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Assessing water quality: a study of physical and chemical parameters for PDAM customers in Handil Bakti Village

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Abstract

Water sourced from the Regional Drinking Water Company (PDAM) has now been widely used and spread to all water customers from household area. The large number of requests and the distribution process for clean water needs will affect the quality of the water either in physical or chemical parameters. The research aims to determine the quality of water and responses from PDAM customers, which is based on the type of research in qualitative methods and surveys using questionnaires to respondents. The results indicated that the quality of water received by PDAM customers shows variations in compliance with the drinking water quality standards set by Indonesian Minister of Health Regulation No. 492/Menkes/Per/IV/2010. Responses to the research questionnaire revealed that perceptions of water quality—such as clarity, odor, taste, crustiness, water flow volume, and daily water needs—tend to be consistent among respondents.

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INTRODUCTION

Water is one of the most vital sources of livelihood for all living things on earth. In urban areas, the community's need for clean water for various purposes is highly prioritized. Although water is an essential element of the ecosystem, a "healthy" water quality is necessary for environmental sustainability (Uddin et al., 2023). The clean water used must be free from disease-causing germs and free from chemicals that can affect the quality of the water. Socio-economic conditions and public health will be better if consuming clean water that is hygienically managed and managed by the Regional Drinking Water Company (PDAM). The people who live in the Barito Kuala Regency area mostly consume clean water managed by the Regional Water Company (PDAM) of Barito Kuala Regency and have been engaged in clean water since March 9, 1993.

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One of the PDAM locations in the area is in the Alalak unit which serves the provision of clean water needs for the Handil Bakti Village community and its surroundings. PDAM Barito Kuala Regency, especially the Alalak unit, aims to treat water that is not suitable for use into water that is suitable for use by referring to the rules of the Indonesian National Standard and with a pH standard of 6.0 or what we usually use for bathing, washing, and cooking. The particular application or geographic area in which they are used impacts the parameters chosen for the evaluation of water quality (Moeinzadeh et al., 2024). So that from this it can be an important thing for research steps towards taking water samples and the responses of the community around Handil Bakti Village, Alalak District, Barito Kuala Regency from clean water sources originating from the PDAM.

1.1 Drinking Water Quality

Drinking water is water that goes through a treatment process or without a treatment process that meets health requirements and can be drunk directly (Ahmad Didik Meiliyadi & Bahtiar, 2023). Drinking water quality is one of the biggest factors affecting human health (Hastiaty, Kusnoputranto, Utomo, & Handoyo, 2023). To measure the water quality, further testing must be done in the good water projects (Al-Khashab et al., 2021). Good water quality includes physical, chemical and biological quality tests, so that when consumed it does not cause side effects for health (Renngiwur, 2016). Physical-chemical parameters such as temperature, pH, TDS, odor and others are widely accepted as other critical water quality parameters for drinking water. If these parameters value surpass the specified limits, they are harmful to human health (Duressa et al., 2019).

1.2 Physical and Chemical Parameters Water Quality

Identifying and focusing on the most impactful parameters becomes a critical aim in the process of parameter selection (Bui et al., 2020). Parameter of physical, chemical and biological are types of water quality (Hassan Omer, 2020). Physical characteristics of water are considered to be those that can be identified through human senses such as sight, smell, touch and taste (Jeyashanthi, 2023). It is generally possible to analyze the appearance of water in condition it is crusty, cloudy and smelly. However, this study included only two parameters in analyzing the water quality test from the local water company. The parameters are summarized in Table 1:

Table 1. Water quality parameters

Type of Water Quality Parameters	
Physical	**Chemical**
Temperature	
TDS	pH
Odor	

1.3 Definition of PDAM and its Distribution

By using methods such as filtration or distillation on a large scale, non-potable water can be made potable and that is where the role of the Regional Water Company (PDAM) becomes necessary (Johari et al., 2019). According to the Regulation of the Minister of Home Affairs Number 2 of 2007, a Regional Drinking Water Company (PDAM) is a government-owned business entity, which functions to provide services in meeting and producing drinking water/clean water needs equally for the entire community, assisting the business world in developing, and setting tariffs in accordance with the level of community capacity (Yusrannastar, Ikhlas, & Surya Ramadan, 2020).The drinking water distribution system consists of piping,

valves, and pumps that transport treated water from treatment plants to housing, offices, and industrial facilities.

