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Determinants of Drinking Water Supply in Indonesia

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ABSTRACT

The government in carrying out the obligation to provide drinking water, faces the obstacles of the lack of safe and affordable drinking water provision for all communities, as well as the increasing demand for drinking water. Using panel data from 34 provinces in Indonesia during 2016-2019, this study used static panel regression to examine the influence of the supply and demand sides of drinking water on access to improved drinking water source. The results showed that the demand side of drinking water has more influence on access to improved drinking water source, compared to the supply side. This is indicated by the level of education that has a significant influence on access to improved drinking water source, followed by the price of water. The low level of education results in a lack of awareness of the improved use of drinking water source. This result indicates the need for policies from local governments to conduct socialization and education in campaigns for the use of improved drinking water source, especially in areas with low levels of education. In addition, local governments need to set special drinking water rates for the poor people.

Keywords: Demand Side, Drinking Water, Panel Data, Public Goods, Supply Side, Universal Access.

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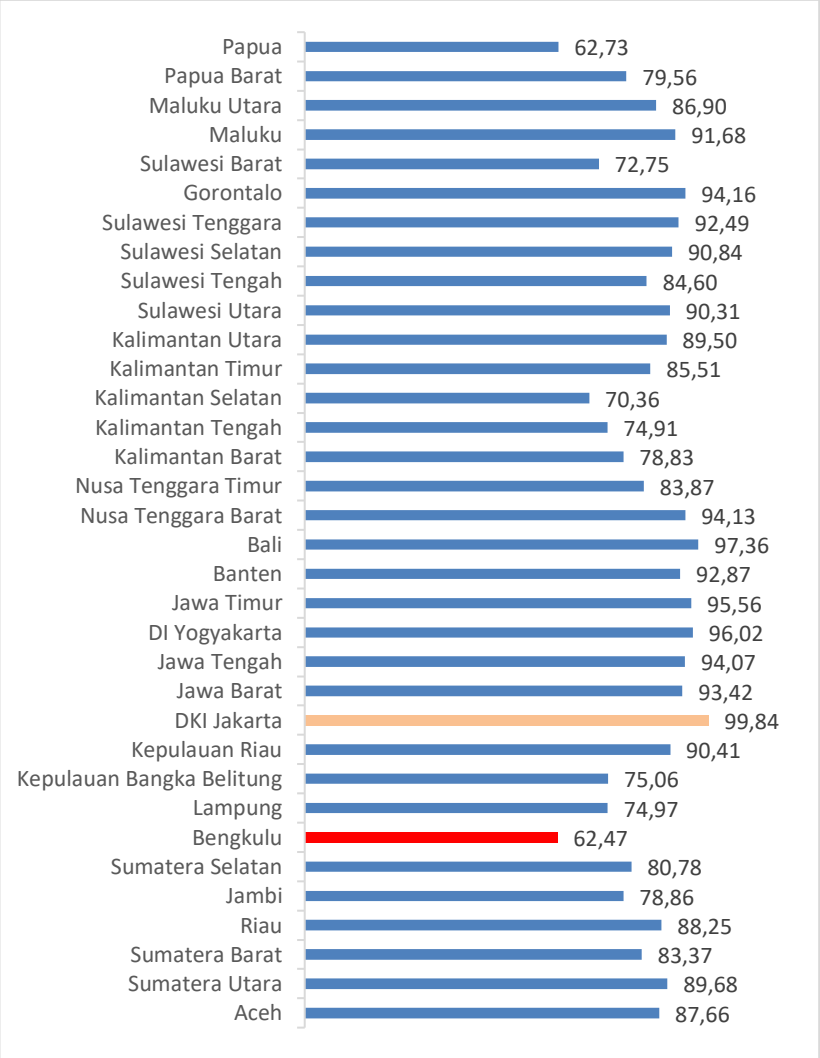
INTRODUCTION

The provision of drinking water is still a major problem in Indonesia. Not all people can enjoy safe and improved drinking water. In 2020, the achievement of access to safe and improved drinking water has only reached 90,21% (Central Bureau of Statistics (BPS), 2021). The gap between provinces is still large, DKI Jakarta Province has the highest achievement with 99.84%, and Bengkulu Province has the lowest achievement with 62.67%. Rahim & Muchlisoh (2019) stated that the role of Local Drinking Water Company (PDAM) has not been maximized because there are more than 80% of people in Bengkulu using other water sources as the main water source, and 29.35% of them use unprotected wells, which are not feasible and not good for health.

