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Research article

Impact of COVID-19 on Water Consumption Patterns for Domestic Needs in Sleman District

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Abstract

The COVID-19 epidemic coincided with an increase in domestic air travel. Breathing is a natural thing to do outside the home. Excessive air use affects air availability. This research aims to determine variations in residential water use in Sleman Regency before, during, and after the pandemic. This research is descriptive and quantitative in nature and uses primary data—basic information collected from surveys sent via Google Forms—as the main source of information. The research subjects were residents of Sleman Regency. Research results show that clean water consumption at home increased by 6.65%, according to a study. The average community water use before the pandemic was 188.47 L per person per day. This amount increased to 201 L per person per day during the pandemic. The Ministry of Public Works sets a standard for clean water use of 150–210 L per person every day. Bathing was the most common water use pattern (31.04% before the epidemic and 29.48% during the pandemic). In Sleman Regency, Cangkringan District has the lowest water demand (2.77%), and Depok District has the highest (11.64%). In order to maintain the availability of clean water sources, it is necessary to plan and assess air availability, especially regarding access to clean water in the Sleman Regency area.

Keywords: Covid-19; Domestic Water Needs; Water Consumption Patterns.

1. Introduction

Water resources are a type of natural resource that humans depend on for survival and deserve careful consideration (Pradinaud *et al.,* 2019). Water resources are essential natural assets for the survival of flora, wildlife, and humans, as well as for fulfilling everyday requirements throughout all sectors of existence. According to Drăguleasa *et al.* (2023), "water is a limited and vulnerable natural resource". Water abundantly exists on Earth, but not all of it is usable because it comprises 97.5% salt water in oceans and 2.5% fresh water, two-thirds of which is found at the poles in the form of glaciers.

Enhancing water utilization can be achieved through the efficient allocation of water resources. Sustainable allocation of water resources, namely, the even allocation of all types of water resources and consideration of the ecoenvironment's water needs in a particular area, must be carried out. However, water resource allocation based on ecological priorities is rare (Deng *et al.,* 2022; Li & Wu, 2023). The COVID-19 crisis demonstrated the importance of water as a public health priority (Warner *et al.,* 2020) and hygienic facilities to safeguard the health of humans (Almulhim & Aina, 2022). The controversial SARS-CoV-2 pandemic drew attention to water insecurities in households around the world (Staddon *et al.,* 2020; Lusk *et al.,* 2021).

This phenomenon is in line with what was expressed by the World Health Organization (WHO) (2020), which states that clean water is crucial to protecting human health during the COVID-19 pandemic. Therefore, keeping water safe and healthy is important during a pandemic (Poch et al., 2020). Similar to regional variations in water use, the pandemic was viewed and handled differently globally (Hale *et al.,* 2021), which could highlight both global variations and global trends in residential water usage profiles.

To prevent COVID-19, the world is focusing on six key infection control strategies: (1) frequent hand washing; (2) maintaining a safe distance; (3) not touching one's face; (4) wearing a mask; (5) seeking medical attention for fever, cough, and breathing difficulties; (6) adhering to recommendations from healthcare professionals to flatten the epidemiological curve (World Health Organization, 2020). Furthermore, the Centers for Disease Control and Prevention in the United States recommends the cleaning and disinfection of home surfaces (CDC, 2021).

Water and sanitation must be a fundamental component in initiatives to halt the transmission of the novel coronavirus. Access to clean and adequate flowing water is essential for the implementation of Covid-19 preventive protocols. Water is therefore necessary to prevent COVID-19 virus from spreading to homes and healthcare institutions. Thus, access to a safe and sufficient supply of water is crucial, particularly in low-income nations where 80% of disease cases are attributed to poor sanitation, hygiene, and water quality (World Health Organization, 2020; Portilo *et al.,* 2023)..Thus, this will indirectly affect household water needs..

Several studies have identified the influence of COVID-19 pandemic on domestic water needs. Academics stated that water consumption is being relocated from public places to homes. According to Sutri and Makin (2020), household or domestic water use has increased by 15%–20%, and water use in public places has decreased by 30% and 50%. The COVID-19 pandemic has increased the need for clean water. During the COVID-19 pandemic, research by the Indonesia Water Institute (IWI) revealed that clean water consumption increased by threefold. This phenomenon was due to society's new habits, which demand an increase in a clean lifestyle. After performing activities outside their home, people wash their hands or shower to prevent coronavirus transmission. In addition, domestic water use increased along with community activities conducted at home and in a work-from-home setup (Julistian, 2021).

According to the IWI, domestic water consumption reached 415–615 L/day/household prior to the pandemic and increased to 995–1,415 L/day/household afterward. The need for water for bathing and washing hands is increasing. The amount of water needed for bathing per person per has increased from 50–70 L prior to the pandemic to 150–210 L during its progression. Before the pandemic, each person used 4–5 L of water daily to wash their hands; this amount increased to 20–25 L. The need for clean water, which did not increase, reaches 100–150 L/day/house for washing clothes. IWI reported that 42% of people did not wash their hands five to ten times a day before the epidemic, but 58% did so during the pandemic. The increased cost of obtaining clean water, which accounts for approximately 20% of people's income, is comparable to the increase in clean water consumption (CNN Indonesia, 2021).

Domestic water needs before and during a pandemic must be determined to enable the government to analyze water availability in a region to ensure sustainable water management and prevent water crises. Water availability remains secured if a watershed or catchment area can deliver sufficient amounts of water to meet current needs without jeopardizing future water supplies (Vaishnavi, *et al.,* 2022). Water consumption tends to increase, and the availability of clean water tends to slow down (Dias *et al.,* 2023) due to natural damage.

E-government can be used to identify and obtain results, including improving public services through information and communication technology to make services more easily accessible to the public. During the COVID-19 pandemic, e-government proved very useful in planning, organizing, and delivering public services (such as secondary data information) to the community. Public services are becoming more effective and efficient (Septiani, 2020).

This study analysed and predicted the need for clean water in Sleman Regency before and during the pandemic. Clean water needs, especially for household purposes, can be met via a comprehensive management strategy. This strategy must expand water distribution infrastructure and facilities while protecting water resources and creating water provision, usage, and management technology.

