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Public Perception of Drinking Water Quality in Bekasi City, Indonesia

Fatima Risha Dianty[1*], Dwi Nowo Martono[1], Cindy Rianti Priadi[2]

[1] Environmental Science, School of Environmental Science, Universitas Indonesia, Indonesia
[2] Civil and Environmental Engineering Department, Faculty of Engineering, Universitas Indonesia, Indonesia

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Corresponding Author:
Fatima Risha Dianty
frishadianty@gmail.com

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Abstract: The study of public perceptions regarding drinking water quality is essential for understanding how people choose and manage safe drinking water for consumption. Understanding public perceptions and the actual drinking water quality can also help to ensure the right policies to improve water quality and minimize possible risks. This study aims to analyze the association between public perceptions and the actual drinking water quality in Bekasi City, Indonesia. This study was conducted in three urban villages (Jatiluhur, Jatirangga, Sumur Batu) in Bekasi City, Indonesia, in the dry season (September-October 2021). The survey was conducted by distributing questionnaires and collecting groundwater samples at point-of-use for drinking (n=51 households). Drinking water samples were analyzed for pH, TDS, Total Coliform, and *Escherichia coli*. Among 51 households, 100% of respondents answered that the drinking water was safe and had good taste, 5% answered that there was a problem with the appearance (color/particles), and 2% of respondents answered that there was an odor in the drinking water consumed. Logistic regression was performed, and the result shows that measured drinking water quality does not significantly contribute to public perception of drinking water quality.

Keywords: Public perception; Drinking water quality; Groundwater

Introduction

Limited water supply, combined with population and economic growth, increased groundwater demand, particularly for drinking water and domestic activities. As a result, groundwater is often used as the main supply for clean water needs due to secure access, good quality, also it is preferable in several developing countries due to low economy and inadequate infrastructure (Kagabu et al., 2011; Munene et al., 2019). The level of groundwater use as the main drinking water in Southeast Asia is relatively high, especially in Indonesia, with 90% in urban areas and 92% in rural areas (Carrard et al., 2019). Unfortunately, most unregulated private water supplies are not regularly monitored and prone to contamination. Private well owners are typically self-assured and feel in control of their water quality, therefore they do not consider the possibility of contamination (Hooks et al., 2019). Bekasi City, which has a population of 2.54 million people, uses groundwater sourced from bore wells with a pump as main drinking water with a percentage of 72.04% (Health Office of Bekasi City, 2019). Nearly half of the 56 urban villages in Bekasi City have not been served by a public water supply network, including Jatirangga, Jatiluhur, and Sumur Batu urban village (Bappeda Provinsi Jawa Barat, 2019). Studies were conducted in those three urban villages and found that the majority of households still utilize basic sanitation facilities, with 50% of households using septic tanks or cubluks (Septarini et al., 2021). This finding suggests that this can lead to groundwater contamination and increase health risks. Moreover, a study in Bekasi City also identified that around 60% of groundwater samples were contaminated with *E. coli* bacteria (Maysarah, 2020).

Humans often perceive aesthetic aspects such as taste, smell, color, and turbidity to assess drinking water quality. Based on previous studies, chemical and

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microbiological parameters in water, organoleptic indicators, socioeconomic status, perceived control, and personal experience can influence the perception of drinking water quality (Alameddine et al., 2017; Doria, 2010). Several physicochemical parameters in drinking water, such as pH, TDS, sulfate, and sodium can affect aesthetic aspects such as the appearance, taste, and smell of drinking water (Ochoo et al., 2017). Moreover, each individual's perception of drinking water quality may vary with the contaminant of concern (Wedgworth et al., 2014). Problems with drinking water quality safety might occur if public perception, particularly organoleptic assessment, differs from the actual drinking water quality.

Previous research, which evaluated perceptions of drinking water quality between private wells consumer and public supplies, suggests that future studies are required to investigate consumer perception of groundwater quality and actual quality measurement (Gevera et al., 2022). Furthermore, consumer perceptions of drinking water quality can provide insights for public policies and service enhancements (Doria, 2010). Therefore, this study aims to analyze the association between public perceptions and the actual drinking water quality in Bekasi City, Indonesia.