The main task of the water distribution system is to deliver clean water to the customers to be served, while taking into account the quality, quantity and water pressure factors in accordance with the initial planning. In addition, treated water storage facilities, also known as distribution reservoirs, are used when water demand increases (Marisi Manurung, 2021).

1.4 Drinking Water Quality Requirements

Good clean water is that which meets the requirements issued by the Indonesian Minister of Health Regulation No. 492/Menkes/Per/IV/2010, namely tasteless, odorless, colorless, not contaminated with bacteria, pesticides and radioactive materials (Zamaruddin, 2018). Good drinking water quality can certainly be seen from the value of the requirements given or shown in the table in the regulation. If the value of the water parameter is below the quality standard of the Menkes requirements, it means that the water meets the standards for consumption. Conversely, if the value of the water parameter exceeds the quality standard, the water does not meet the standard for consumption. Furthermore, drinking water sources to be sustainable over the long term from user perceptions of water quality are also crucial (Addisie, 2022).

1.5 Domestic Water Demand of PDAMs

Domestic water demand is the need for water used for household purposes, namely for drinking, cooking, bathing, washing clothes and other purposes (Asta, 2018). However, highly smelly water in many household areas is not even suitable for cleaning and washing. This domestic water demand is the largest component for the basic needs of the treatment unit supply (Singal & Jamal, 2022). In addition, urbanization and dense human activities around the environment can adversely affect water quality (Ismael et al., 2021). Habits, patterns and living standards driven by socio-economic development have resulted in an increase in basic water needs (Fróna, Szenderák, & Harangi-Rákos, 2019). Surface water and groundwater quality and availability frequently decline as a result of a number of significant causes, including household conditions, population growth, and environmentally harmful behaviors (Tyagi et al., 2020).

This research was conducted with the aim of obtaining data and knowing how the responses of PDAM customers in the reference households of the research location. The systematics of this research is based on the curiosity of drinking water sources towards its use in daily life, as the writing of this research is organized in detail as follows:

- Section 1 (introduction) which defines water and its influence on the fulfillment of consumption needs through the management of the local PDAM, water quality test parameters carried out in the study, distribution and how the PDAM carries out its obligations in order to meet clean water needs, drinking water quality requirements, and domestic demand for PDAM water.
- Section 2 (method) which explains the idea of the research flowchart, research location, data collection location, tools and materials, population and research sample and data collection methods.
- Section 3 (results and discussions) describes the research findings starting from checking water samples to responses from respondents regarding the quality of the water they receive.
- Section 4 (conclusion) provides conclusions on the research that has been carried out and suggests to the local PDAM regarding the research.

METHOD

2.1 Research Stages

This research uses a quantitative approach method that needs to take water samples directly from the homes of PDAM customers and a survey method using a questionnaire which is then tested using a Water Quality Tester tool with the parameters tested are temperature, pH and TDS. This research is also based on literature studies taken from several similar studies from journal references, books, to theses. The research flow diagram is in Figure 1.

