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Research Paper

Revealing Conditions of Detailed Water Usage, Daily Life Water Quality, and Awareness Related to Waste Water at Urban Kampung in Indonesia

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Abstract

This research aimed to investigate the actual water use of residents and the quality of well water used daily at the urban kampung located in Bandung, Indonesia. The status of wastewater treatment and residents' awareness of the water environment were also investigated in the target area. The methodology used included a survey of residents, water quality testing, and an assessment of wastewater practices. The results showed that approximately one-half of the respondents used water from the water utility, with the other half using well water as their main domestic water source. Identifying water sources by end-use revealed that residents mainly used bottled water for drinking and cooking. Since *Escherichia coli* was detected in many wells, it is not recommended that residents drink well water without disinfection. In addition, most of the wastewater in the area was discharged into a nearby river without treatment.

Keywords: groundwater quality; urban kampung; detailed water use; questionnaire survey.

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1. Introduction

Water is a resource that is indispensable for the survival of not only humans but also all living things on earth. In particular, clean and safe water is essential for human life. However, many water-related problems remain unsolved globally. Goal 6 of the Sustainable Developing Goals (SDGs) aims to provide safe water and sanitation worldwide (United Nations Department of Economic and Social Affairs). Its targets include "access to safe and affordable drinking water for all," "access to adequate and equitable sanitation and hygiene for all," and "halving the proportion of untreated wastewater" by 2030. However, in 2022, 2.2 billion people could not access safe and controlled water supply services. Furthermore, 3.5 billion people could not access safe and controlled sanitation facilities (United Nations Children's Fund (UNICEF) and World Health Organization (WHO), 2023). Many countries have low Wastewater treatment rates (United Nations UN Water).

Southeast Asia has experienced rapid economic development and population growth in recent years, accompanied by an increasing demand for water each year. However, the water infrastructure that forms the foundation of people's daily lives has not kept pace in some areas. The Republic of Indonesia, including the target area of this research, is no exception. Improving access to safe water and sanitation remains a challenge, particularly in urban communities with rapid development (Putri and Moulaert, 2017; Putri, 2019). As of 2018 in Indonesia, 73% of households had access to "improved water," and 69% had access to "improved sanitation" (Eng et al., 2020). However, the percentage of people accessing safe water has been reported as low, with only around 2% having networked sewage systems (World Bank, 2021). Additionally, the public water authority, known as Perusahaan Daerah Air Minum (PDAM), mainly provides the water supply through a network of pipes. However, many people have not yet received water from the pipe network (Obermayr, 2017). Particularly in informal and densely populated residential areas, known as urban kampungs, many people are unable to access the water provided by a PDAM due to economic reasons or delays in facility development. Therefore, as an alternative to PDAM, community-managed communal wells (CWs) and individual wells (IWs) are used for domestic water (Maryati et al., 2018; Maryati, 2019).

Most of the previous studies regarding community-level water use in Indonesia have been assessed from sociological perspectives, such as the willingness to pay (WTP), the water resource carrying capacity (WRCC), and the city blueprint approach at the urban kampung level (Jiang and Rohendi, 2018; Djuwansyah, 2018; Rahmasary, 2021). However, quantitative information, such as water quality data, has rarely been used for community-level water resources assessment at the urban kampung level, mostly because of a lack of data and observation facilities. For example, a previous study conducted in the Lebak Siliwangi subdistrict, which is the same target area as this study (Suryani et al., 2019), revealed that the water quality is not safe, as *Escherichia coli* (*E. coli*) has been detected in many of the CWs and IWs. However, many residents still use CWs or IWs as their main water source since they are the only available water supply systems with affordable costs. In addition, the concentration of nitrate nitrogen was high in many wells, suggesting that domestic wastewater affected the well water quality. Thus, it is necessary to install wastewater treatment facilities at the urban kampung level in the future. Furthermore, it is also important to ascertain residents' awareness and recognition of wastewater treatment and the nearby water environment, as they will have to bear the cost.

Bottled water (BW) has become a popular water source in recent years (Fulazzaky, 2014). The preliminary study conducted by the authors observed that many households in the target area were using bottled water. It was assumed that residents used different types of water according to their needs and end-use purposes. However, the actual situation is still unknown. Imami et al. (2024) investigated the amount of domestic water consumption, depending on residents' needs, through field surveys and questionnaires at the urban kampung level. Thus, investigating the quality of water used by residents in urban kampungs could represent the next step in raising residents' awareness about their surrounding environment.

The objectives of this research were to investigate the domestic water use situation and assess the relevant water quality. The findings were then compared with data from a previous survey, which was conducted only once during the rainy season in the same area. Continuously accumulating seasonal water quality data will allow us to identify the water environment in urban kampungs. Therefore, in this study, an integrative approach was employed, including an interview-style questionnaire survey and a comprehensive water quality analysis, to clarify the detailed water use conditions in one of the representative urban kampungs, the Lebak Siliwangi subdistrict, in Indonesia. A thorough water sample collection from various water sources in the target area was conducted to analyze the quality of the water used by residents. At the same time, an in-depth questionnaire survey was conducted to reveal residents' awareness of wastewater and the nearby water environment. The novelty of this study lies in the simultaneous collection of quantitative (i.e., water quality data) and qualitative (i.e., residents' awareness) information and its analysis for the purposes of wastewater and environmental management in an urban community. Understanding the situation of water usage, the condition of water quality, and awareness of wastewater and the surrounding water environment can improve access to safe water, as outlined in SDG Goal 6, and help create a sustainable water circulation system in communities.