Figure 1. Percentage of Household Population by Province and Improved Drinking Water in 2020



Source: Author's compilation from BPS (2022)

Achieving universal access to safe and affordable drinking water for all is the Government's target by 2030, as contained in the Sustainable Development Goals (SDGs) prepared by the National Development Planning Agency in 2017. Ease of access to safe and improved drinking water is very important because it can be beneficial for

health and improve economic and social life (World Health Organization (WHO), 2019). When people easily get and meet their drinking water needs, they will be able to be free from water-related infectious diseases, such as diarrhea. In addition, if many people do not spend much time searching and fetching drinking water, then they will be able to be more productive, and the time can be used for studying and working, so that their quality of life can improve. The better the level of health will be able to drive the economy to be better (Anwar, 2017).

The government is faced with complicated conditions in an effort to fulfill improved drinking water, where the quantity and quality of drinking water tends to decrease, while the need for drinking water is increasing from time to time. Meanwhile, the Government is required to provide good services to the entire community. According to Suharmiati *et al*., (2012), access to services is determined by two factors, namely service factors which include infrastructure, institutions, service costs, and service quality, as well as user factors which include education level, community income, and socioeconomic conditions of the community. The government can pursue strategies to overcome these problems, namely by improving institutional governance, increasing the capacity of drinking water providers, and developing and managing Drinking Water Supply System (SPAM).

Research on the provision of drinking water has been carried out, but the results are inconsistent, so it requires further research. In addition, in previous studies, there has not been much discussion about the supply side of drinking water, especially in Indonesia. The provision of home connections from water suppliers to households can have a great effect in the ease of obtaining water, according to the quantity of water required (Ahuja *et al*., 2010).

Therefore, our research complements previous research by analyzing the effect of supply and demand for drinking water in improving access to safe and improved drinking water. There are additional variables on the supply side of drinking water, namely the institutional of SPAM and the availability of raw water, according to suggestions from research by Soebagyo *et al*. (2013) and Sudarsono & Nurkholis (2020). Against the background of these problems, this study aims to determine the influence of demand and supply of drinking water on increasing access to improved drinking water in Indonesia.

LITERATURE REVIEW

The government has an obligation to provide drinking water for all communities, without exception. Drinking water is a public good, where people should be able to meet the need for water freely, either through groundwater, springs, river water, or lakes. Paul A. Samuelson in his article entitled The Pure Theory of Public Expenditure in The Review of Economic and Statistics (1954) stated that public goods are goods that are enjoyed together, which means that consumption of these goods does not reduce other individuals' consumption of these goods. In other words, there is no competition between actors in accessing such public goods. The government's role in water as a public goods is to ensure water quality and protect water catchment/catchment areas, so that water is safe and suitable for drinking (Sudarsono & Nurkholis, 2020).

The government needs to intervene in the provision of public goods because it can have a positive impact on society (positive externalities). In addition, there is a market failure in the provision of public goods, one of which is due to free riders (stowaways). The emergence of free riders in the provision of public goods can have a negative impact,

that is, people's consumption of a public good becomes very excessive, because everyone can use and benefit from the goods freely, by maximizing their own utility.

In Indonesia, the role of the Government in providing drinking water is regulated in Government Regulation Number 122 of 2015, namely by developing facilities and infrastructure for the provision of drinking water in the form of SPAM, which consists of piping network spam and not piping networks. the development of piping network spam is carried out through the provision of raw water intake infrastructure, raw water treatment, and networks to home connections. SPAM is not a piping network consisting of shallow wells, pump wells, rainwater reservoirs, water terminals, and spring catchment buildings.

There are two forms of government responsibility in providing drinking water, namely forming SPAM organizing institutions, be it in the form of BUMN and/or BUMD, UPT or UPTD, as well as Community Groups and Business Entities that specifically meet their own needs. Another form of responsibility from the Central and Regional Governments is to obtain financing that is used to finance the development and management of SPAM. These funds can be from Government funds (APBN, APBD, DAK Drinking Water, and Drinking Water Grants) or non-Government, with Government and Business Entity Cooperation (KPBU), banking loans, foreign loans and grants, Corporate Social Responsibility (CSR), as well as investments made by PDAM).