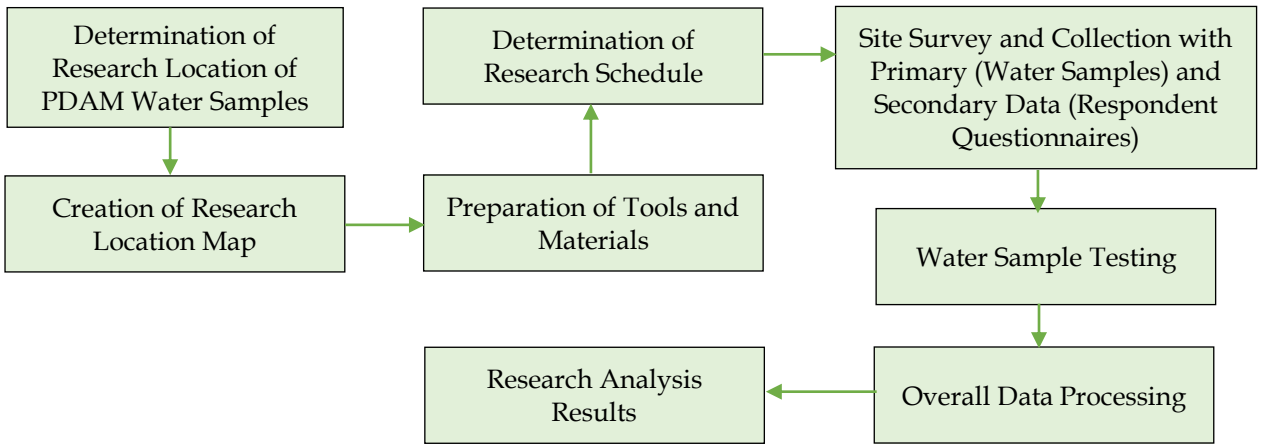

Figure 1. Research flow diagram

2.2 Data Collection Location

Geographic Information System (GIS) can be used to assess an area's water quality. It can be an effective technique for creating local solutions to issues pertaining to water resources (DeepChand, 2022). The research location is in Handil Bakti Village with a housing complex mostly located in the Bakti Lestari Complex with a total of 10 respondents to fill in primary data from water sampling and secondary data from the questionnaire. The research location can be seen Figure 2.

2.3 Tools and Materials

The tools and materials used in the research are stationery, 500 ml water jerry cans, sticker paper labels, laptops for ArcGIS mapping, and Word & Excel software.

2.4 Research Population and Sample

The questionnaire was needed to obtain personal data and PDAM customers' responses to the water quality of their homes. The population of this study were customers of PDAM Barito Kuala Regency Alalak unit which is adjacent to the location of the respondent's housing complex and a total of 10 respondents were collected. And research samples were taken at the tap water source of each respondent's house to be brought and tested later.

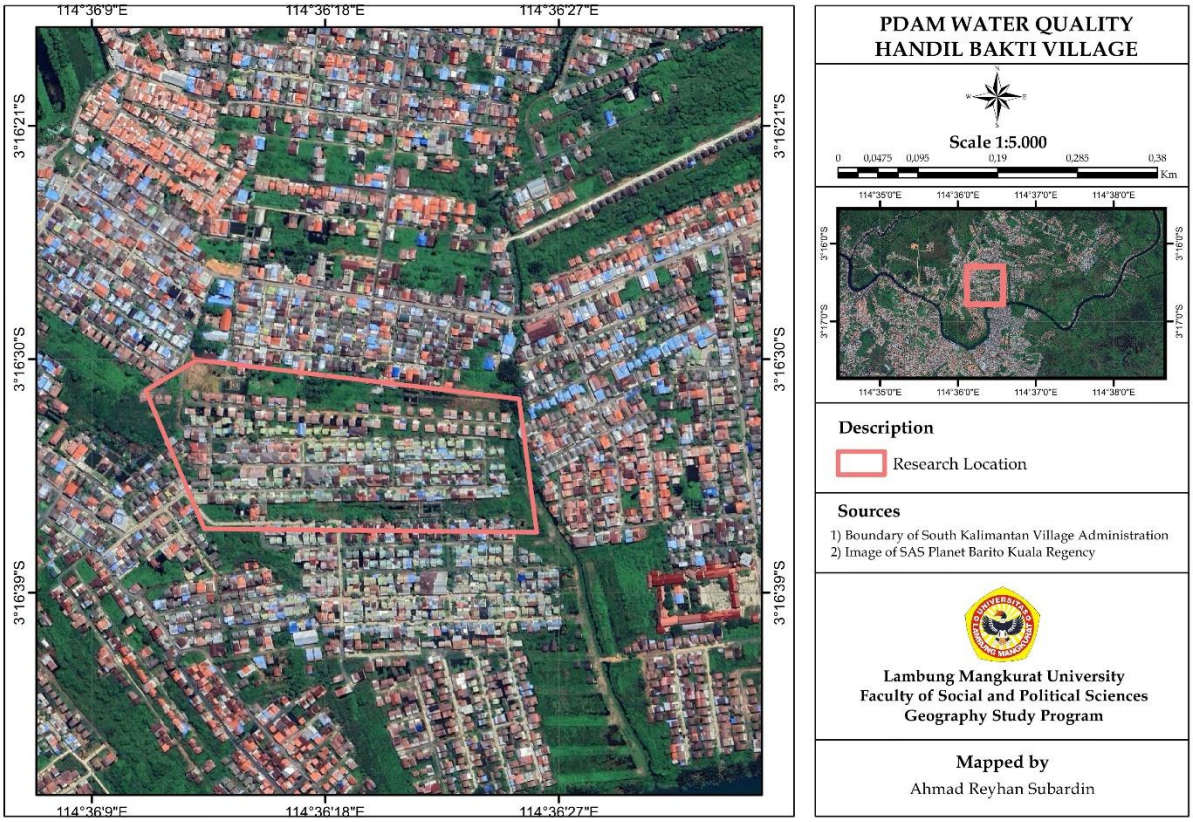

Figure 2. Map of PDAM water quality research location in Handil Bakti Village, Alalak District, Barito Kuala Regency