2. Study Area

The study area is in Lebak Siliwangi subdistricts or villages. The target area was chosen based on the water utility coverage, data availability, and accessibility according to the previous survey. It is part of the Coblong District in Bandung City (see Figure 1). Bandung City is the capital of the West Java province in Indonesia. The city is a part of the Bandung Metropolitan Area (BMA). The Lebak Siliwangi subdistrict, which is the target area of this research, is located in the northern part of Bandung City. The subdistrict is situated along the Cikapundung and Cikapayang Rivers and comprises closely built unregistered houses. The subdistrict is divided into certain areas called RWs (neighbourhood units). The population of the Lebak Siliwangi subdistrict was approximately 3,000 as of 2017 (Lebak Siliwangi Subdistrict Office, 2017) and 3,972 in 2022 (BPS Kota Bandung, 2022). The population is concentrated on four RWs, from RW5 to RW8. The total area of the four RWs is 8.7 ha (Lebak Siliwangi Subdistrict Office, 2017).

Water is supplied from the water utility, i.e., the Tirtawening PDAM, in the Lebak Siliwangi subdistrict. However, the water supply covering ratio in the subdistrict is not high (PDAM Tirtawening, 2020). According to a previous study (Suryani et al., 2019), the main water resources in the subdistrict are PDAM (approximately 50%), CWs (approximately 30%), and IWs (approximately 20%). There are two types of CW. One is a CW with a small piping network (CN). The other is a CW without a network (public well) (Maryati et al., 2021; Maryati et al., 2022). This research categorized both of these types of CW, CN, and public as CW. There are no wastewater treatment systems covering the whole subdistrict. Instead, several pilot treatment plants have been installed in the limited zones.

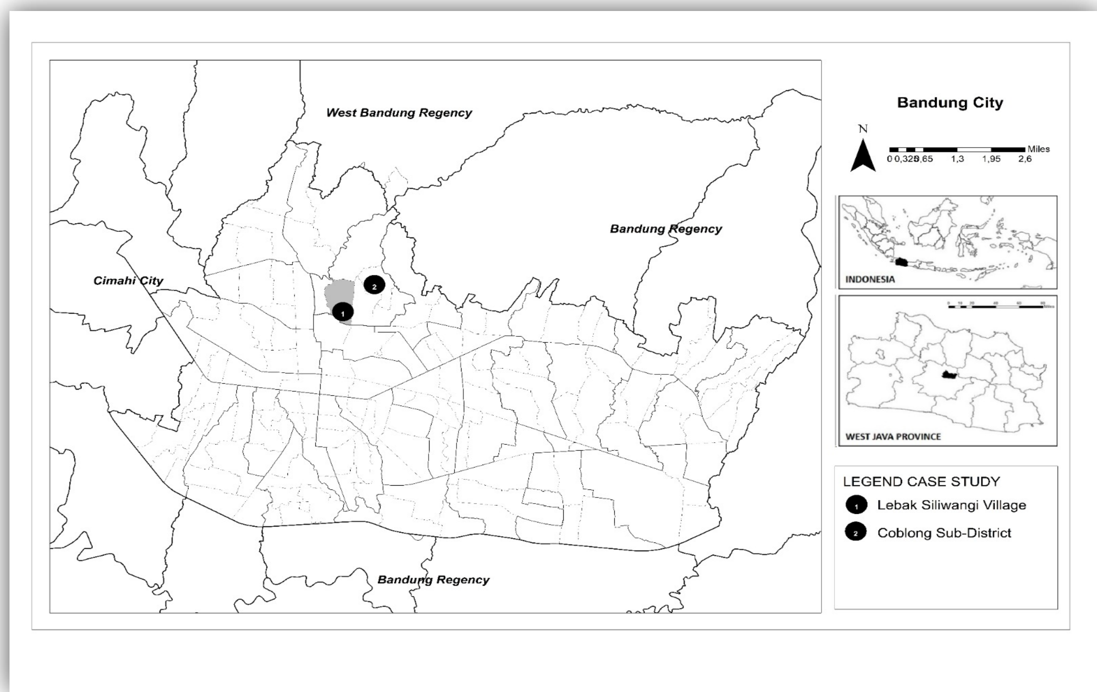


Figure 1. Lebak Siliwangi in the Context of a Wider Administrative Region

3. Methods

3.1 Data Collection

Data were collected from questionnaire distribution and water sample collection. The survey was conducted from 19 to 26 November 2019 (8 days). This research aimed to investigate the seasonal difference in water quality and thus conducted the survey in November since the previous survey of 2018 (Suryani et al., 2019) was conducted in February, which is during the rainy season.

3.1.1 Questionnaire Distribution

The questionnaire was on a cooperation request basis as enumerators randomly visited households in the subdistrict and got the consensus on the spot. The items of the questionnaire ranged from household information, water usage, sanitation conditions, awareness, and willingness to pay (see Table 1). The survey aimed to identify household information related to items in the questionnaire. If a 95% confidence level with a 10% margin of error is considered, more than 94 samples are needed. Thus, this research collected 101 samples.