RESEARCH METHOD

This research was conducted by taking a period of time between 2016 to 2019 in 34 provinces in Indonesia. The research period was chosen starting in 2016. The data used is sourced from the Central Statistics Agency, the Ministry of Finance, and the Ministry of Public Works and Public Housing (PUPR).

The dependent variable used in this study was access to improved drinking water (ACC), namely drinking water obtained from safe and protected water sources, with an indicator of the percentage of achieving access to improved household drinking water. The data was obtained from the results of the BPS National Socioeconomic Survey (Susenas).

The independent variables used are community income, water prices, education levels, raw water availability, drinking water funding, and SPAM organizing institutions. Community income (ICM) is the ability of the community to obtain goods/services. The indicator used in this study is the per capita GRDP, whose data is obtained from BPS.

The price of water (PCE) is the amount of service fees set by the Regional Head for each volume of water use. The indicator used in measuring the price of water is calculated from the value of the water delivered divided by the volume of water delivered. The data is obtained from clean water statistics issued by BPS every year.

The level of education (EDU) is used to see the quality of the population in a region. The indicator used is the average length of schooling (in years), which is taken by residents aged 15 years and over for all levels of education.

According to the Government Regulation Number 122 of 2015, raw water is water that comes from surface water sources, groundwater, rainwater, and seawater that meets certain quality standards for drinking water. The variable availability of raw water (RAW)

is measured by the amount of raw water available. The data was obtained from the Ministry of PUPR.

Drinking water funding is the amount of investment for drinking water financing sourced from the State Budget, Special Allocation Fund (DAK) Drinking Water, Drinking Water Grants, Banking Loans, and PDAM Investment with data from the Ministry of PUPR, as well as the drinking water sector APBD from the Ministry of Finance. The drinking water funding variable (LnFND) will actually include all sources of drinking water funding, but funding data sourced from non-governmental funds (CSR and KPBU) cannot be obtained.

The institutional variables of SPAM (INS) implementation are measured by the results of the PDAM performance assessment conducted by the Drinking Water Supply System Improvement Agency (BPPSPAM) and the Financial and Development Supervision Agency (BPKP). The data used is sourced from the Ministry of PUPR.

The data analysis methods used are descriptive statistical analysis and static panel regression analysis, with the model form listed in Equation (1).

$$ACC_{it} = \alpha + \beta_1 ICM_{it} + \beta_2 PCE_{it} + \beta_3 EDU_{it} + \beta_4 RAW_{it} + \beta_5 LnFND_{it} + \beta_6 INS_{it} + \varepsilon_{it} \quad (1)$$

RESULTS

The achievement of access to drinking water in Indonesia

The achievement of access to drinking water in Indonesia increased by 15.47% between 2016-2019. If divided equally for four years, then every year there is an increase of 3.87%. From the average value of the increase, assuming ceteris paribus, a prediction of achieving 100% access to drinking water can be made, and the results are obtained that access to safe drinking water can be evenly achieved in 2024 or six years earlier than the target in 2030.

The results of the calculation of the average value, the highest value, and the lowest value during 2016-2019 on all variables are presented in Table 1. The highest and lowest values of all independent variables show that there is still a high level of inequality between provinces in Indonesia, both from the socioeconomic level of the community and the Government's ability to provide improved drinking water needs for the community. This is what the Government needs to address to achieve the goal of universally or affordable access to drinking water for all.

Table 1. Descriptive Statistics (*N*= 136)

Variables	Mean	Maximum	Minimum
Access Improved Drinking Water	74,11	92,70	47,04
Community income	41,23	161,79	12,08
Price of Water	4.182,47	6.225,40	2.483,06
Level of Education	8,00	11,00	6,00
Availability of Raw Water	6.454,27	29.278,50	1.171,00
Drinking Water Funding	143.847,91	1.801.917,78	40.305,72
Institutional of SPAM	2,42	3,28	1,95

We started the static panel regression analysis by selecting the best model used, and selected FEM as the best estimator model. Based on the regression results of the FEM panel, the adjusted R-squared (R2) value in the supply model was obtained at 0.5180,

while the demand model had an R2 value of 0.6910. These results indicate that the demand side of drinking water has more influence on access to improved drinking water, compared to the supply side of drinking water. Meanwhile, in the combined model, an R2 value of 0.7348 was obtained, meaning that the independent variables used in the model were able to explain 73.48% of the variations of the dependent variables of proper access to drinking water, while the remaining 26.52% was explained by other variables outside this study. In detail, the results of estimates with FEM are presented in Table 2.

