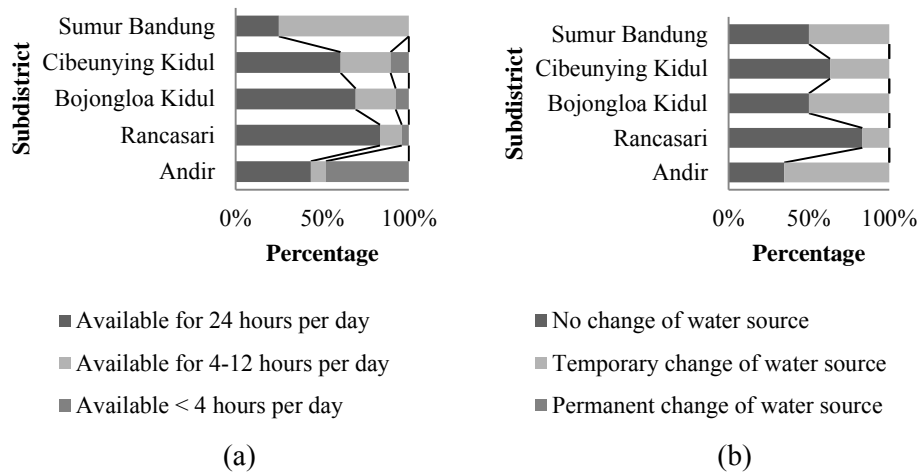
As shown in Figure 3 above, majority of respondents stated that quality of water is the main reason of their multiple water source use and use of unimproved water sources for drinking water and cooking. In term of quantity and continuity, water from borehole is quite reliable especially in wet season, but households testified that water from borehole has a yellowish color and certain turbidity so they refuse to use it as drinking water source.

In tackling the issue on water quality, Figure 4 below shows household water treatments as strategies in obtaining desired quality level. Water boiling is the most popular strategy in increasing water quality. Based on the survey, 98% respondents believe that unboiled water can contain dangerous pathogens and 84% believe that water that has been filtered still needs to be boiled. The efficacy of boiling based on water temperature and pathogen survival had been discussed. It was stated that boiling water in  $^{\circ}\text{C}$  will kill most of pathogen including *Giardia lamblia*, *Escherichia coli*, and enteric viruses [12].



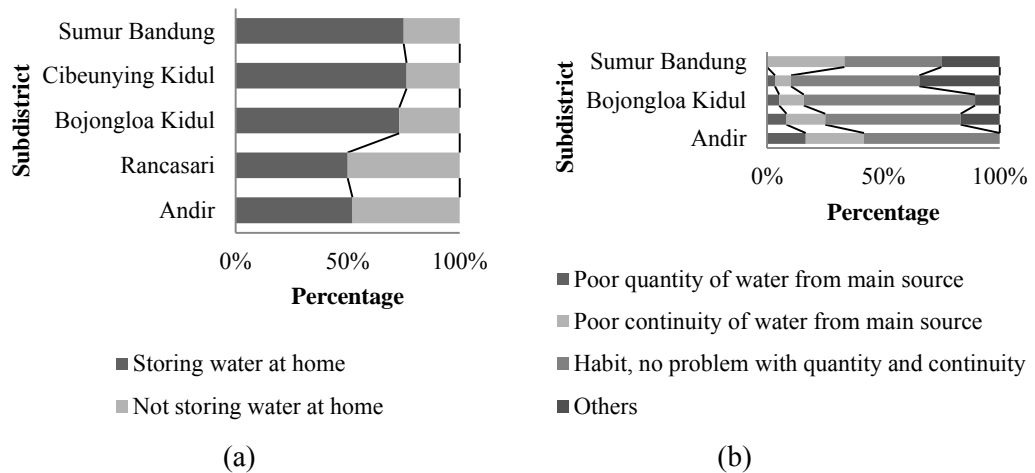
**Figure 4** Selection of household water treatment and storage.