Table 1. The items of the questionnaire survey conducted in this research.

Item	Content
Household Information	size of household, income
Water Usage	type of water source, main water source, water source for each end-use, water expense, residents' evaluations of water quality (taste, odor, color)
Sanitation	type of sanitation facility
Awareness	river water quality, surrounding environment
Willingness to pay	improvement of river water quality

Source: Authors

3.1.2 Water sample collection

Water samples were collected from CWs and IWs in the Lebak Siliwangi subdistrict (Figure 2). Tap water samples supplied by PDAM were also obtained from faucets in the area. There are 10 CWs and 12 IWs in the subdistrict. The CWs in Figure 1 are alphabetically labeled following the previous study in order to facilitate a comparative analysis. The collected water samples were stored in a 100-mL sterilized bottle. Table 2 shows the water quality parameters investigated in this research. Water sample collection from CWs was conducted twice during the survey period. The pH, Electric Conductivity (EC), *E. coli*, and the coliform group were analyzed using first water samples at a laboratory on the campus of the Bandung Institute of Technology. The nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N), ammonium nitrogen (NH_4-N), total organic carbon (TOC), turbidity, and phosphate phosphorus (PO_4-P) were analyzed immediately after the second water samples were collected and brought to Japan. *E. coli* and coliform groups are widely used in water quality guidelines. Since the application of testing methods is relatively easy in developing regions, this research employed *E. coli* and coliform groups as microbial indicators.

In the previous study (Suryani et al., 2019), there were three CWs labeled as H, H-1, H-2, and H-3. However, the second collection of water samples from H-2 and H-3 was not possible due to water pump failure; therefore, water sample collection was performed only once for those CWs.

3.2 Water Quality Analysis

Data from water sample collection was analyzed by various testing methods (see Table 2). The parameters tested include pH, EC, turbidity, *E. coli*, the coliform group, NO_3-N, NO_2-N, NH_4-N, TOC, and PO_4-P. The pH and EC were measured using the pH and EC meter HI98129 (Hanna, USA). Water samples were appropriately diluted with sterile dilution water for the enumeration and measurement of *E. coli* and the coliform group (3M™, D9PBS). Then, the water samples were inoculated into the REC Plate Petrifilm (3M, USA). NO_3-N, NO_2-N, and NH_4-N were analyzed using the High-Performance Liquid Chromatography (HPLC) method, the Naphthylethylene-diamine method, and the Indophenol Blue method. TOC was analyzed using the TOC analyzer (TOC-V, Shimadzu, Japan). Turbidity was measured using the turbidity meter (2100AN, HACH, Germany). PO_4-P was analyzed using the Molybdenum Blue method. The analytical methods for NO_2-N, NH_4-N, and PO_4-P followed Standard Methods for Water Quality Examination (Japan Waterworks Association, 2011), and NO_3-N analysis was performed in accordance with Feed Analysis Methods (Food and Agricultural Materials Inspection Center, 2008). The volume of some of the water samples from IW was insufficient; thus, some water quality parameters could not be measured for IW. In addition, one water sample of PDAM (i.e., tap water), in which the coliform group was detected, was brought to Japan for further analysis.