2.5 Data Collection Method

The sampling point is located in Handil Bakti Village in the Bhakti Lestari Complex which is carried out once and taking water samples at the location with the Grab Sampling method, namely taking water samples directly from the PDAM tap source of each house. The tools used are jerry cans, and sticker paper labels. The sampling procedure for water quality testing is to prepare a sampling tool according to the type of water to be tested. The method of taking customer water samples at the customer's home is as follows:

1. Prepare a jerrycan of water sample size ± 500 ml.
2. Turn on the tap.
3. Collect water flow in jerrycans as needed.
4. Turn off the tap.
5. Close the jerrycan again.
6. Jerrycans are labeled.
7. Water samples were taken to the Lab Building of the Geography Study Program of Lambung Mangkurat University to be tested for quality.

The research was made by going directly to the location to obtain questionnaire data on households, with the results of the research attachment in the form of the following accessible link: https://drive.google.com/drive/folders/1Ieq05Fy0wuKFOgAAvROVQtHKFR1RNM1?usp=drive_link.

RESULTS AND DISCUSSIONS

3.1 Results of Physical and Chemical Parameters in Drinking Water Quality Received by PDAM Customers

This study was conducted on December 15, 2024 by examining the physical and chemical parameters. In terms of the physical quality of the water from the taps of Handil Bakti Village customers' homes, it is in accordance with the Minister of Health Regulation No. 492/Menkes/Per/IV/2010 on Drinking Water Quality Requirements as in Table 2.

Table 2. Test results of each parameter and water quality standard limit

No.	Parameters	Handil Bakti Village Testing Results and According to Respondents			Quality Standard
		Respondent's House	Value	Unit	
1.	Temperature	1	28.5	°C	±3
		2	28.5		
		3	28.1		
		4	28.1		
		5	28		
		6	28.4		
		7	28.4		
		8	28.4		
		9	28.7		
		10	28.7		
2.	pH	1	7.61		6.5-8.5
		2	7.65		
		3	7.77		
		4	7.58		
		5	8.9		
		6	7.77		
		7	7.91		
		8	7.85		
		9	7.66		
		10	7.75		
3.	TDS	1	91	mg/l	500
		2	77		
		3	92		
		4	79		
		5	2		
		6	86		
		7	71		
		8	91		
		9	91		
		10	91		
4.	Odor	1	Smell		Odorless
		2	Smell		
		3	Odorless		
		4	Odorless		
		5	Smell		

No.	Parameters	Handil Bakti Village Testing Results and According to Respondents Respondent's House	Value	Unit	Quality Standard
		6	Smell		
		7	Odorless		
		8	Smell		
		9	Odorless		
		10	Odorless		

Source: Test results and water quality standards from the Regulation of the Indonesian Minister of Health No. 492/Menkes/Per/IV/2010 on Drinking Water Quality Requirements

3.1.1 Temperature Testing Results

Temperature measurements were tested using the Water Quality Tester tool where the average value obtained was around 28.38 ° C as many as 10 sources of home locations as in Figure 3.

