Assessment of the level of drinking water services that are perceived as safe in Metro City, Lampung

V F Aswirta[1*] and *C R* Priadi[1]

[1]Civil and Environmental Engineering Department, Faculty of Engineering, Universitas Indonesia, Depok 16424, Indonesia

Abstract. Self-supply water source systems are still widely used in Indonesia, such as in Metro City, Lampung, where only 5,05% of households are served by piped drinking water services. Metro City is known to occupy the fourth position as an area that has clean water quality problems in Indonesia. Therefore, this study aims to determine the variability of the level of drinking water services that are perceived as safe by households perceptions of safety, taste, appearance, smell, reliability, and availability of drinking water sources. The method used is longitudinal monitoring of drinking water sources in households with monthly surveys. The monitoring results show that during the 6 months of the surveys Non-self-supply systems (n=147) are known to be safer than self-supply systems (n=115) with the percentage of 98% and 95%. The source of drinking water with the highest safety level is refill water and bottled water (100%) which is the most consistent level of safety. Thus, the results of this study are expected to increase public awareness and the local government concerned to obtain an equitable supply of safe drinking water.

1 Introduction

WHO and UNICEF (2017) stated that 71% of the world's population already uses drinking water services that are safely managed [1]. According to the results of the Studi Kualitas Air Minum Rumah Tangga (SKAM RT) 2020, there is still a gap of around 7% to 100% proper access and 3.1% to 15% safe access by 2020-2024 RPJMN target. This indicates that drinking water services in Indonesia has not yet achieved universal, equitable, and sustainable access. One of the reasons is the low level of piped water services. One of them is Metro City, Lampung, where 92.86% of the people use self-supply water sources which are divided into a borehole and dug wells [2]. However, the safety of self-supply water sources is an important issue in the community because the reliability of self-supply water sources is known to be lower than non-self-supply water sources [3]. Thus, efforts are needed to overcome these problems, one of which is by monitoring water sources in the household to assist the assessment of the level of drinking water services.

* Corresponding author: virly.ferliani@ui.ac.id

The purpose of this research are to determine the variability of the sources of drinking water used and the level of service of drinking water sources that are perceived as safe by household perception about safety, appearance, smell, reliability, and availability of drinking water sources.

2 Methodology

2.1 Study location

This study was located in five villages in Metro City, Lampung, namely Hadimulyo Barat, Rejomulyo, Iringmulyo, Ganjarasri, and Karangrejo. Futhermore, it was conducted during wet season (April – July 2021) and dry season (August – October 2021). The study location was determined based on the consideration of population density, the low level of PDAM water services, and the economic condition of the population. Figure 1 shown the study location in Metro City.

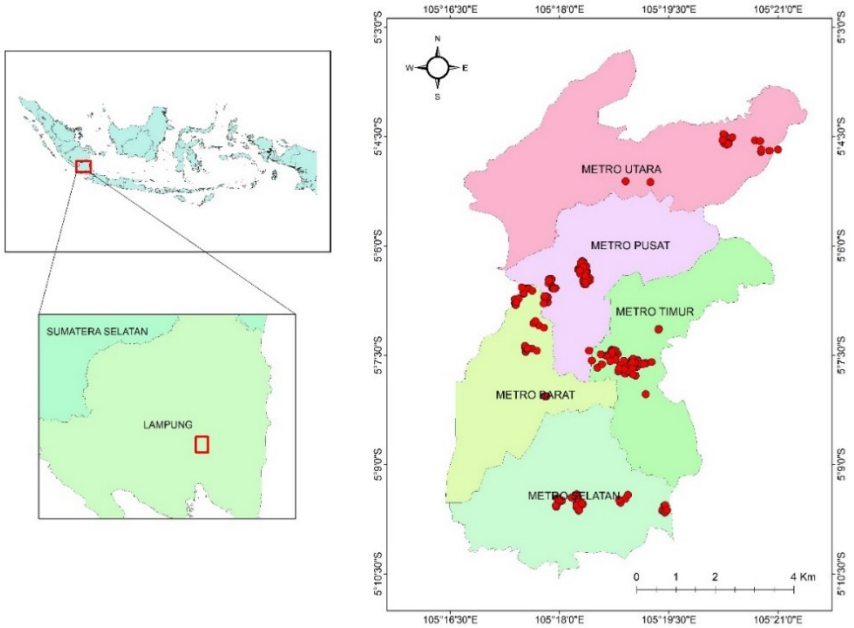


Fig. 1. Study location.