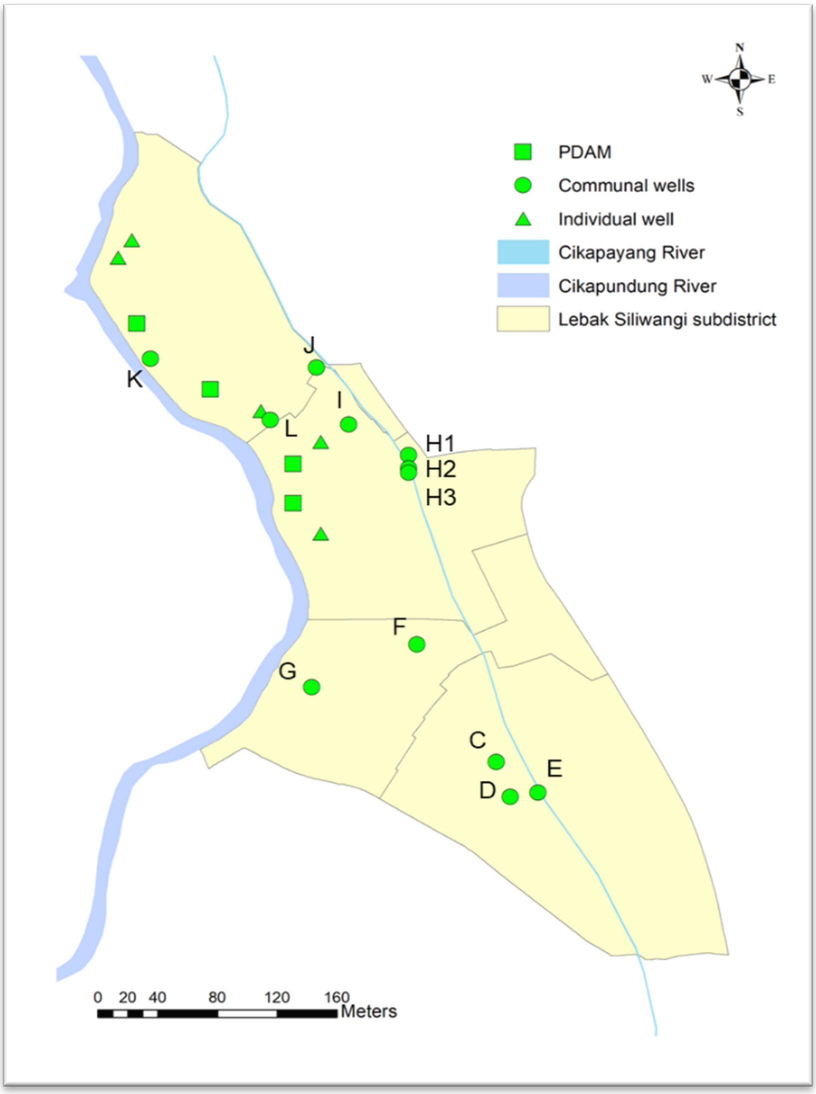


Figure 2. Distribution of Water Sources
Source: Authors' Analysis

Table 2. Water quality parameters investigated in this research.

Parameters	Equipment, Methods
pH Electric Conductivity (EC)	pH and EC meter HI98129 (Hanna, USA).
E. coli Coliform Group	REC Plate Petrifilm (3M, USA)
Nitrate Nitrogen (NO_3-N)	High-Performance Liquid Chromatography (HPLC) method
Nitrite Nitrogen (NO_2-N)	Naphthylethylene-diamine method
Ammonium Nitrogen (NH_4-N)	Indophenol Blue method
Total Organic Carbon (TOC)	TOC analyzer TOC-V (Shimadzu, Japan)
Turbidity	Turbidity meter 2100N (Hach, USA)
Phosphate Phosphorus (PO_4-P)	Molybdenum Blue method

Source: Authors

4. Results and Discussion

4.1 Water usage condition

There were a number of combinations of water source types for the residents in the area. Table 3 shows the condition of water source types used by households. In the target area, many households used multiple water source types, such as a combination of PDAM and IW. The most common combinations, including bottled water (BW), were "PDAM and BW" and "CW and BW". The utilization rates of PDAM, CW, IW, and BW were 61.4%, 25.7%, 31.7%, and 74.3%, respectively. Particularly for domestic use, the utilization rates of PDAM, CW, and IW as the main water source were 52.5%, 19.8%, and 27.7%, respectively. Regarding the reasons for choosing the main water source, a high percentage of respondents selected water quality for all water sources (Table 4). However, compared to the other water sources, CW users were more likely to select the cost, with "cheap" being the dominant reason among them.

The results of median household income and water costs, depending on the main water source, are shown in Table 5. There is a tendency for low household income among CW users, though the difference is not statistically significant. The median household income was IDR 2,700 thousand for households using BW and IDR 3,200 thousand for households not using BW, with the result that households using BW had lower incomes. However, the difference was not statistically significant, suggesting that income did not affect BW use. Residents' evaluations of the taste, color, and odor of each water source were mostly positive, as shown in Table 6. However, PDAM users rated the PDAM water comparatively low for color and odor. Furthermore, IW users rated the IW water slightly lower than the others for color.

Water sources for each end-use purpose of the residents in the Lebak Siliwangi subdistrict are shown in Figures 3 and 4. The results were categorized depending on the main domestic water source, PDAM (Figure 3) or wells (Figure 4). Regarding the main domestic water source, this paper considered both CW and IW as wells. In both main water sources, BW usage is commonly high for drinking, suggesting that the practice of using BW for drinking is somewhat widespread in the area. It should be particularly noted that, although the water quality of CW and IW was not rated poorly, a higher proportion of residents whose main source of water is groundwater use BW for drinking. This implies that many residents consider groundwater to be unsuitable for drinking. A few households use wells for drinking when the main domestic water source is PDAM. PDAM, well, and BW are the dominant water sources for cooking. However, when PDAM is the main domestic water source, it is also used as the dominant water source for cooking. For other end-use purposes, the main domestic water source, i.e., PDAM or wells, is primarily used, regardless of its purpose.

Table 3. Water source types used by households in the Lebak Siliwangi subdistrict.

Water Source Types	n	%
PDAM	11	10.9
CW	2	2.0
IW	7	6.9
PDAM, CW	3	3.0
PDAM, IW	2	2.0
PDAM, BW	34	33.7
CW, BW	15	14.9
IW, BW	14	13.9
PDAM, CW, BW	4	4.0
PDAM, IW, BW	8	7.9
CW, IW, BW	1	1.0

Source: Authors' Analysis

Table 4. Reason for choosing the main water source in the Lebak Siliwangi subdistrict.

Reason for choosing the main water source	Main Source					
	PDAM (n=53)		CW (n=20)		IW (n=28)	
	n	%	n	%	n	%
Quality	33	62.3	11	55	15	53.6
Quantity	25	47.2	8	40	9	32.1
Cheap	3	5.7	6	30	4	14.3
Practically (convenient)	17	32.1	2	10	9	32.1
N/A	4	7.5	1	5	2	7.1

Source: Authors' Analysis

Table 5. Median household income and water costs in the Lebak Siliwangi subdistrict.