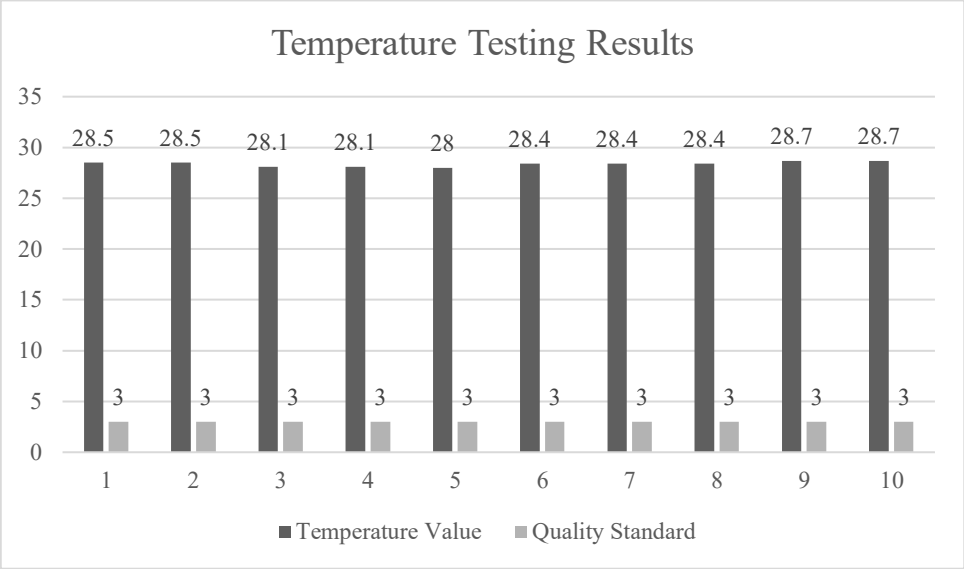

Figure 3. Graph of test results on water temperature

These measurements are in accordance with previous research that water temperature should not be too hot and cool, good water should have the same temperature as the ambient air temperature so that there is no dissolution of chemicals in the channel or pipe that can endanger health, inhibit biochemical reactions in the channel or pipe, and pathogenic microorganisms do not easily develop (Pramaningsih et al., 2023).

3.1.2 Test Results of Acidity Degree (pH)

The degree of acidity is a chemical parameter that is an important benchmark in determining water quality. This parameter aims to determine how much acid or base content in a water (Addelia Iqlima et al., 2020) as the results in Figure 4.

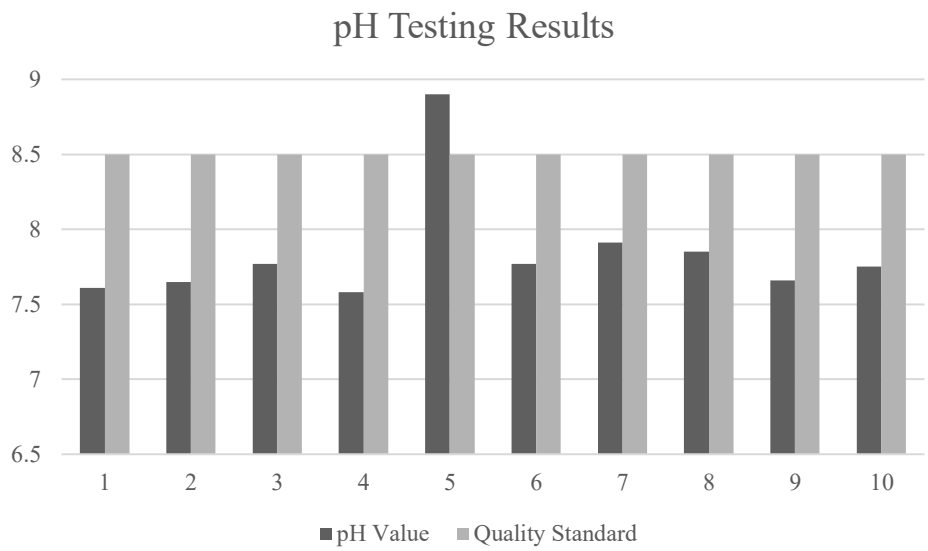

Figure 4. Graph of test results on the Degree of Acidity (pH) of water

Based on the measurement results with the Water Quality Tester, all water samples are at an average of 7.8 or the lowest pH is 7.58 and the highest pH is 8.9, which means that it has met the quality standards for clean water quality based on the Minister of Health Regulation No. 492 of 2010, namely water with a normal pH or quality standards ranging from 6.5 - 8.5. This value indicates that the water is alkaline or safe enough for consumption. Even so, the local community prefers to use gallon water for consumption because most consider the water to be often cloudy.

3.1.3 Total Dissolved Solid (TDS) Testing Results

The TDS parameter test was carried out with a TDS Meter tool which obtained an average value of 71 out of a total of 10 water samples as shown in Figure 5.