Figure 5 below shows continuity of drinking water sources in slum households and whether people will find other water sources permanently when there is no water from main sources. According to Figure 5(a), 59.06% of main water sources used by households are reliable for 24 hours, but 26.77% can only be accessed for 4-12 hours per day and 14.17% are only for less than 4 hours per day. When access is scarce (see Figure 5(b)), 57.5 % still choose to use water from the main source, while 47.5% choose to temporary shift to other water source, for example, by buying water from vendors. This emerging market in water sector, particularly for the urban poor, which is based on cost recovery basis is wrought with socioeconomic consequences that need to be taken into account; but in the other hand, eradicating it will also limit access of water for the urban „water poor „,[4].



**Figure 5** (a) Continuity of drinking water sources in slum households; (b) Strategy while having no access to drinking water in slum households.

Figure 6 below demonstrates behavior on storing water at home along with its reasons.



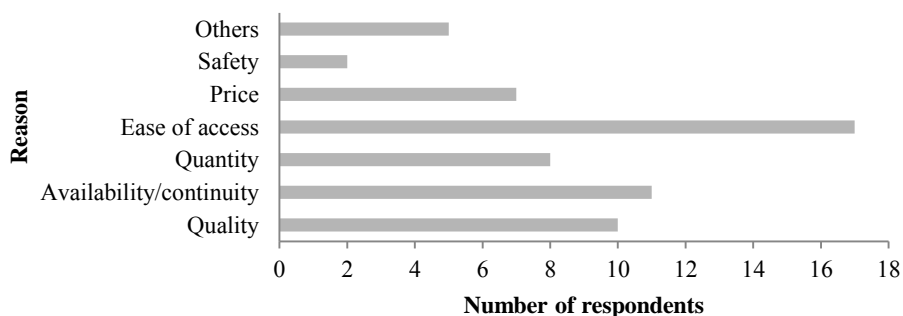
**Figure 6** (a) Behavior on storing water at home in slum households; (b) Reason for storing water at home in slum households.

As shown in Figure 6(a), 66.14 % of respondents are used to store water at home and the rest of respondents do not like to do so. Poor quantity and quality of water from the main source are the reasons for storing water for 5.95 % and 15.47% of respondents, respectively. Although storing water is one of coping strategies practiced by slum households, safety of the water stored needs to be taken into consideration. As much as 40% of households that perform water storage practice



use open containers for storing water at home, and this put risk of contamination to water vessels. Investigation on water quality in slum households has been conducted and it was found that all bacterial contamination of drinking water occurred due to post-source contamination during storage in the household [13]. The same study also suggested that safe storage and household water treatment interventions may improve water quality in slums [13].

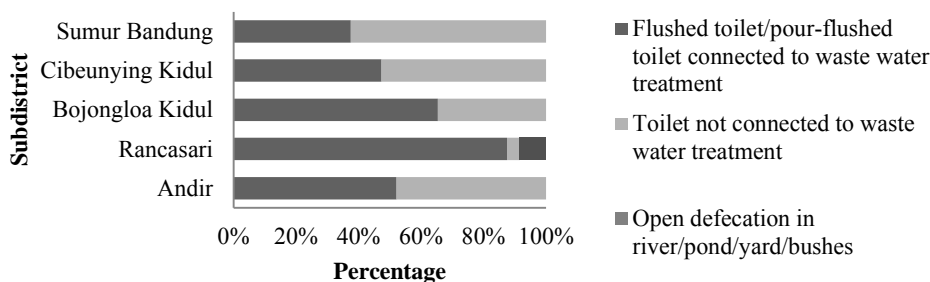
Next, trust level to the service provider is discussed. As much as 66% respondents stated that, to their knowledge, there are no government's drinking water provision program within their neighborhood, and only 34 % stated that government's programs are available. But unfortunately, only 16.3 % of respondents who have access to water sources from government program are willing to use the water as a single source; 32.6 % are willing to use it with water from other sources, and 51.2 % refuse to use it at all. Figure 7 below depicts reasons for not willing to use water from government's program or willing to use the water from government's program together with other water sources.



**Figure 7** Reasons for not willing to use water from government program; or willing to use water from government program together with other sources.

According to Figure 7, ease of access is the main reason of the reluctance of people for using water from government program as the main household's water source. Others state they also have issue with continuity, quality, quantity, and price.