E-Government eased the collection of Sleman Regency data, which can also be used to determine water consumption patterns and needs based on socioeconomic conditions. Such information is important because water is the most essential element for life. Therefore, the "Impact of COVID-19 on the Distribution of Water Consumption Patterns for Domestic Needs in Sleman Regency" must be determined from the above background information.

The following section will explain the research method. This section describes how the data was obtained and analyzed to obtain results in the Results and Discussion section. The final results of this research can be concluded in the last section of this manuscript.

2. Research Methods

The investigation involved the use of quantitative description methods. Quantitative descriptive research uses empirical techniques based on recognized descriptive data to answer queries systematically, objectively, and factually regarding the facts and characteristics of a particular population or location. The data are collected, analyzed, and presented numerically.

2.1. Selection of Location and Research Subjects

The research location in this study is Sleman Regency, Special Region of Yogyakarta Province. The location was selected by purposive sampling, with the research subjects being individuals who consume water from various water sources in the Sleman Regency (Figure 1).

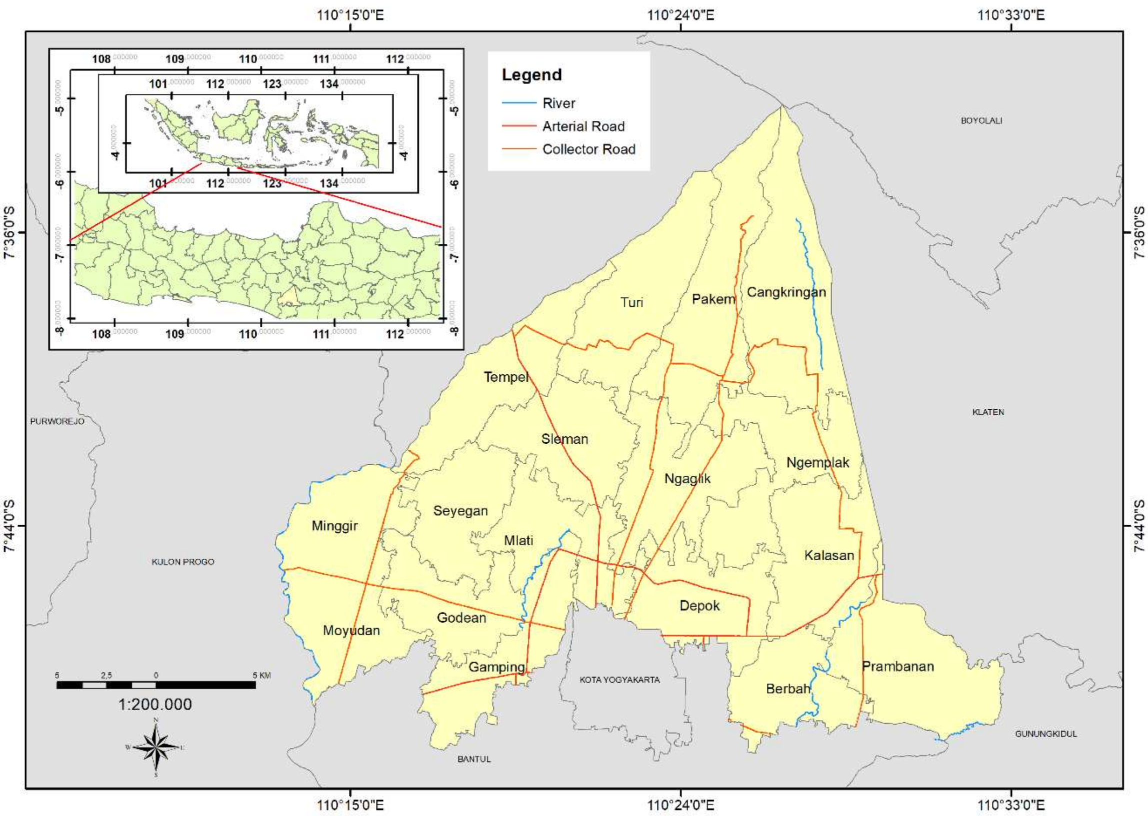

Figure 1. Administrative Map of the Research Location.

2.2. Research Data and Variables

The primary data used in this research were obtained from a Google Online questionnaire for basic data collection. Data collection of the questionnaire applied for this research took place online in June – October 2021. The data studied included water consumption used for domestic needs and the community's demographic, social, and economic information. Administrative maps and demographic statistics of Sleman Regency were used as secondary data supporting this research.

2.2.1. Data collection

This research involved primary data as the main types of data. The methods used in this research to obtain data are as follows:

a. Questionnaire

A questionnaire is a data collection technique in which respondents are presented with written questions (Taherdoost, 2021). This data collection method is highly adaptable and easily implemented. A questionnaire contains structured questions that respondents must thoroughly answer to collect data. For this survey, data collection was performed using Google Forms. Validity and reliability were verified by directly confirming the theory underlying the indicators before distributing the questionnaire.

b. Observation

Observation indicates selecting, changing, documenting, and categorizing organizational behaviors and atmospheres based on scientific objectives (Dziallas, & Blind, 2019). In this research, observations refer to observation methods performed before, during, and after the study, and they were used as an auxiliary technique to assess actual location conditions.

c. Literature review

Snyder (2019) defined literature study as a method for collecting information to increase the comprehension of various ideas, which serve as a basis or guide for research. Literature reviews can also be used as a secondary data collection method, that is, by collecting data from books, newspapers, and scientific research publications. Literature research aims to gather information and gain insights into the theory behind a selected approach.

2.2.2. Population and Sample

According to Sarstedt (2015), a population is a generic area consisting of subjects and objects with specific attributes; researchers select populations to investigate and draw conclusions. The population used in this study included residents of Sleman Regency. Population characteristics were also included in the sample. This research determined the number of targets that must be met during population sampling via the quota sampling technique. The minimum sample quota was 30, which enabled the statistical processing of the collected data.

2.3. Data Analysis

2.3.1. Domestic Water Source Analysis

Frequency distribution was applied in this research. The data were arranged in a frequency distribution based on specific classes (Dziallas & Blind, 2019). Naseem *et al.* (2023) described frequency distribution as the grouping of data into groups depending on their quantity; each piece of data cannot be classified into more than one category. The data presentation stage involves presenting classified data as graphic tables and maps.