2.2 Data collection and survey

Data collection is carried out every month by telephone survey method to predetermined respondents (continuous monitoring). The questions on the questionnaire are broadly divided into 5 parts: (1) water sources; (2) WASH (Water, Sanitation, and Hygiene) conditions; (3) respondent's economic condition; (4) health conditions; and (5) environmental conditions. The survey was conducted by 3 enumerators. Interview duration ranged from 5-12 minutes for one respondent. The results of the interview are then sent via an online survey application. After the interview results are submitted to the server, the enumerator performs data cleaning to re-check the interview results and correct them if there are errors. The survey was initially conducted with the Qualtrics app from April 2021 to August 2021. Then, in September –

October 2021 using the SurveyCTO application due to an interruption in the Qualtrics server, where the Qualtrics server cannot be accessed. This also causes the data for August to be inaccessible, so the data obtained is only 6 months with a total of 374 data.

2.2.1 Data analysis

These assessments were taken based on six parameter questionnaires namely, the safety, taste, appearance, smell, reliability, and availability derived from household's perceptions. The service level concept was adopted from WHO which was published in the Joint Monitoring Program (JMP) Report, while accessibility indicator is not included because most households use directly connected pipes by field survey 2020. Meanwhile, each parameter has a score of 1 if the respondent's answer was good and a score of 0 if the respondent's answer wasn't good, and then the score was summed up. A total score of 6 is categorized as perceived as safe while <6 is perceived as unsafe.

3 Results and discussion

3.1 Survey data characteristics

Table 1 presents data on respondents who took part in the monthly survey from April 2021 to October 2021. August survey results could not be accessed due to an interruption to the Qualtrics server in September 2021, so the data used was only 6 months of the survey. The number of respondents fluctuates every month. In April 2021, the lack of respondents was caused by the large number of respondents who could not be contacted. Meanwhile, in September 2021, it was caused by a decrease in the interest and saturation of respondents every month, making it difficult to contact or no longer willing to take the survey. In addition, there were some respondents who changed their phone numbers, so they could not be contacted again. Thus, the total data that has been collected from April 2021 to October 2021 is 374 data. The highest amount of data, namely in May 2021, was 70 respondents. While the minimum amount of data, namely in April 2021 as many as 50 respondents.

Table 1. Number of monthly survey respondents.

Month	Villages					Total (n)
	Ganjarasri	Iringmulyo	Hadimulyo Barat	Karangrejo	Rejomulyo	
April	13	14	19	8	1	55
May	12	22	24	10	2	70
June	10	21	24	9	2	66
July	10	22	21	8	2	63
September	9	19	20	7	2	57
October	12	17	23	9	2	63
Total (n)						**374**

In this monthly survey questionnaire, there are also questions about environmental conditions such as 24-hours rain events. Thus, it can be seen that the incidence of rain is the most and the least for approximately 6 months. In addition, the incidence of flooding was also asked on the survey questionnaire to find out the number of respondents' houses that experienced flooding. The results of the survey of environmental conditions are presented in Table 2.

Table 2. Environmental conditions.

Environmental Condition	April*	May*	June*	July*	September**	October**
24-hours rain events	51	61	91	24	46	62
Flood events	2	0	0	0	0	3

*) Wet season
**) Dry season

Based on Table 2, it is known that the frequency of 24-hours rain events before the interview is the highest, namely in June 2021. While the lowest frequency is in July 2021. Floods in Metro City almost never happen even though the rainfall is quite heavy. Based on the results of interviews with respondents, some respondents said that their home area is not an area prone to flooding. Thus, on average above 95% of respondents did not experience flooding in the period April to October 2021.

3.2 Variability of drinking water sources

The assessment was carried out on self-supply water sources (BH, UW, PW, N-BH, N-UW) and non-self-supply (P-BH, PDAM-PT, PDAM-PDY, RF, BW). Figure 2 shows unprotected dug wells are the most widely used water source by the people of Metro City with a percentage of 30% for drinking water sources. This proves that the majority of drinking water sources for the people of Metro City is private unprotected dug well (UW) [3]. The use of refill water also has a fairly high percentage, which is around 22% for several reasons, such as more reliable water quality, saving on gas usage, more practical, and the groundwater used as a "rough" taste. Meanwhile, the least water sources are piped water from PDAM-PDY and PDAM-PT. Based on the data from the BPS Kota Metro (2021), where it is known that only 5.05% are served by piped drinking services [4].

In general, the use of non-self-supply water sources as a source of drinking water is 3% and the use of self-supply water sources is 97% of the total data. This condition is in line with the research conducted by Jauhari et al., where >90% of the water sources used by the people of Metro City, Lampung are self-supply water sources [2]. If viewed temporally, it can be seen that the sources of drinking water sources have quite fluctuating differences, but not significant. However, for BH and UW, the difference can be seen when changing seasons. When entering the dry season, the use of BH increases, while the use of UW tends to decrease. According to several respondents, the dug wells they use will dry up during the dry season or have poor quality, so they switch to other water sources such as boreholes or refill water for drinking water (Figure 2).