Table 2. FEM Panel Regression Results

Variables	Coefficients, Standart error
1. Supply Model (*R-squared* 0,5180)	
2. Demand Model (*R-squared* 0,6910)	
3. Combined Model (*R-squared* 0,7348)	
a. Supply Side	
Availability of Raw Water	0,00636***
	(0,00171)
Drinking Water Funding	-1,774
	(1,260)
Institutional of SPAM	2,498
	(3,412)
b. Demand Side	
Community income	0,075
	(0,198)
Price of Water	-2,137***
	(0,862)
Level of Education	25,85***
	(3,429)
Observations	136

Notes: ***p<0,01; **p<0,05; *p<0,10.

In the results of the regression above, it can be concluded that there is an additional water price of 1 Rupiah / m3, ceteris paribus, then access to improved drinking water will decrease by 2,14%; the addition of the level of education (length of schooling) 1 year, ceteris paribus, then access to improved drinking water will increase by 25,85%; the addition of raw water 1 liter / second, ceteris paribus, then access to improved drinking water will increase by 0,006%. Meanwhile, the variables of drinking water funding, spam organizing institutions, and community income do not affect access to improved drinking water.

DISCUSSION

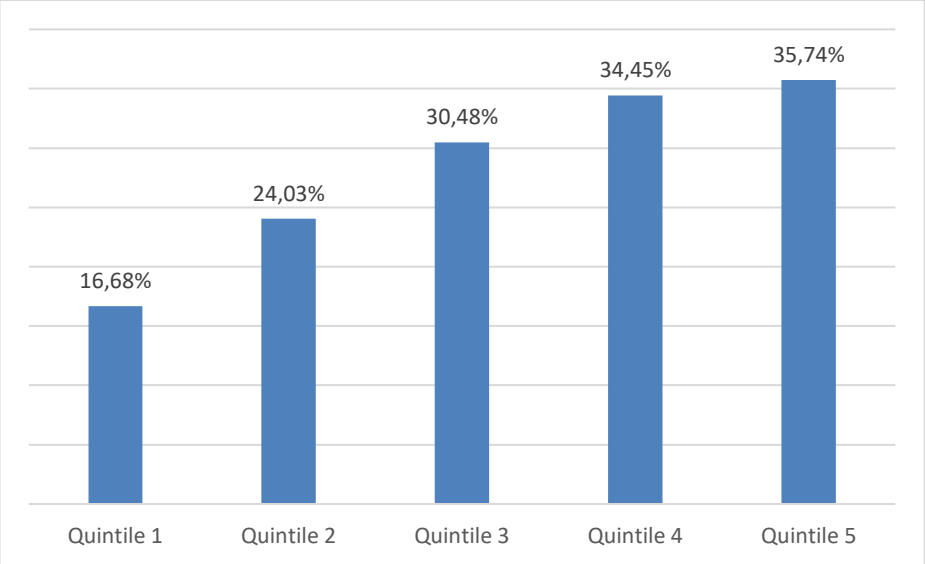
Impact of Drinking Water Demand on Access to Improved Drinking Water

The demand for drinking water can be influenced by several factors, one of which is household income, which is the main determinant in the demand for drinking water. According to Ahmad *et al*. (2010), Saraswaty (2013) and Akram & Khaliq (2019) revealed that income is the main determinant in the demand for safe and improved drinking water. However, in the study revealed the opposite. This is in accordance with Engel Law which states that an increase in household income is not used to meet the basic / primary needs of households (drinking water), but is used for the consumption of luxury goods (Ahmad *et al*., 2010).

The positive influence or marginal social benefit of drinking water is often not seen, causing people to not realize the importance of drinking water with good quality and adequate quantity (Sudarsono & Nurkholis, 2020). Benito *et al*. (2019) stated that improving the economic condition of the community makes people not care about public services provided by the Government, resulting in inefficiencies in the provision of drinking water.

From the results of the March 2020 Susenas, shows that the higher the level of household welfare, the use of refillable water as the main source of drinking water becomes higher and higher (Figure 2). Even though refillable water is not a source of drinking water that is safe to drink because the quality has not met drinking water standards, so it can have a bad impact on health. This can be caused by the low level of education that has not realized the importance of meeting the needs of improved drinking water.