2.3.2. Domestic Water Consumption Analysis

Domestic water needs refer to the water needs of a household obtained individually from specific water sources. The amount of clean water a household uses is expressed in liters/person/day. In this study, the analysis of household water use was carried out using questionnaire data. Water usage included in the calculation is based on average water consumption per person per day. Therefore, water consumption can be calculated using the Equation 1

$$Domestic\ water\ consumption = average\ water\ use\ x\ population \quad (1)$$

2.3.3. Analysis of Domestic Water Consumption Patterns

Domestic water consumption patterns were analysed, with the essential data comprising total domestic water consumption, which was classified based on its use. These uses include toothbrushes, washing clothes, washing dishes/kitchen utensils, bathing, cooking, urination/defecation, cleaning the house, watering plants/draining fishponds, washing vehicles, and drinking water (Table 1). The variables, methods, and data analysis in this study are presented in Table 2.

Table 1. Details of Domestic Water Use.

No.	Details of Domestic Water Use
1.	Toothbrush
2.	Washing clothes
3.	Washing dishes/kitchen utensils
4.	Bathe
5.	Cook
6.	Urination/defecation
7.	Cleaning the house
8.	Watering plants/draining fish ponds
9.	Washing vehicles
10.	Drinking water

Table 1. Variables, methods, and research data analysis.

Analysis	Variable	Method
Domestic Water Sources	Source Type	Frequency Distribution
Domestic Water Consumption	Average Water Usage Amount Total population	Statistic analysis
Water Consumption Patterns	Total domestic water consumption by use	Frequency Distribution

3. Results and Discussion

Clean water is a determinant of community survival. Household water usage has significantly increased throughout the pandemic (Abu-Bakar *et al.,* 2021; Kim *et al.,* 2021; Lüdtke *et al.,* 2021). As is the case in Sleman Regency, water consumption has increased due to the spread of coronavirus (COVID-19) and the demand for water as a medium to halt virus transmission while implementing health protocols. Not only the availability of water from existing groundwater sources but also the increase in clean water need to be considered. This analysis is essential for the assessment and monitoring of clean water needs in the future.

3.1. Sources of Clean Water Use

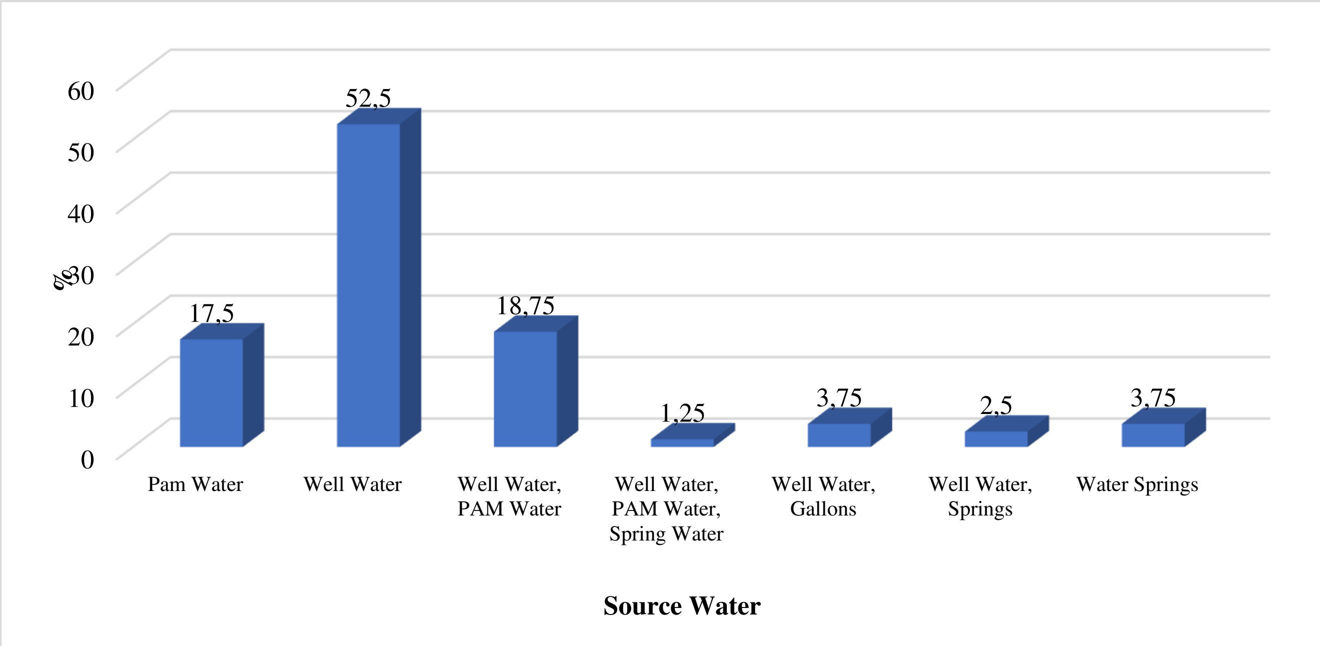

Figure 2. Clean Water Sources in Sleman Regency.
Source: Primary data analysis, 2021

The most dominant use of clean water (Figure 2) involves healthy water (52.5%) and the least includes healthy water, PAM water, and spring water (1.25%). The remaining uses comprise PAM water (17.5%), the combinations of healthy water and PAM water (18.75%), well water and gallons (3.75%), well and spring water (2.5%), and spring water (3.75%). The novelty and contribution of the manuscript, in various studies regarding the effect of water consumption on COVID-19 in parts of the world, this research uses well water as the primary water source. This is related to the geographical and cultural conditions in the research area, namely Sleman Regency. Meanwhile, in other studies, the dominant water sources are PAM water and tap water, such as in Poland, where the majority of residents use tap water for drinking and daily activities (Ober & Karwot, 2023).

For the 37.5% of users of healthy water and PAM water, people paid an average of IDR 15,150 for PAM water every month before the pandemic and an average of IDR 15,676 during the. The costs people must pay to access clean water increased by Rs 526 or 3.47% (Table 3). In Sleman Regency, the PDAM tariff is IDR 3,420 per cubic meter, and the average PAMSIMAS tariff is IDR 1,000 per cubic meter.

Table 3. Average Domestic Water Use and Average Expenditure for Domestic Water Access Before and During the Pandemic.

	Average Clean Water Use (person/liter/day)	**Average Expenditure for Access to Clean Water (Rp)**
Before the pandemic	188,47	15.150
During a pandemic	201	15.676

Source: Primary data analysis, 2021.