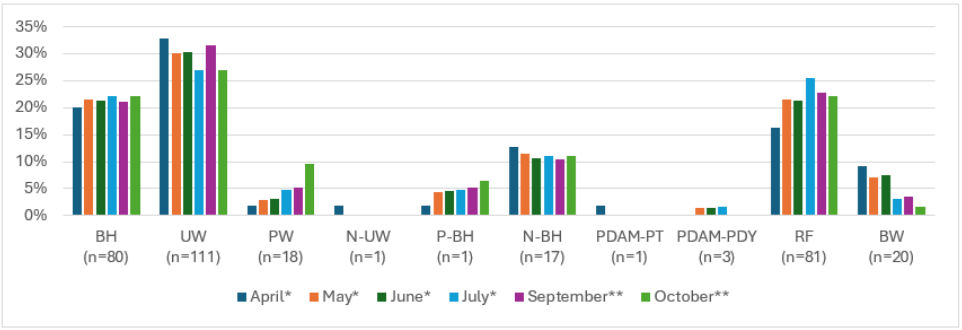


Fig. 2. Variety of sources of main drinking water in Metro City, Lampung.

Description:
BH = private borehole
N-BH = neighbor's borehole
PW = private protected dug well
PDAM-PT = public tap PDAM
P-BH = public borehole
N-UW = neighbor's unprotected dug well
RF = refill water
UW = private unprotected dug well
PDAM-PDY = PDAM piped into residential buildings, yards or plots of land
*) Wet season
**) Dry season

3.3 Variability of service level of drinking water sources perceived as safe

The assessment was only carried out on drinking water sources categorized as improved sources and on-premises, namely 8 main drinking water sources, excluding unprotected dug wells (n=262).

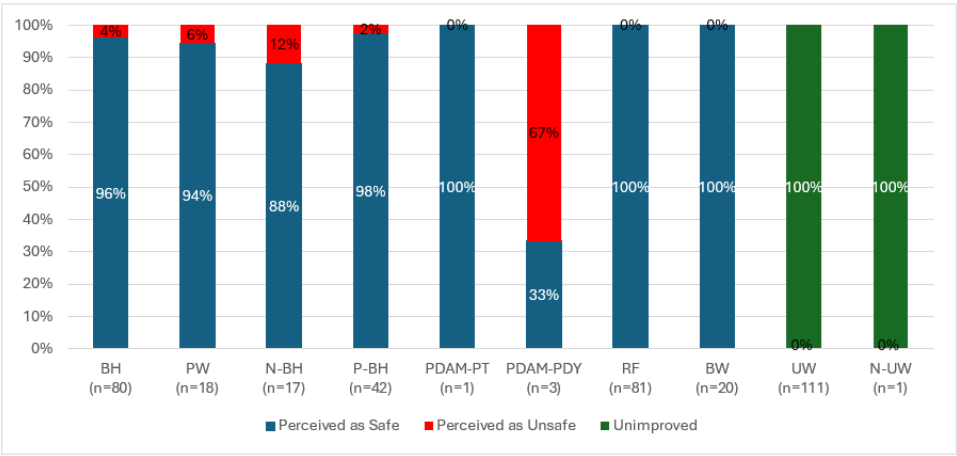
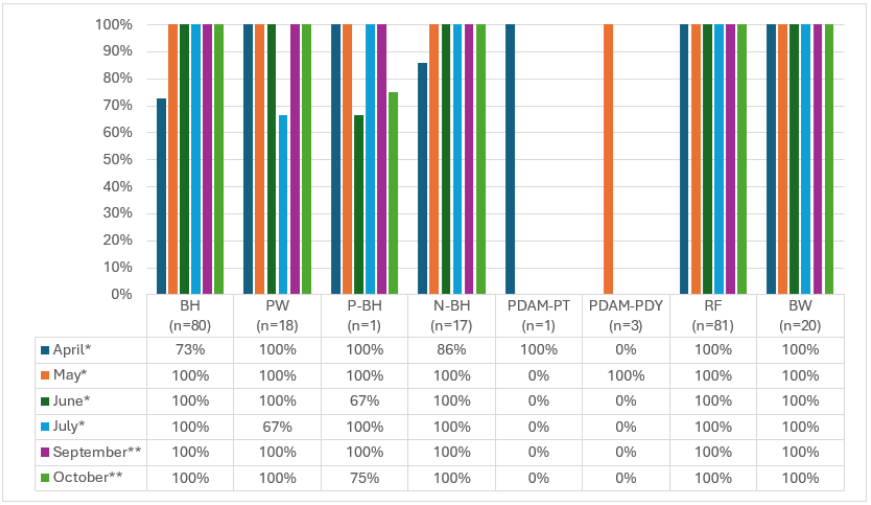


Fig. 3. Level of drinking water service perceived safe.