Figure 2. The Relationship between Economic Status and Refillable Water Consumption in 2020



The results of the study concluded that the level of education has a positive and significant influence on access to improved drinking water. These results support the research of Nauges & van den Berg (2009), Watekhi *et al*. (2011), and Rachim & Muchlisoh (2019), which concluded the level of education pursued, particularly by household heads, could have a significant effect on increasing demand for improved drinking water.

In general, the level of education in Indonesia is still low, in the 2016-2019, it shows that the average length of schooling taken is 8.3 years or equivalent to graduating from elementary school. In fact, the level of education of the population has an important role to form healthy behaviors to prevent the occurrence of diarrheal diseases. According to WHO (2019), diarrheal diseases can be increasingly common if the household does not maintain its sanitary hygiene, as well as water used for drinking and cooking.

Soebagyo *et al*. (2013) stated that educated people will make large investments in the field of health. This is reinforced by the results of the Susenas in 2020, which states that

the level of Head of Household Education (KRT) who graduated from higher education has the highest average expenditure for water per month, which is IDR 13,395.00, while domestic violence with a low level of education, expenditure on water is the lowest, which is IDR 2,849, 00.

Water expenditure is closely related to the price of water. In this study, the price of water has a negative influence on access to improved drinking water, where the higher the price of water can reduce access to improved drinking water. Water pricing is a dilemma for local governments, on the one hand, it is necessary to set drinking water rates according to the Principle of Full Cost Recovery (FCR), where the average rate is equal to the basic cost. On the other hand, the Government does not want to burden the people with high drinking water rates. So that PDAM in providing public services in addition to meeting the basic needs of the community, also carry out social tasks.

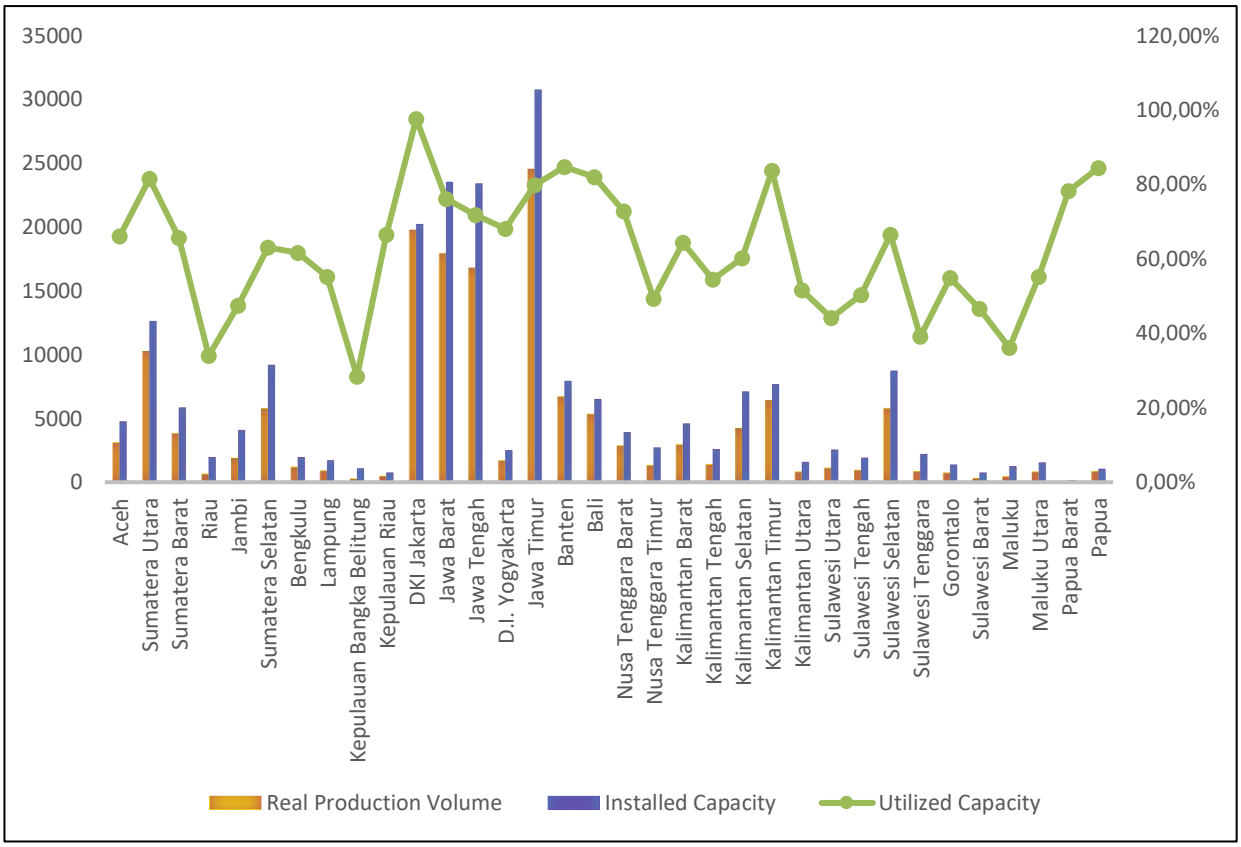
Given the low awareness of the use of proper drinking water, local governments should take serious steps, *first* by conducting socialization and education in a frequency both directly and indirectly about the use of proper drinking water, especially in areas with low levels of education. Socialization and education directly can be taken by visiting community members face-to-face, while indirect socialization is carried out using intermediary media as delivery of educational materials, such as through pamphlets and print media. *Second,* local governments need to set subsidies on drinking water rates for the poor, so as to make it easier for people to enjoy improved drinking water.