Method

This study was conducted in three urban villages in Bekasi City, namely Sumur Batu, Jatirangga, and Jatiluhur. The location selection was based on the lack of availability of public water supply, so that most people still use groundwater as the main source of clean water. The data was purposively collected among 51 households by distributing questionnaires and drinking water sampling in dry season (September - October 2021). The questions included general information, sources of drinking water, as well as perception related to drinking water quality that consist of four criteria, such as safety, taste, smell, and the appearance (color/particles). The respondents were asked whether their drinking water quality in each aspect with dichotomous answers (1 = "Yes", 2 = "No").

Drinking water samples were taken at the point-of-use (POU) sourced from groundwater that have been pre-treated by cooking, filtering, or other processing techniques. The drinking water quality parameters tested were pH, total dissolved solids, total coliform, and *E. coli*. About 250 ml of water samples were stored in sterile polypropylene bottles for measurement of pH and TDS parameters, and 100 ml of the water samples were taken into the Whirl-pack for total coliform and *E. coli* contamination. Water samples that were taken with different containers aim to enable measurement according to the required volume and avoid cross contamination. Furthermore, the samples were brought to the laboratory using a cooler bag to maintain the sample temperature at 4°C with a maximum sample storage time of 6 hours to prevent changes in microbial populations in water samples. Measurement of pH and TDS were carried out using a multiparameter water quality meter. Bacterial concentrations were measured using IDEXX-Colilert 18 method and calculated using the most probable number (MPN). Descriptive and statistical analysis were used to describe and analyze the data results. Logistic regression was performed to analyze the association between perception and drinking water quality using IBM SPSS software version 20.

Result and Discussion

The result shows that among 55 respondents, the respondents were 71% female and 29% male. Respondents were selected purposively in three urban villages which 29.4%, 35.3%, 35.3% were collected from Jatiluhur, Jatirangga, Sumur Batu urban villages, respectively. In this research, most respondents use groundwater sourced from the borehole (73%) as their source of drinking water, followed by unprotected dug wells (14%), private protected well (8%), and artesian well (6%). All respondents reported that they treated their drinking water by boiling it before consumption. In addition, some respondents also utilize unbranded refilled water and branded refilled water as the alternative sources of drinking water. Sources of drinking water used by respondents are presented in Table 1.

Table 1. Household respondents' sources of drinking water

Sources of drinking water	Frequency (N)	Percentage (%)
Borehole	37	73%
Unprotected dug well	7	13%
Private protected well	4	7%
Artesian well	3	7%
Total	51	100%

Based on the public perception of drinking water quality, most respondents answered that their drinking water quality is in good condition (Figure 1). Among the four aspects, all respondents (100%) reported that the drinking water they consumed was safe and tasted good. In appearance (color/particles), as many as 5% of respondents answered that the drinking water they consumed had an unfavorable appearance. They reported that the drinking water they consumed was

sometimes cloudy and had black grains. Likewise, in the smell aspect, as many as 2% of respondents answered that that there was an odor in the drinking water they consumed. These results align with a study that shows that people's dissatisfaction regarding water quality can be caused by taste, smell, and turbidity (Ochoo et al., 2017).

Seemingly, the presence of particles or unpleasant smells that sometimes occur in their drinking water is not a significant problem for respondents, particularly regarding drinking water safety. This is in line with a study conducted in South-Eastern Kenya that most respondents reported that the amount of water they consume did not affected by the smell and color of their drinking water (Gevera et al., 2022). A study stated that people who receive their main drinking water from private sources are more likely to believe tap water is safe for consumption because of having water treatment systems for their homes and no persceptible health issues (Gholson et al., 2018).

The results of physicochemical and microbiological parameters of drinking water samples are shown in Table 2. TDS values in the three urban villages' drinking water samples still met the TDS parameter quality standard which should be less than 500 mg/L. On the other hand, the acidity and alkalinity (pH) level on all drinking water samples in the three urban villages showed that 22% of the samples exceeded the pH parameter quality standard with an average of 7.1 (SD = 0.83). Overall, 90% of drinking water samples were contaminated with total coliform bacteria and about 24% were contaminated with *E. coli* which also exceeded the drinking water quality standard. Recontamination of drinking water may occur during water collection and storage which does not comply proper hygiene practices (Mahmud et al., 2019).