Before and during the pandemic, the average amount of clean water increased by 11.65 L or 6.18%. The average use of clean water before the pandemic was 188.47 L/person/day, and it reached 201 L/person/day. This amount is very wasteful compared with the findings of a 2006 survey, which reported a household water need amounting to 144 L per day. The research of the Directorate General of Human Settlements (2006) revealed considerably lower water requirements compared with this amount. With the average number of household members being four, the total domestic water demand before the pandemic was assumed to be 753.88 L/day/household. Compared with the IWI findings, that is, between 415 and 615 L/household per day, this consumption is relatively high. However, during the pandemic, clean water consumption (804 L/day/household) was lower than IWI's findings and increased between 995 and 1,415 L/household (CNN Indonesia, 2021).

Sleman Regency is considered a metropolitan area based on standard data on the population's domestic water needs supplied by the Ministry of Public Works. In 2020, Sleman Regency had a population of 1,125,804 people. Based on these standards, the average water requirement for the population of Sleman Regency ranges from 150 to 210 L/person/ha of water. Humans need water for important functions, including drinking, cooking, and bathing. Apart from economic purposes, water also has social purposes, which require clear, pure, and healthy water. The social and economic role of water must be considered because the need for water will increase as the population increases. Therefore, if water resources are not managed well, management and control conflicts can occur if the water supply is sufficient in quantity and quality (Ahmad *et al.,* 2023; Budhy *et al.,* 2022). However, in this study, which is confirmed by research by Tleuken *et al.* (2021) in Kazakhstan, the increase in water use is more due to other factors (in this case, it is assumed to have changes in daily water consumption habits related to the lockdown effect pandemic) rather than population increase.

3.2 Potential Availability of Water Resources in Sleman Regency

In this study, an assessment was conducted on the availability of water resources in Sleman Regency, which comes from potential water sources spread across several sub-districts. The availability of water resources is presented in liters/year, as shown in Table 4.

Table 4. Potential Water Availability from Springs.

No	Subdistrict	Spring Potential		Water Availability (liters/year)
		Amount	Debit (liters/day)	
1.	Mlati	3	46	4.351.968.000
2.	Depok	2	45	2.838.240.000
3.	Ngemplak	7	40	8.830.080.000
4.	Ngaglik	9	24	6.811.776.000
5.	Sleman	4	30	3.784.320.000
6.	Turi	2	8	504.576.000
7.	Pakem	10	30	9.460.800.000
8.	Cangkringan	8	78	19.678.464.000
9.	Sleman Regency	45	301	56.260.224.000

Source: Data analysis, 2021.

Springs are usually found at the bend between a foot slope and a plateau. Springs also occupy upstream areas at the end of watershed boundaries. A total of 45 springs can be found in Sleman Regency, spread across eight subdistricts. The most negligible discharge from the spring occurs where water is discharged. Calculation results show that spring water availability in Sleman Regency reaches 56260224000 L/year. Cangkringan District showed the greatest water availability, at 19678464000 L/year. The most minor water availability (504576000 L/year) was observed from springs in Turi District.

3.3. Distribution of Clean Water Use in Sleman Regency

In 2020, Sleman Regency had a population of 1,125,804. As shown in Table 4, Sleman Regency is classified as a metropolitan city because its population reaches 1,000,000–2,000,000 people; its total water requirement amounts to 150–210 L (Department of Public Works, 2006). The average household water consumption before the pandemic was 188.47 L/person/day and 201 L/person/day in 2006. These values still meet the standards issued by the Ministry of Public Works (Table 5).

Table 5. Household Water Needs Based on City Type and Population.

Population (people)	City Type	Amount of Water Needed (litres/person/day)
2,000,000	Metropolis	210
1,000,000 to 2,000,000	Metropolis	150 – 210
500,000 to 1,000,000	Big city	120 – 150
100,000 to 500,000	Big city	100 – 150
20,000 to 100,000	Medium City	90 – 100
3,000 to 20,000	Small town	60 - 100

Source: Construction and building guidelines, Department of Public Works in the Directorate of Water and Irrigation BAPPENAS, 2006.

Before the pandemic, the calculated total consumption of clean water in Sleman Regency was 212,171,825.18 L/day, which increased by 13,112,813.26 L/day and reached a value of 225,284,638.44 L/day. Given the increased demand for domestic water, awareness of its practical use must be promoted. A sense of responsibility is also needed for water source facilities and infrastructure to ensure water availability, especially domestic water.

Table 6. Assumptions for Total Domestic Water Needs Before and During the Pandemic in Sleman Regency.

Subdistrict	Population	Water Needs		Enhancement
		Before Pandemic	During the Pandemic	
Moyudan	33.514	6.316.131,89	6.706.486,54	390.354,65
Minggir	32.110	6.051.530,56	6.425.532,10	374.001,54
Seyegan	51.231	9.655.121,83	10.251.835,41	596.713,58
Godean	72.255	13.617.357,22	14.458.948,05	841.590,83
Gamping	103.192	19.447.821,28	20.649.751,12	1.201.929,84
Mlati	100.524	18.945.003,35	20.115.857,64	1.170.854,29
Depok	131.005	24.689.528,51	26.215.410,55	1.525.882,04
Berbah	59.004	11.120.040,76	11.807.290,44	687.249,68
Prambanan	53.113	10.009.808,24	10.628.442,43	618.634,19
Kalasan	86.163	16.238.493,53	17.242.077,93	1.003.584,40
Ngemplak	67.555	12.731.583,52	13.518.431,05	786.847,53
Ngaglik	105.612	19.903.900,50	21.134.017,32	1.230.116,82
Sleman	71.888	13.548.191,49	14.385.507,68	837.316,19
Tempel	53.628	10.106.866,42	10.731.499,08	624.632,66
Turi	36.559	6.890.000,17	7.315.821,49	425.821,32
Pakem	37.320	7.033.420,13	7.468.105,20	434.685,07
Cangkringan	31.131	5.867.025,78	6.229.624,41	362.598,63
Sleman Regency	1.125.804	212.171.825,18	225.284.638,44	13.112.813,26

Source: Primary data analysis, 2021.