Impact of Drinking Water Supply on Access to Improved Drinking Water

This study also revealed a positive and significant effect of raw water availability on increasing access to improved drinking water. The results of this study show that the availability of raw water in an area can increase access to improved drinking water in the area. The massive development of raw water infrastructure (upstream sector) over the past few years has been able to have an impact on the increasing availability of raw water in Indonesia. This is reinforced by the fact that the amount of raw water availability in Indonesia for the 2016-2019 period increased by 3.62%, from the previous one of 213,139.00 liters/second to 221,152.25 liters/second.

In the 2019 PDAM Performance Book, it shows data on installed piping network infrastructure and the real production volume of raw water that has been treated for drinking water (Figure 3). It can be seen that there is still a large production capacity that has not been utilized (idle capacity). Idle capacity is partly due to lack of raw water capacity, lack of distribution infrastructure, decreased technical capacity, or damaged infrastructure (Sudarsono & Nurkholis, 2020). Therefore, the need for adequate management so that the raw water infrastructure that has been carried out has optimal results.

Figure 3. Comparison of Piping Network Infrastructure with Percentage of Capacity Utilized in 2019



The lack of support from local governments in providing drinking water often occurs due to inefficiency in utilizing the available budget. According to the World Bank's Public Funding Study (2020), the allocation of drinking water sector funding is highly dependent on the central government's budget. The drinking water funding is used to build large infrastructure projects, especially piped water, but the conditions are exactly the opposite of those in the regions, where local governments tend to spend more on the sanitation sector, while the obligation to provide drinking water in the regions is left to PDAM.

In order to increase access to improved drinking water on the supply side, the Government needs to improve several things that can support the provision of drinking water, first, encouraging local governments to commit by seeking the allocation of funding for the drinking water sector, especially in the downstream section, namely distribution units and service units. The construction of a distribution network is important because infrastructure development, especially in the upstream part, will not be felt directly by the community, if it is not connected with the distribution network to the home connection. Second, the Government needs to innovate by finding other sources of funding sourced from nongovernmental funds, namely CSR, KPBU, and banking loans. This is done considering that government funds are limited, and not enough if used for infrastructure development both in the upstream and downstream sectors.

CONCLUSION

The government has targeted access to safe and affordable drinking water for all by 2030. The importance of managing the demand for drinking water and providing improved drinking water is the key to achieving this target. This research shows that the demand for drinking water is more influential on access to improved drinking water, compared to the supply side of drinking water. This is shown by the high influence of education levels on access to improved drinking water. Meanwhile, on the supply side of drinking water, the availability of raw water has a small significant influence on improved drinking water.

In order to increase access to improved drinking water, this study suggests, first, conducting socialization and education both directly and indirectly in a frequency, especially in areas with low levels of education. Second, it sets subsidies on drinking water rates for the poor. Third, committed to building a distribution channel (piping) of drinking water. Fourth, look for other sources of funding sourced from nongovernmental funds, namely with CSR, PPP, and banking loans.

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DECLARATION OF CONFLICTING INTERESTS

The authors report no conflicting of interest.

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