Main water source	PDAM	CW	IW
Household Income (thousand IDR*/month)	3,000 (n=52)	2,000 (n=19)	2,500 (n=28)
Water Expense (thousand IDR*/month)	100 (n=53)	20 (n=18)	-

*100 thousand IDR = 7.1 USD (at the end of November 2019)
Source: Authors' Analysis

Table 6. Residents' evaluations of the taste, color, and odor of each water source in the Lebak Siliwangi subdistrict.

Water source		PDAM (n=62)	CW (n=26)	IW (n=32)
Fulfillment of water quality (%)	Tasteless	98.4	100	93.8
	Colorless	82.3	96.2	84.4
	Odorless	82.3	96.2	93.8

Source: Authors' Analysis

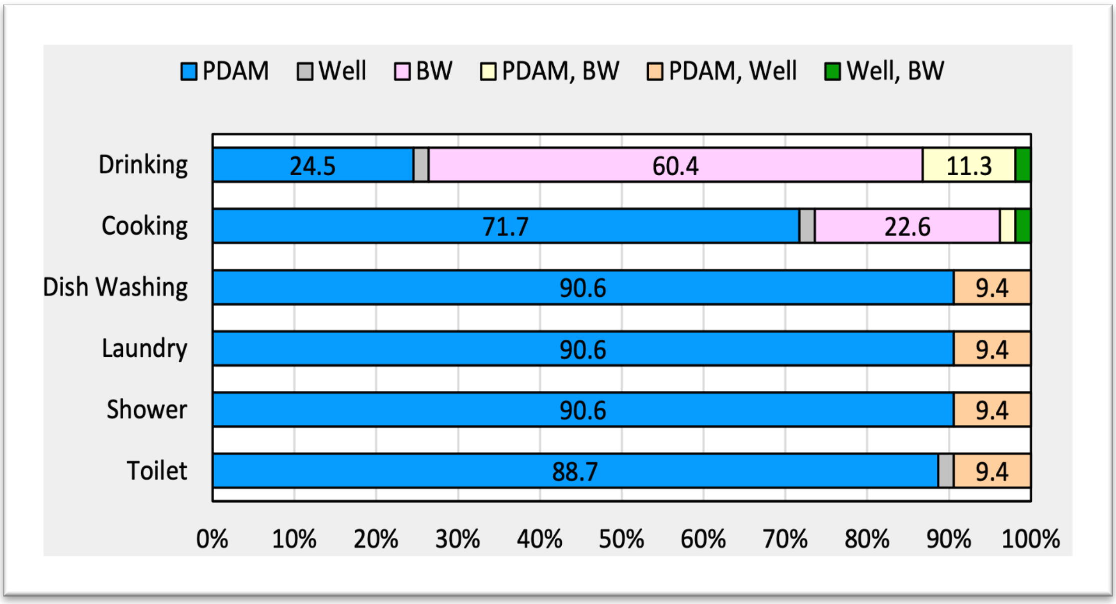


Figure 3. Water sources for each end-use purpose when the main domestic source is PDAM.
Source: Authors' Analysis

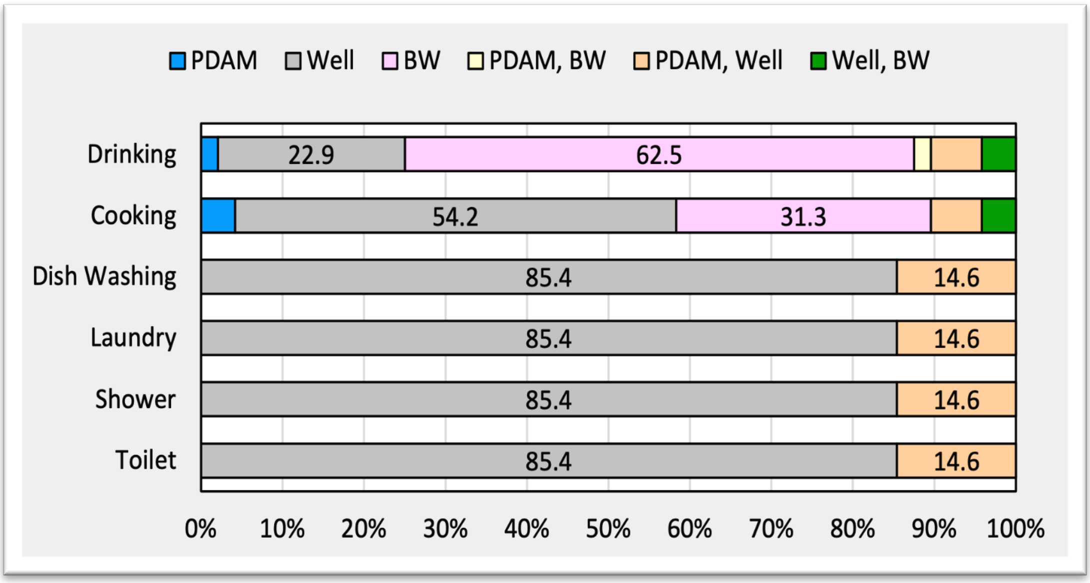


Figure 4. Water sources for each end-use purpose when the main domestic source is CW or IW.
Source: Authors' Analysis

4.2 Water quality of PDAM and wells

The results of the water quality survey are summarized in Table 7. *E. coli* was not detected in water samples from PDAM. However, it was detected in 9 out of 12 water samples collected from CWs and 4 out of 5 from IWs. A comparison of the results of *E. coli* in CWs with the results of the previous survey, conducted in February 2018, is shown in Figure 5. In the survey conducted in 2019 by this research, *E. coli* was not detected in wells D, H-3, or J, as was the case in the previous survey of 2018. The two wells, H-3 and J, are deep wells. In well E, *E. coli* was detected in the 2019 survey, although it was not detected in the 2018 survey.