Overall, the level of drinking water service that is perceived as safe from all data is quite high, reaching 97% (n=253). Based on Figure 3, the water sources with the most consistent safety levels are refill water (RF) and bottled water (BW) with a percentage of 100%. By the JMP statement, that bottled water has the potential to provide safe water [5]. In Europe, bottled water quality is often tested, either by independent laboratories or by companies [6]. Thus, the quality is always monitored so that it is considered safer. Meanwhile, refill water (RF) is known to have a lower level of safety than bottled water (BW). Whereas, the water source with the lowest level of safety is PDAM-PDY at 33%. According to the results of the interview, the factors that affect this level of safety are the appearance of the water which is quite cloudy due to heavy rain for several days.

Temporarily, the average level of service for safe drinking water sources each month is not much different (Figure 4). The lowest level of safety is in April 2021 with a total safety level of 89%. In that month, it is known that 51% of respondents stated that it rained 24 hours before the survey was conducted and 2% of respondents experienced flooding. Rain and flood events or run-off have the potential to increase turbidity and contamination of water sources which can affect the level of safety of these water sources [7]. This is caused by the infiltration of water into the soil, where the water can dissolve various contaminants. Pollution that occurs can affect household perceptions of taste and smell which is one of the criteria for receiving drinking water by respondents [8].



	BH (n=80)	PW (n=18)	P-BH (n=1)	N-BH (n=17)	PDAM-PT (n=1)	PDAM-PDY (n=3)	RF (n=81)	BW (n=20)
April*	73%	100%	100%	86%	100%	0%	100%	100%
May*	100%	100%	100%	100%	0%	100%	100%	100%
June*	100%	100%	67%	100%	0%	0%	100%	100%
July*	100%	67%	100%	100%	0%	0%	100%	100%
September**	100%	100%	100%	100%	0%	0%	100%	100%
October**	100%	100%	75%	100%	0%	0%	100%	100%

Fig. 4. Percentage of perceived safe drinking water service level per month.

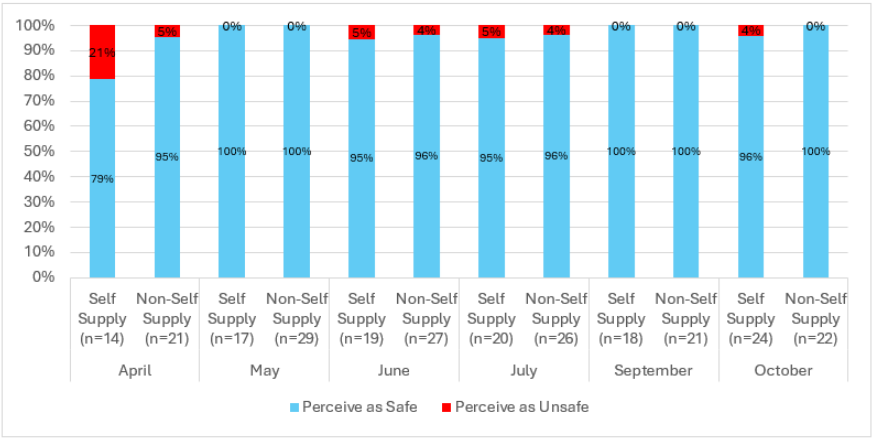


Fig. 5. Comparison of perceived safe drinking water levels based on water source system.

Based on Figure 5, it can be seen that the level of supply of drinking water sources that are perceived as safe for non-self-supply (n=147) water source systems (98%) each month is higher than the self-supply (n=115) water source systems (95%). This condition is caused by a self-supply water source system that is easily contaminated by various contaminants [9]. This is because self-supply water sources have a simpler water supply structure or mechanism than non-self-supply water sources which are more complex and protected [10]. Thus, self-supply water source systems are said to be more dangerous and pose a risk of health problems, especially waterborne diseases [11]. In addition, this is also supported by research conducted in rural Dhani Mhabbatpur, where 86% of household respondents stated that they felt safer to consume water facilitated by the government (non-self-supply) rather than using private wells [12].

4 Conclusion

The majority of drinking water sources for the people of Metro City, Lampung use a self-supply system, especially unprotected dug wells with a percentage of 30% for drinking water sources. Meanwhile, the least used water sources are piped water (PDAM-PDY and PDAM-PT), namely 1% for drinking water. Refill water and bottled water are the most consistent sources of drinking water with a percentage of 100%. Meanwhile, the source of drinking water that has the lowest level of safety is PDAM-PDY with a percentage of 33% of the total 3 data because the appearance of the water is quite cloudy due to heavy rain for several days. Based on the water source system, the safety level for the non-self-supply water source system is higher than the self-supply water source system with a percentage of 98% and 95%, respectively.

This research was conducted in collaboration with Water for Woman and University of Technology Sydney.

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