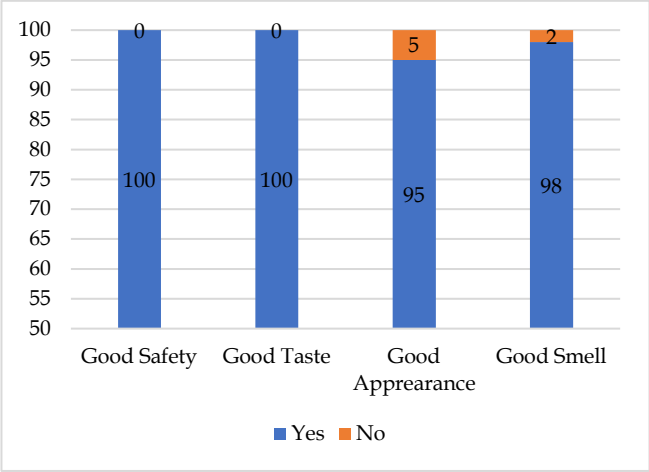

Figure 1. Perception of Drinking Water Quality

Table 2. Measured Drinking Water Quality

	TDS (mg/L)	pH	Total Coliform (MPN/100 mL)	*E. coli* (MPN/100 mL)
Mean ± SD	126.82 ± 65.48	7.1 ± 0.83	885.62 ± 1013.97	15.6 ± 76.77
Median	112	7.1	387.3	0.5
Range	13 - 342	5.4 – 8.6	0.5 - 2420	0.5 – 547.5
Permissible limits of drinking water [a]	500	6.5 – 8.5	0	0
Exceeded %	0%	22%	90%	24%
Not Exceeded %	100%	78%	10%	76%

According to Indonesian Minister of Health regulation about drinking water quality (Peraturan Menteri Kesehatan 492/Menkes/Per/IV/2010)

The result of measured drinking water quality was then analyzed to the accumulated value of public perception of drinking water quality at "4 = good quality" compared with other rating ">4 = poor quality". The result of analysis is shown in Table 3.

Table 3. The effect of drinking water quality parameters towards public perception

Parameters	Constant	df	*P*-value
TC	4.201	1	0.811
E. coli		1	0.787
pH		1	0.752
TDS		1	0.724

As shown in Table 3, it is obtained that the significant values of four parameters are more than 0.05 (*P-value* > 0.05), so it can be concluded that the four parameters of drinking water quality (pH, TDS, total coliform, *E. coli*) do not significantly contribute to public perception. This finding shows that human perception of drinking water quality is quite complicated, with reviews that may vary from each individual. Furthermore, organoleptic may not be an ideal assessment for the presence of fecal bacteria (Brooks et al., 2017). This finding is similar to studies conducted in Kenya and Alabama which do not find associations between measured parameters with the perception of drinking water quality (Wedgworth et al., 2014; Brooks et al., 2017). Another finding by Wedgworth et al. (2014) which contradicts with the result of this research is that they found a statistically significant association between decreased odds of total chlorine and reported odor. In addition, another study in the urban coastal area discovered that respondents' perceptions of well water correlated with the measured water quality (TDS

parameter as a significant predictor) (Alameddine et al., 2017).

In this study, some respondents generally had good perceptions of their drinking water, although certain parameters, such as total coliform, *E. coli*, and pH, did not meet the drinking water quality standard. People may assess their drinking water as safe to consume through visual aspects without considering the risk of microbiological contamination. This result can be caused by lack of public knowledge regarding the actual quality of drinking water. Private well owners tend to be more confident of their water quality and feel in control over contamination risks (Schuitema et al., 2020), which can lead to an unwillingness to test their drinking water quality regularly. A study conducted in Canada showed that the discrepancy between public perceptions regarding drinking water quality and the actual quality can also be caused by a lack of communication between the government and the public (Ochoo et al., 2017).

Conclusion

This study evaluated and analyzed the association between public perception of drinking water quality and the actual drinking water quality. Most respondents used groundwater borehole as their primary source of drinking water and rated that their drinking water quality is in good condition. We found that drinking water quality results in some water samples with parameters such as pH, *E. coli*, and total coliform had exceeded the quality standards. Also, the result of statistical analysis showed that there was no association between measured drinking water quality and public perception of drinking water quality. Limitation of this study is the absence of social factors that may influence public perception. Likewise, further studies might have needed a more extensive dataset involving several other urban villages for a more comprehensive and varied public perception regarding drinking water quality. Lastly, future studies may consider socioeconomic aspects and other physicochemical parameters such as turbidity, iron, and total hardness to predict which variables affect public perception of drinking water quality.

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