In the results of water quality analyses, shown in Table 7, the range of EC was similar to that of the previous survey. The concentrations of NO_2-N, NO_3-N, and NH_4-N tended to be higher in 2019 than those in 2018. Seasonal variation might be a factor in these differences, as the survey in 2018 was conducted at the end of the rainy season, while the survey in 2019 was conducted at the end of the dry season. Previous research in other countries has shown that groundwater quality indicators were slightly higher in the dry season compared to the rainy season (Nguyen et al., 2015). Our survey results demonstrated a similar trend. Regular water quality monitoring, which considers the seasonal impacts, is thus necessary to accurately assess water contamination by NO_2-N and NO_3-N in wells. Since a certain percentage of the population uses wells for drinking, as mentioned above, measures to protect against waterborne diseases should be taken, such as installing disinfection facilities and advising the public to boil water. In addition, it is necessary to issue warnings not to use water from wells with high nitrogen concentrations for drinking or cooking.

Table 7. Results of the water quality survey in the Lebak Siliwangi subdistrict

Parameter	Water source					
	PDAM		CW		IW	
	2019 (n=5)	2018 (n=2)	2019 (n=12)	2018 (n=12)	2019 (n=5)	2018 (n=3)
pH (-)	7.2 ~ 7.7	7.3	6.4 ~ 7.5	6.4 ~ 7.2	6.7 ~ 7.3	6.9 ~ 7.1
EC (uS/cm)	242 ~ 344	149 ～ 250	223 ~ 418	265 ～ 448	268 ~ 526	308 ～ 608
E. coli (CFU/mL)	N.D.	N.D.	N.D. ~ 1,510	N.D. ~ 189	N.D. ~ 217	N.D. ~ 500 or more
Coliform Group (CFU/mL)	N.D. ~ 10*	N.D.	N.D. ~ 3,810	N.D. ~ 500 or more	14 ~ 2,860	N.D. ~ 500 or more
NO_3-N (mg/L)	3.5*	0.06 ~ 3.6	0.39 ~ 17**	0.01 ~ 6.3	0.48 ~ 12	0.01 ~ 12
NO_2-N (mg/L)	0.01*	<0.01	<0.01 ~ 0.22**	<0.01	<0.01 ~ 0.61	<0.01
NH_4-N (mg/L)	0.2*	0.01 ～ 0.13	0.14 ~ 1.5**	0.01 ～ 0.58	0.14 ~ 8.5	0.01 ~ 1.3
TOC (mg/L)	3.8*	-	0.76 ~ 3.0**	-	2.8 ~ 8.1***	-
Turbidity (NTU)	5.06*	-	0.13 ~ 13**	-	0.83 ~ 11***	-
PO_4-P (mg/L)	0.09*	-	0.01 ~ 0.45**	-	0.09 ~ 1.1***	-

N.D.: Not detected

* Coliform group was detected in only one of the PDAM samples. For NO_3-N and others, this is the same sample in which coliforms were detected.

** Ten samples were analyzed because a second collection was not possible at two wells.

*** Only two samples were analyzed due to the small sample volume.

Source: Authors’ Analysi

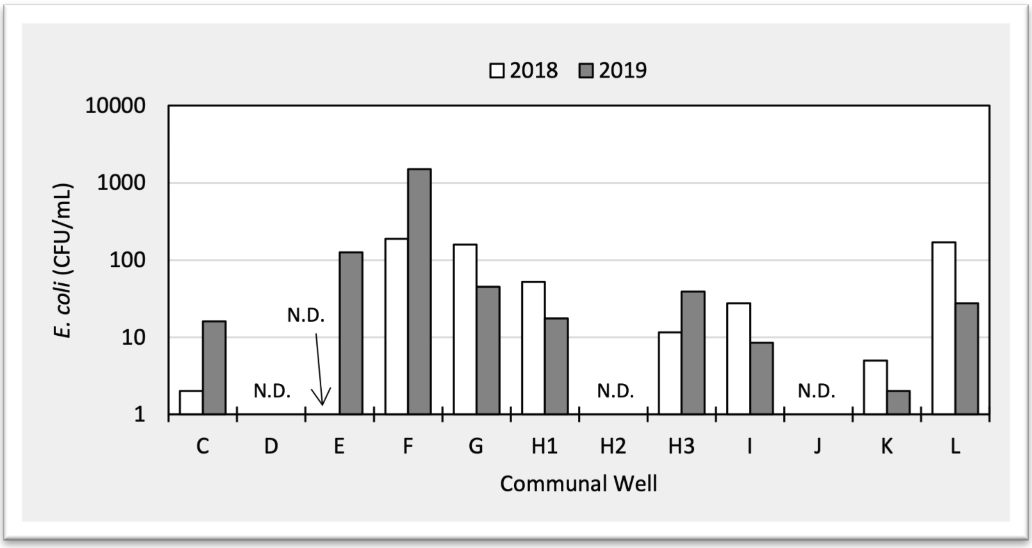


Figure 5. Results of *E. coli* in communal wells in the Lebak Siliwangi subdistrict.
Source: Authors' Analysis

4.3 Sanitation condition and awareness of river water quality

The drainage facilities in the Lebak Siliwangi subdistrict are depicted in Figure 6. It shows that 78% of the facilities discharge untreated wastewater into rivers via pipelines. The usage rate of septic tanks was 17%. Some households used public wastewater systems. With regard to where the wastewater ultimately flows out, 98 out of 101 respondents recognized it as the river.