In study area, groundwater has become the main water sources for many households. In this case, sanitation will be one of contributing factor to water quality. Figure 8 below shows types of sanitation facilities owned by slum households. It is shown that many households are still not connected with any waste water treatment. Faecal material are dumped daily into receiving water bodies nearby. From the survey, only 33% of households are connected to a septic tank, the most common on-site domestic waste water treatment in urban Indonesia.



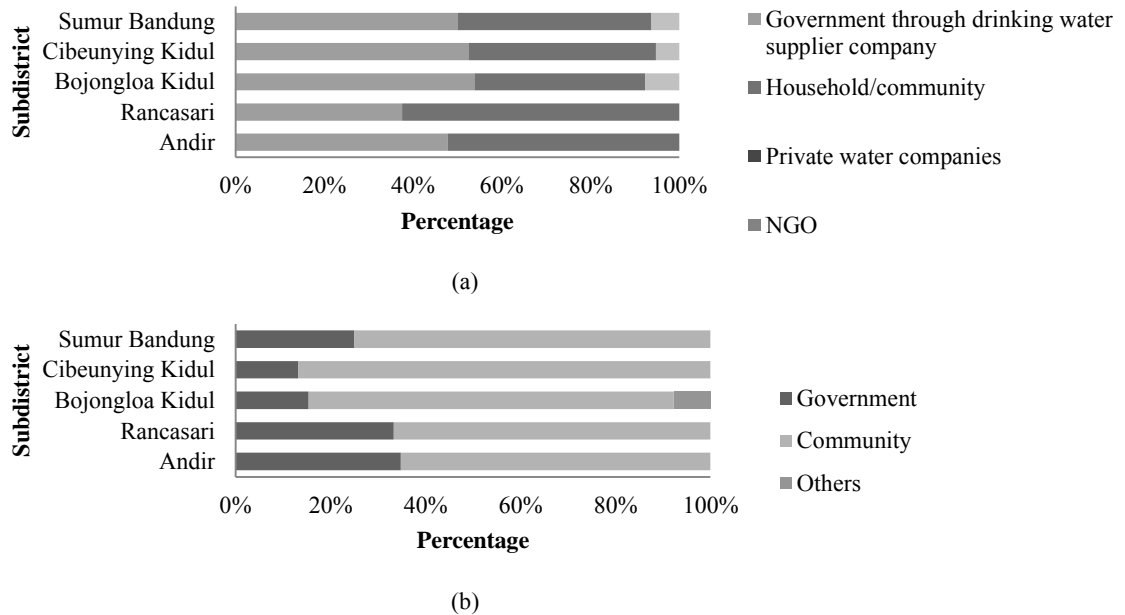
**Figure 8** Sanitation facilities in slum households.

Moreover, as shown in Figure 8 above, in Rancasari Subdistrict, one of the outer subdistrict of Bandung Municipality adjacent to Bandung Regency, people still practice open defecation in the river, pond, or yard. National and international initiatives to improve access to water and sanitation in the developing world tend to neglect the peri-urban context [4]. Also, there is evidence that a greater proportion of residents in the outer zones of city cores have poorer access to services and a lower standard of living [14]. Even so, the effect of poor sanitation on health may be compensated by the use of bottled water, instead of groundwater, as primary potable water sources for those without access to piped water.

Figure 9 below shows stakeholder in whom the respondents feel should be responsible for providing water supply and sanitation service for the slum households. Figure 9(a) shows that 48.82% feels the government through PDAM that should be responsible for that, and 47.24% feels that the community itself should strive to look for potable water sources and water for daily uses. This indicates a low trust level with the service quality of water supply from government agency, but in contrast, this can also be a good basis for building sustainable community-based drinking water system for the marginalized urban dwellers.

Meanwhile Figure 9(b) shows that 76% of respondents feel that households are the ones that should be responsible for sanitation provisions. For long, households bear the burden of sanitation provision; there was a paradygm that sanitation is a private matter and little attention were made by the local officials for enhancing service quality within this sector. Public expenditure on sanitation and sewerage development has been minimal over that last decade, reflecting a longheld de facto view that responsibility for sanitation investments lies with households [5]. But, since 2010, government commitment to urban sanitation has grown remarkably; 12 cities have developed city sanitation strategies and have started to implement them, there has been an increase in government budgets for sanitation of 300%, and

adoption of a national roadmap entitled “Accelerated Development of Sanitation in Human Settlements 2010-2040” in over 3 cities [15].