Depok District had the highest domestic water demand during pre- and post-pandemic. The population of this district reached 131,005 people in 2020, the highest number observed in Sleman Regency (Table 6). Water demand in Depok District was 24,689,528.51 L/day before the pandemic, and it increased from 1,525,882.04 L/day to 26,215,410.55 L/day. The high demand for water in Depok District was due to the high number of residential settlements, where the standard of living in housing is higher than that of a village. The higher a person's standard of living, the higher the need for water (Piekut, 2020).

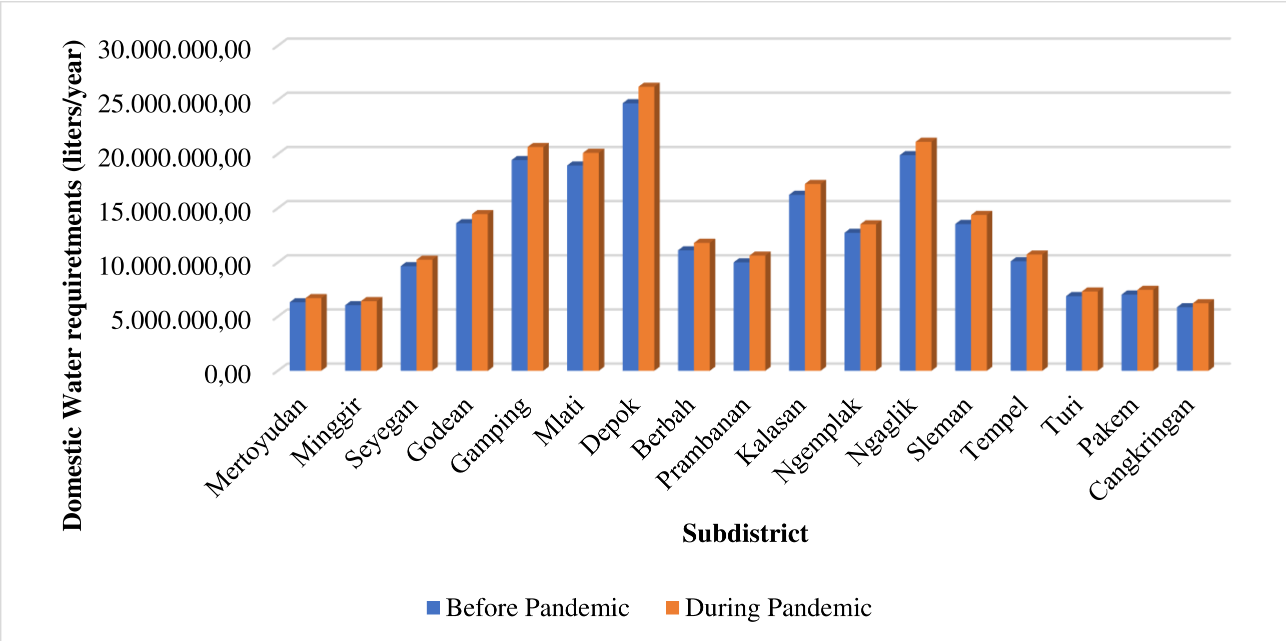

Figure 3. Bar Diagram of Domestic Water Demand Before and During the Pandemic in Sleman Regency.

As shown in Figures 5 and Figures 3, the lowest domestic water demand in Sleman Regency before and during the pandemic occurred in the Cangkringan District. The total water demand before the pandemic was 5,867,025.78 L/day, which implies an increase of 362,598.63 L/day, resulting in a final value of 6,229,624.41 L/day. Such a result was observed because the pattern of clean water usage is also determined by the size of a city (Boretti & Rossa, 2019; Gebremichael, 2021).

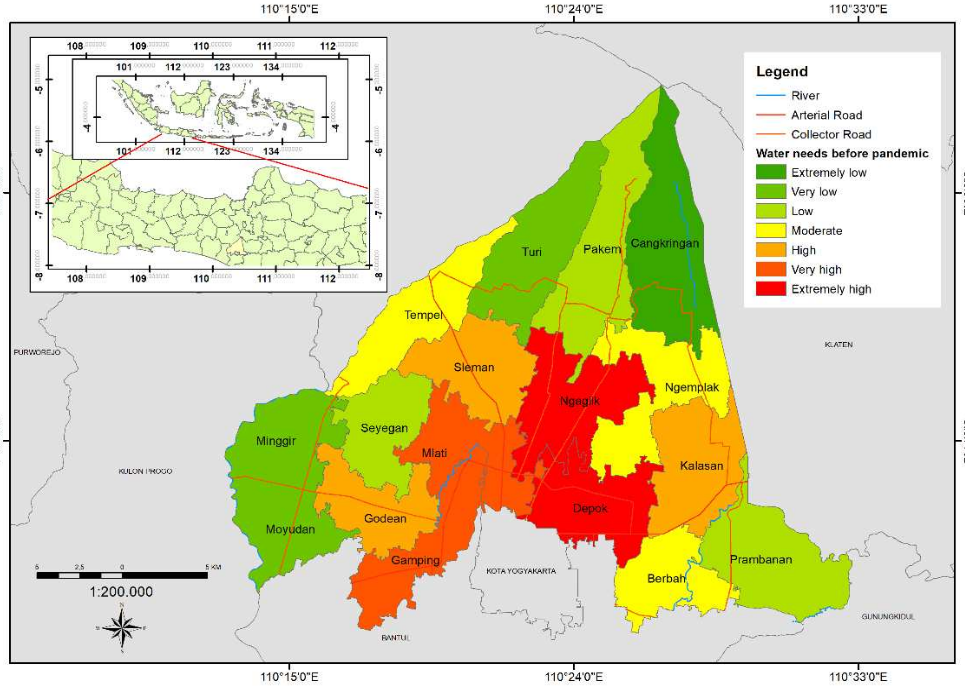

Figure 4. Distribution Map of Clean Water Use Before the Pandemic in the Sleman Regency
Source: data processed in ArcGIS, version 10.7.1

As with domestic water demand during and before the pandemic, the percentage increase is directly proportional to the population in each subdistrict (Figure 4). As displayed in Figure 6, the growth rate of domestic water demand from before the start of the pandemic was the highest in the Depok Regency (11.64%), and the lowest was observed in the Cangkringan Regency (2.77%).