Regarding the residential environment and the water quality of the nearby river (Figure 7), more than 80% of the respondents described the residential environment as "good"; however, more than 90% categorized the river water quality as "bad" or "very bad." Residents recognized that the water quality conditions of the surrounding rivers are poor.

The median monthly cost that people would be willing to pay (WTP) to improve the water quality of nearby rivers was 13 thousand IDR. In addition, when the median values were calculated according to awareness of river water quality, the WTPs were 15, 10, and 16.5 thousand IDR for those groups that considered the river water quality to be good, bad, and very bad, respectively. Therefore, no difference in WTP was observed based on awareness of river water quality. The relationship between household income and WTP is shown in Figure 8. The plots in the figure are divided based on the awareness of river water quality. The results show that a higher income is not necessarily related to a higher WTP.

In addition, many residents recognized that domestic wastewater flows into the river, deteriorating its water quality. However, their WTP is low compared to the cost of the PDAM. One possible reason for this is that residents believe their lives will not be affected even if the nearby river's water quality remains poor and unimproved. On the other hand, residents might place more importance on using PDAM to ensure safe water for direct use rather than on environmental conservation. Therefore, it is necessary to raise awareness among local communities about the costs of improving river water quality and to improve understanding of the need for wastewater treatment. Furthermore, the cost burden of installing wastewater treatment facilities should also be considered for low-income residents. It is important to consider affordable pricing, including subsidies from various agencies when introducing the wastewater treatment system. At ITB, as the local representative university, students are examining various wastewater treatment methods in the urban kampung at a workshop (ITB SAPPD GLOBAL STUDIO 2022, 2022). This is an important example of a collaboration between the urban kampung and the university to share ideas and tackle local environmental issues together. It is hoped that a sustainable wastewater treatment system will be introduced through activities aimed at raising residents' awareness.

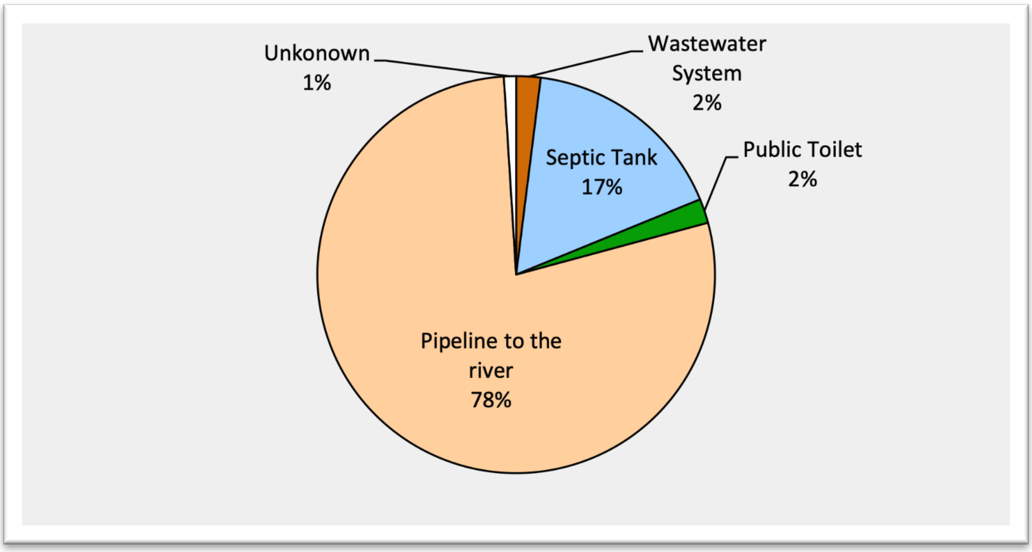


Figure 6. Current drainage facilities in the Lebak Siliwangi Subdistrict.
Source: Authors' Analysis