**Figure 9** Perception on stakeholders who responsible for (a) drinking water service; (b) sanitation service provision for slum households.

#### 4 Discussion and Recommendation

Despite high access to improved water sources, safety, reliability and other elements of service quality of household water sources are still compromised. Contaminations at the point-of-use are likely and there are risks for waterborne diseases among slum households. Piped drinking water, which undergone full set of drinking water treatment to eliminate microbial, physical, and chemical agents that may pose people to health risk, cannot be accessed by many of slum households. Therefore, needs-driven practices, including informal sector vendors such as push carts, use of re-filled bottled water and buying water sold from privately owned wells are thriving. Households also invest in several means of household water treatment and storage to get better drinking water in term of quality and reliability.

Those abovementioned are coping strategies of slum community members in gaining desired level of service. When centralized water treatment is absence, the responsibility of securing the safety of drinking water falls to consumer by default

[16]. The most popular method is boiling water, in which despite its efficacy, it provides no residual protection, is associated with scalding and economically and environmentally unsustainable [16]. Guidelines and advocacy on safe water storage and home water treatment in study area are still very limited. Therefore it is important to establish a technical norms for advocating and promoting such guidelines.

The findings in this preliminary study are also in line with a investigation journalism in urban Bandung which captured governance failure in drinking water service provision for low income communities, reflected by low piped-water service proportion, inadequate quality, quantity, and continuity, the presence of privatization in several tiers that undermining the poor's ability to gain access illegal connections, high cost burden to the poor, and low trust to the public service provider [16]. Surges of optimism in improvement of water and sanitation provision are linked to the BAPPENAS policy in prioritizing acceleration of Target 7c MDGs to the urban poor [10] and decentralized model of service provision which provide opportunities as well as disputes. Before 2001, Indonesia has a highly centralized planning and development of basic infrastructure, while operation and maintenance was assigned to local governments, therefore weakening ownership, accountability and capacity development at local level and [17]. Today, decentralized governmental system in Indonesia, especially with the enactment of Government Regulation No.38 Year 2007 regarding Distribution of Governmental Affairs and Government Regulation No.16 Year 2005 regarding Drinking Water Supply System, makes the municipal/regency government is responsible for urban water and sanitation. Advocates of decentralisation argue that decentralised governments have an information advantage over the central government with regard to local needs and priorities, for which reason they are assumed to supply services in accordance with demand, allocate resources more equitably, and ultimately conceive and implement policies with a focus on poverty reduction [18]. Such information is often missing in many developing countries; but even when it is available, there is no guarantee that it is adequately exploited for planning and monitoring purposes [18], despite the common rule of thumb that every policy formulation in service development must be based on informed-decision making. Therefore, by optimizing tools for building sound data base in water and sanitation sector, local government can formulate pro-poor strategies for improving access and service quality to the most vulnerable urban population. This is will particularly challenging in the area with highly decentralized and informal water and sanitation service, such as Bandung.

## 5 Conclusion

Being recognized as human right, achieving sustainable urban water system to ensure equal access of water and sanitation for all urban dwellers is never more important than now. From this study, it is suggested that households commonly used both improved and unimproved water sources, and low piped water coverage results in reliance on decentralized drinking water sources in urban slum setting. Moreover, inadequate sanitation poses households to enteric contamination of water sources and health risks, but may be counterbalanced with high dependency on bottled water. Although government's commitment in water and sanitation have improved significantly, the urban water and sanitation challenges have not been resolved. Active participation from household in adoption of improved drinking facilities as well as hygiene practices also play a great role in improving urban health as the outcome of safe drinking water and adequate sanitation. Furthermore, securing technical norms and regulation for decentralized water and sanitation options and promoting household water treatment and safe storage practices should be prioritized. This is particularly useful when many households relies on non-piped, informal water sources.

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