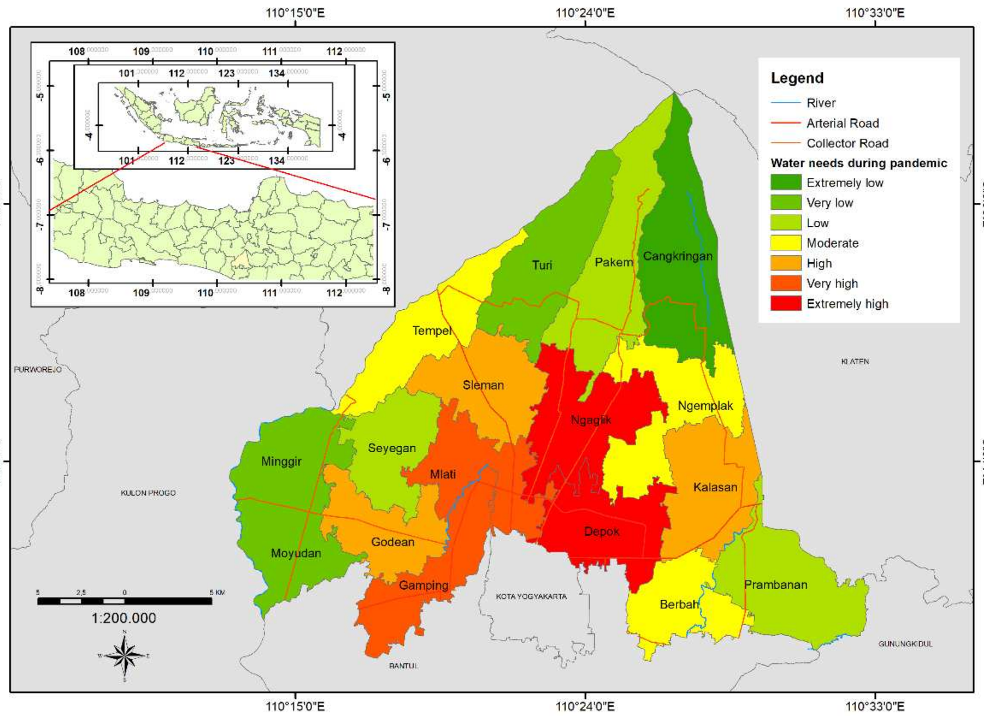

Figure 5. Map of Distribution of Clean Water Use Before the Pandemic in the Sleman Regency.
Source: data processed in ArcGIS, version 10.7.1

As a result of the fluctuation of activity levels, several factors influence each person's water needs. According to the WHO (2013), factors that affect one individual may not necessarily influence others. According to Almulhim (2022), variations in household water needs are influenced by climatic conditions, demographic composition, environmental problems, water tariffs, meters, and the need for water conservation. Hasan *et al.* (2020) mentioned that variables such as income, the number of family members, education level, and use of water-saving practices in a household all determine the extent of water needed by each household based on sociodemographic factors. Water demand increases with the increase in population per capita, as is the case in industrialized countries (Vaishnavi & Chinnan, 2022). In Joinville, southern Brazil, Kalbusch *et al.* (2020) examined changes in daily water use of a group of approximately one thousand consumers. According to both studies, household water consumption has increased, and the water usage profile has changed due to remote working and lockdowns. However, industrial and commercial water consumption has declined sharply. Still, in Brazil, the results showed that water consumption had a slight but significant increase. Peak water consumption times are also changing. COVID-19 has significantly impacted the UK economy, society, and water sector. The need for water is increasing along with the increasing importance of public health, as well as for the business world and stakeholders in the water sector, and this shows the importance of water for society (Frontier, 2020). Increased water consumption also occurred in Italy. According to a study, the total amount of water used in residential areas increased by 18% during the lockdown. In addition, water use appears to spread more evenly throughout the day, with a decrease in the morning consumption peak, which is especially noticeable on weekdays (Stefano *et al.,* 2021). Meanwhile, in Rybnik, Poland, it was reported that there was a decrease in water consumption originating from tap water. This is because many residents are under lockdown at home, so the consumption of tap water from companies and industries has decreased (Ober & Karwot, 2021).

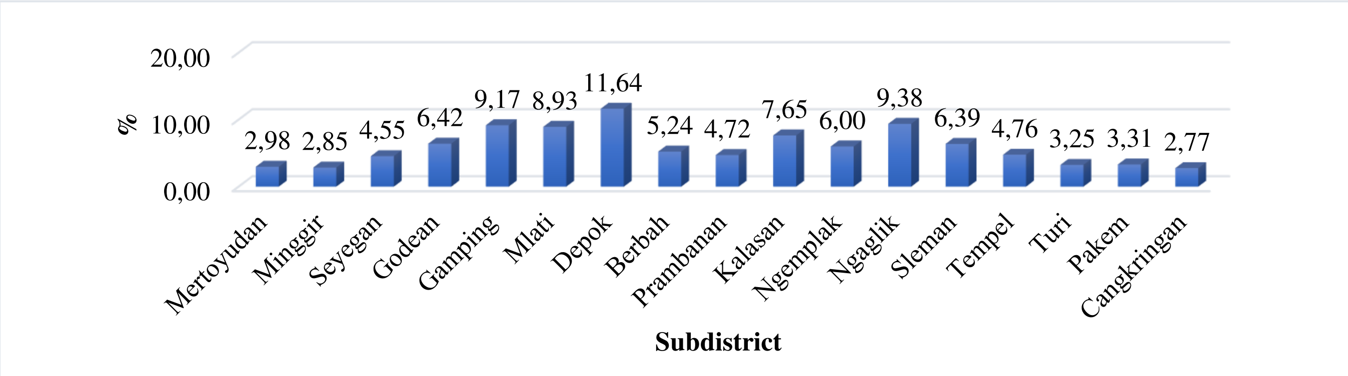

Figure 6. Percentage Diagram of Increase in Domestic Water Use.
Source: Primary data analysis, 2021.

We focused on the potential availability of existing water for domestic water needs before or during the pandemic. Water resources in Sleman Regency can no longer supply these needs because water availability is only calculated from springs, and water availability from surface runoffs from deep aquifer funds is ignored. Local communities should actively participate in the maintenance of sustainable water. Therefore, adequate supply and education regarding the efficient use of clean water in daily household life are urgently needed.