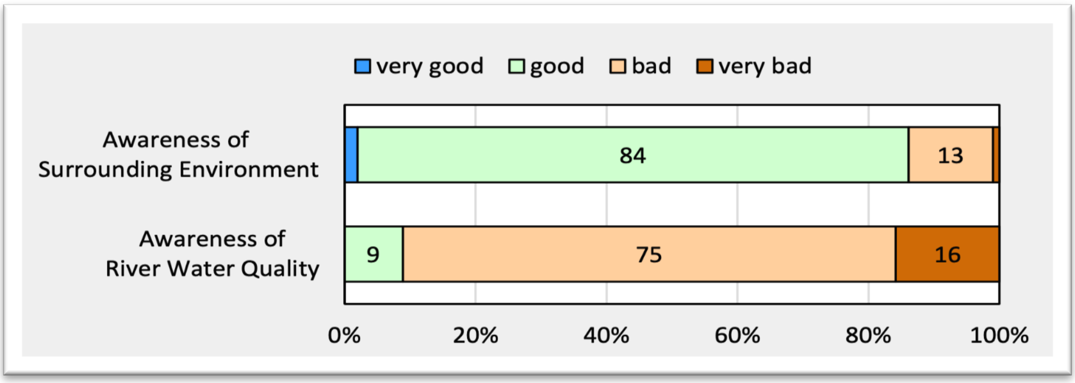
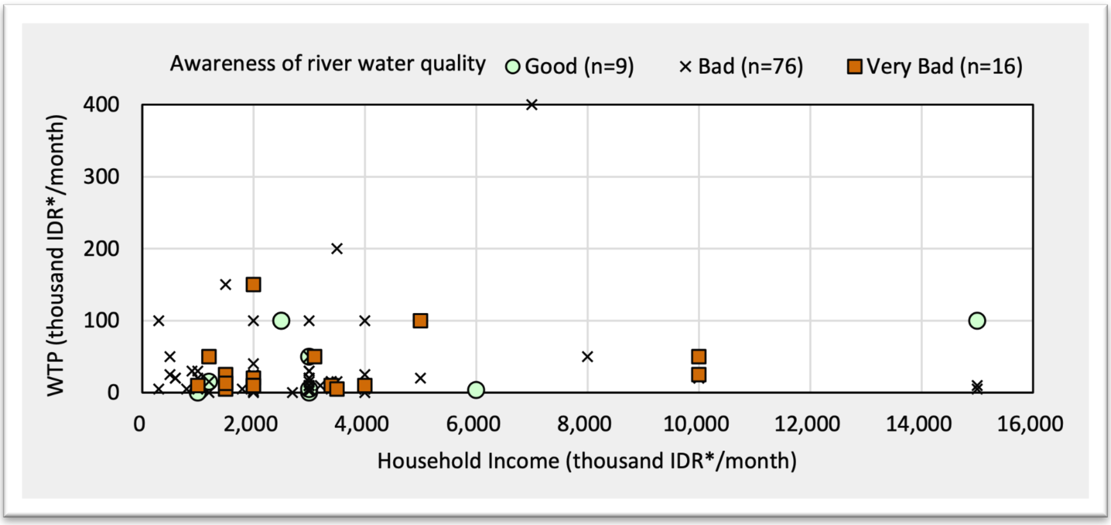


Figure 7. Awareness of the surrounding environment and river water quality.
Source: Authors' Analysis



*100 thousand IDR = 7.1 USD (at the end of November 2019)

Figure 8. Relationship between household income and WTP for improvement of river quality
Source: Authors' Analysis

Conclusion

In this study, details of the current water use situation, domestic water quality, and awareness of sanitation conditions and the water environment were clarified at the urban kampung in Bandung, Indonesia. The main domestic water source was either PDAM, communal wells or individual wells, with PDAM accounting for approximately 50%. Many residents used multiple water sources. Regarding end-use, many residents used bottled water for drinking and cooking, even if their main domestic water source was communal wells or individual wells. It was found that water quality is a key consideration for many residents when making their choice of water source. Regarding the well water quality, *E. coli* was detected in both communal wells and individual wells samples. In addition, it was shown that ammonia nitrogen and nitrate nitrogen may be worse in water quality in the dry season than in the rainy season. It was found that approximately 80% of households were discharging untreated wastewater into rivers in the target area. Most residents were aware that their wastewater was flowing into the nearby rivers. The WTP to improve nearby river water quality was not high compared to the cost of PDAM and was not correlated with household income. It was not revealed whether perceptions of river water quality influenced WTP.

This research is important to inform the government and decision-makers about water supply conditions in densely populated areas. Public water supply is an urgent need in the area related to water quality from water sources, as well as the improvement of sanitation facilities. Nevertheless, there is a cost problem with providing up-to-standard infrastructure. The results, in general, could be used in other places with the same conditions.

Limitation

Several limitations were found in the surveys conducted in this research; thus, we summarize them for future studies.

The number of samples obtained in the questionnaire survey for this study was 101. Although this sample size enabled identifying trends to some extent, a larger number of samples would be needed to improve the accuracy of the analyses. In particular, when considering the feasibility of introducing a wastewater treatment system to improve water quality, it would be beneficial to conduct further research on WTP, including the presentation of the benefits of the wastewater treatment system to residents. Furthermore, the amount of water used, including wells, water supply, and bottled water costs, should be investigated in detail. This is to consider the cost of water and sanitation services, including not only wastewater treatment but also public water supply and BW. It is ultimately crucial to be able to provide these services at affordable prices.

Water quality survey results showed that water quality might be worse during the dry season compared to the rainy season. However, regular water quality monitoring is also needed to assess the condition of wells and whether they are contaminated by NO_2-N and NO_3-N. Furthermore, *E. coli* and coliform groups were used as microbial indicators in this study. More investigations on other pathogenic microorganisms would also be necessary for environmental and health risk assessments.

Regarding bottled water, there are many drinking water refilling stations (DWRS) in Bandung, and there is a possibility that some of the bottled water is unsafe (Sari et al., 2020). Further research will be necessary in the future to investigate the types and quality of the BWs used by the residents.

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