3.4. Clean Water Use Patterns

Changes in the pattern of water usage have been observed in cities worldwide since March 2020, when some countries implemented lockdowns (Bich-Ngoc & Teller, 2020; Hale *et al.,* 2021) (Bich-Ngoc & Teller, 2020; Feizizadeh *et al.,* 2021). Utilization of clean water is vital to reducing the likelihood of spreading viruses such as coronavirus (COVID-19). In April 2020, the WHO started recommending water for hand washing and other hygienic facilities. To a certain extent, people can keep themselves safe by often washing their hands. It takes a sufficient amount of water to maintain a hand-washing regimen (Cooper, 2020). Therefore, access to water at all societal levels is essential to implementing preventive health measures to halt the spread of the COVID-19 virus.

Indonesia has a higher average domestic water consumption than the WHO water adequacy standards. According to WHO, the average water requirement for each person is 50–100 L daily, where the need for water is aimed at meeting needs and reducing the negative impacts on health. The domestic water use included in this report is consistent with the numbers provided by several agencies, which showed that toilet and bathroom demands account for most water use.

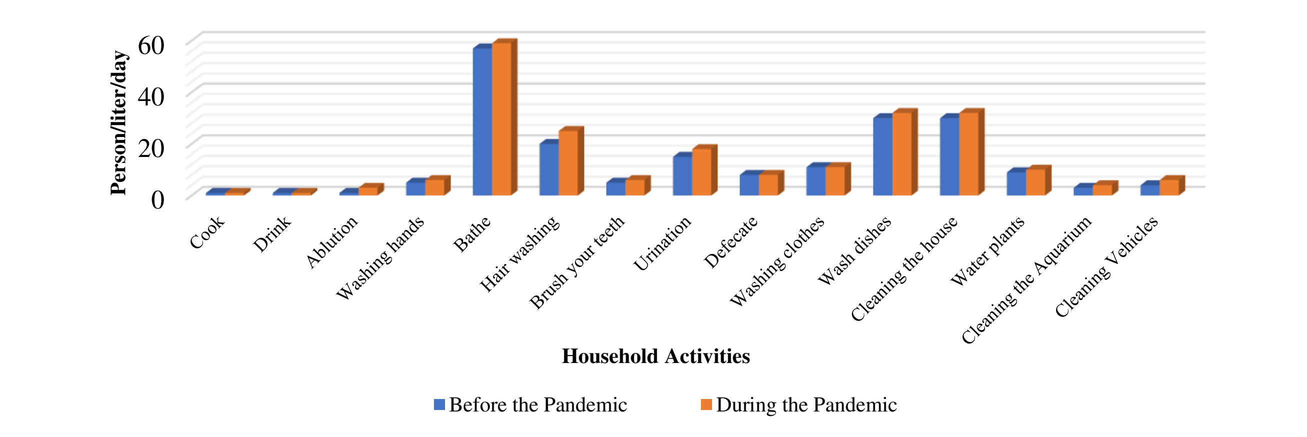

Figure 7. Clean Water Use Patterns**.**

The average population's total clean water consumption increased by 12.53 L/person/day during the pandemic. The highest water use before the pandemic was for bathing activities (29.48%), with the water use assumption of 59.25 L/person/day. The community's pattern of clean water use changes over time and can be influenced by several factors (Figure 7). Meanwhile, during the pandemic, most of the water used was allotted for bathing activities (31.04%), that is, 58.50 L/person/day. However, this finding still needs to be higher than that of IWI's research, which revealed that the water needed by each person amounted to 50–70 L per day before the epidemic and 150–210 L per day during. The amount of water used for bathing depends on the bathing equipment used. The volume of water used for bathing is more significant when using a scoop than when using a shower. If you shower twice a day, you will need 9 L of water/minute, whereas if you use a dipper, you will need 20 L/minute. Like Metropolitan cities in other countries, namely Dammam, Saudi Arabia, it is noted that the ranking of the percentage of water consumption in the Dammam Metropolitan Area from highest to lowest is for cooking, personal hygiene, and outdoor activities such as gardening, swimming, and washing vehicles as well. (Yustiana & Adi, 2024).

Most people practice inappropriate bathing habits, which results in the wastage of clean water. Showering can reduce the water used for bathing (Rueda *et al.,* 2023). In terms of percentage, water use for bathing before and during the pandemic decreased by 1.56%, but in terms of the amount used, it increased by 0.75 L/person/day (Table 7). A decrease was observed in the percentage of water used for bathing because the water allocated for other activities also increased. Meanwhile, water conservation, reuse, and reduction—the three Ps —are essential to implementing the optimal use of clean water.

Table 7. Percentage of Clean Water Use Patterns.

Type of activity	**Use of Clean Water (%)**	
	Before the Pandemic	**During the Pandemic**
Cook	0,43	0,44
Drink	0,51	0,54
Ablution	1,45	1,41
Washing hands	0,80	1,17
Bathe	31,04	29,48
Hair washing	10,32	11,71
Brush your teeth	1,27	1,20
Urination	7,73	7,56
Defecate	3,18	3,04
Washing clothes	4,83	4,99
Wash dishes	16,00	15,89
Cleaning the house	16,45	15,92
Water plants	4,19	4,13
Cleaning the Aquarium	0,84	1,03
Cleaning Vehicles	0,94	1,49
Total	100,00	100,00

Source: Primary data analysis, 2021.

An increase in domestic water was also observed in hand washing activities. The use of water for washing hands increased by an average of 0.84 L/person/day, from 1.51 L/person/day before the pandemic to 2.35 L/person/day during. In terms of percentage, the average use of clean water for washing hands increased by 0.37%, from 0.80% to 1.17%. The analysis reveals that more respondents washed their hands less than three times before the pandemic (74%). However, the number of respondents washing their hands changed since the pandemic. Respondents started washing their hands three or more times, with 44% washing their hands 3–6 times daily and 21% washing their hands six or more times a day (Figure 8).

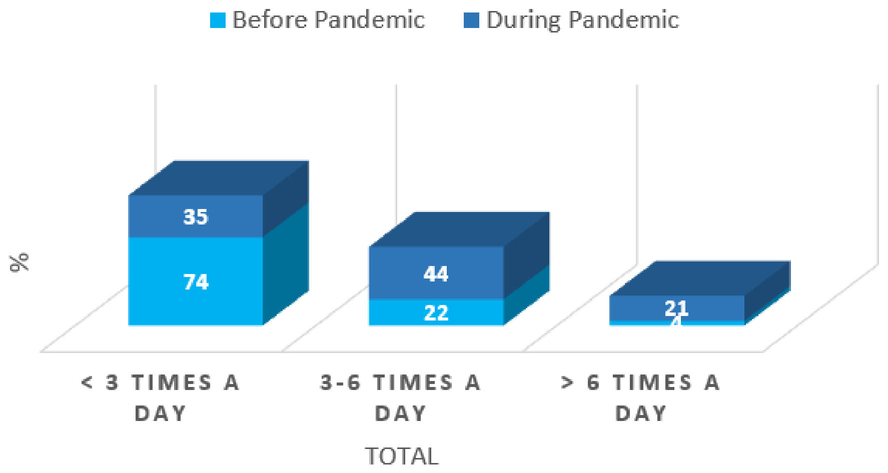

Figure 8. Handwashing Activities During the Pandemic.

The results achieved are also below those of the IWI study. Before the pandemic, the need for hand washing was 4– 5 L per person per day, and during the pandemic reached 20–25 L per person per day (CNN Indonesia, 2021). A number of studies have also shown that changing habits in Australia—such as washing hands more frequently—may have a significant impact on increasing water use in the country. Using proper cleaning equipment is thought to reduce a person's chances of contracting COVID-19 (Seale *et al.,* 2020). In the global effort to stop the spread of COVID-19, washing hands with soap and water is one of the greatest approaches to reduce transmission. This has an obvious explanation: Frequent and thorough hand washing reduces the likelihood of illness transmission by physically breaking down and eliminating virus particles from the hands. Numerous health organizations advise hand washing for at least 20 seconds, up to eight or ten times a day. The average hand basin tap uses two to three liters of water per minute when washed with running water. This suggests that each person needs eight to ten liters of clean water per day, along with soap and suitable drying facilities (i.e., not reusing or contaminated towels or rags) (Staddon *et al.,* 2020). The increase in clean water use is also attributed to the increased use of water in toilets, such as for urination (0.62 L/person/day) and defecation (0.11 L/person/day). Indonesian culture still uses a ladle or tub to flush the toilet, with each flush requiring 5–6 ladles of water, which is equivalent to 24 L per person daily.

3.5. Water Resources Management

Water resource management in Sleman Regency can involve protecting water resources through the implementation of a land use orientation model in the area. Such a strategy aims to control population concentration and land use grouping based on specific criteria to achieve optimal, efficient, and sustainable management of potential water resources. The bases or criteria for determining normative land use guidelines in Sleman Regency comprise two groups of characteristics.

First, community characteristics include population density, community activities, and community opinions regarding water resource management. The second group includes characteristics of water resources, such as water catchment areas, river flow systems, spring potential, and regional water potential. These two sets of characteristics can help conserve water resources (Chantonati *et al.,* 2019).

In Sleman Regency, groundwater flows from north to south, whereas in the south, less flow occurs based on existing hydrological formations. Water discharge points in the form of springs are spread across Pakem, Ngaglik, and Cangkringan subdistricts with high potential. By contrast, subdistricts with moderate spring potential are spread across Sleman, Mlati, Depok, and Turi subdistricts. In general, drainage areas are located near Mount Merapi's foot, and water catchments are found on mountain slopes. This spring has a flow rate range of 1–78 L/s. In addition, two watershed systems (DAS), namely, the Progo DAS and Opak DAS, drain Sleman Regency. The river's year-round flow makes it accessible to residents for various purposes (Gundersen, 2021).

Given these circumstances, the land use direction model was developed based on land use planning principles to protect and conserve water resources and land use regulations to preserve springs in areas containing such bodies of water. The fundamental way springing preservation is via the arrangement of the surrounding land within a radius of 25 m to maintain the quantity and quality of water supply. Agricultural activities must be kept away from this area to avoid harmful impacts. River boundaries should be established, management measures should be implemented to protect riverbanks from adverse impacts, and reforestation should be encouraged in river basins. These fundamental tactics can be used in river protection. Normally, preservation of river watersheds is achieved through limit changes in land use and conversion into their residential areas to maintain adequate watershed areas and manage pollution affecting agricultural activities (Lin *et al.,* 2022). In addition, there is a need to incorporate disaster management strategies into water policies to better manage public health emergencies, such as the COVID-19 pandemic, such as the interventions and policies implemented by governments in Europe, which can allegedly help reduce the impact of lockdowns on water use (Almulhim, 2022).

Based on the researcher's direct experience in this research process, there are several limitations experienced and can be several factors that future researchers can pay more attention to in further perfecting his research. The limitations of this research are: Primary data used in this research was obtained from the Google Online questionnaire for basic data collection. The use of questionnaires via Google Online is still doubtful about the authenticity of the sources because they do not meet directly. A study conducted by Einola & Alvesson (2020), the ideal study is a study that shows how respondents interpret questions during a research project so that the validity of the data can be ensured.

In future research, it is recommended to take more samples, this aims to have better data accuracy in the research. Apart from that, it is recommended to interview respondents directly in order to avoid invalid data. Additionally, several limitations of this study that may lead to future exploration should be highlighted. For example, data on lockdown conditions (i.e. occupancy levels, water usage habits, population health, building types, etc.) can provide important insights into their impact on water consumption. Household income may have changed during the lockdown, but the need for face-to-face conversations to communicate with residents as well as limiting information regarding water sources and water needs are recommended in future research so that the results can be generalized to a wider context (Sawicka, et al., 2022).

4. Conclusion

Well water is the most dominant water source in Sleman Regency. The analysis results using the mapped level of domestic water demand in Sleman Regency were used to determine the level and distribution of domestic water demand in each subdistrict. The highest and lowest household water demands were recorded for Depok District and Cangkringan District, respectively. Influential users include those who use household water in the Sleman Regency area. Household water consumption before and during the pandemic—188.47 and 201 liters/person/day, respectively—was still range 150–210 L/person/day, which is the limit for water use in metropolitan areas. Bathing with clean water is the most common pattern of clean water use. A link exists between availability and need. Therefore, regional planning management, including directing land use as a form of water management for domestic needs, is critical.

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Conflict of interest

All authors declare that they have no conflicts of interest.

Data availability

Data is available upon Request.

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