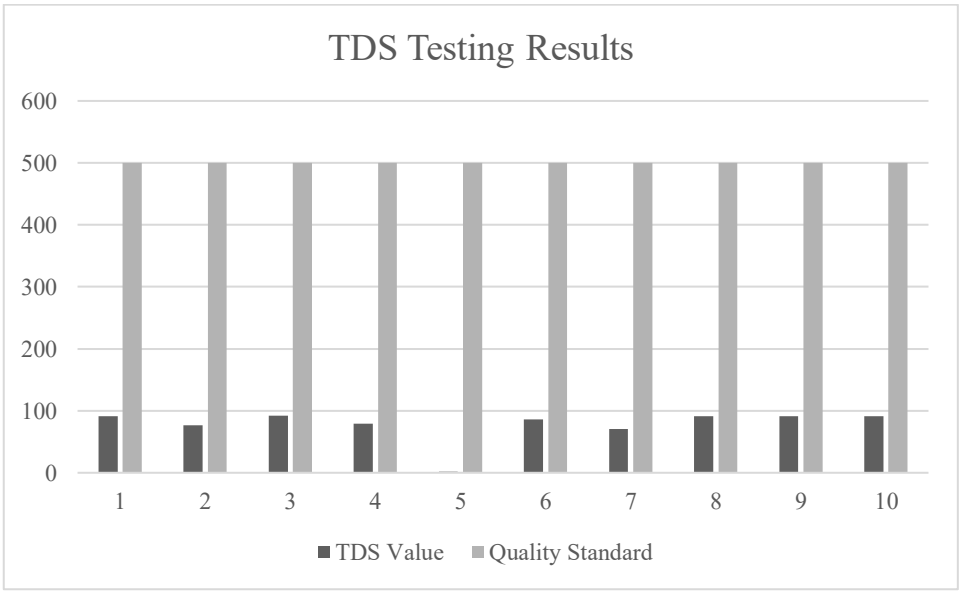

Figure 5. Graph of test results on Total Dissolved Solids (TDS) water

The main cause of TDS is inorganic material in the form of ions that are commonly found in waters, one of which comes from the use of pesticides and inorganic fertilizers from the agricultural sector.

3.1.4 Test Results for Odor and Bitter Taste Parameters in Water

Odor and taste parameter tests were carried out by observation through the sense of smell and taste (Rohmawati & Kustomo, 2020) which found that there were 5 water samples (50%) which were declared to smell and 5 other water samples did not smell (50%) according to the respondents' responses. Meanwhile, there were 8 water samples (80%) that were stated to taste bitter and the remaining 2 water samples did not taste bitter (20%). Odor and taste usually occur simultaneously and are usually caused by the presence of decaying organic matter (Maya Malle, 2021). The changes in odor and taste in water can be caused by decaying organic matter, chemical compounds, the presence of algae and other aquatic plants and animals that enter as contaminants in water samples.

3.2 Customer Responses to the Quality of Drinking Water Received by PDAM Customers

The questionnaire survey was conducted on December 15, 2024 with an explanation of the respondents' responses varying based on the questionnaires listed in the following subsections.

3.2.1 Respondent Characteristics

The questionnaire obtained data on the age of respondents varying from 22 to 54 years of age from the number of respondents can be seen in Figure 6.

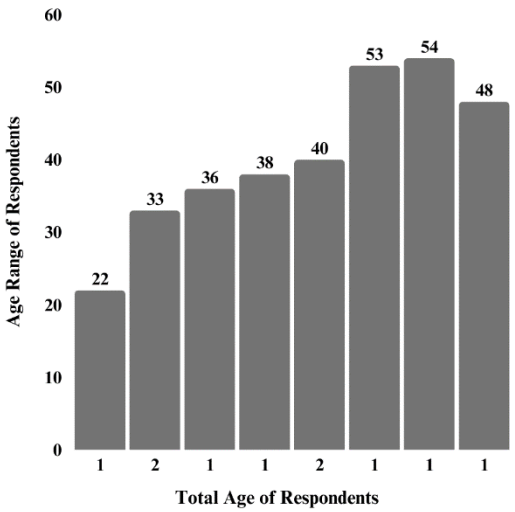

Figure 6. Respondent characteristics questionnaire results regarding age

The level of education of respondents obtained from the survey results in the form of elementary school (SD) graduates as much as 10%, junior high school (SMP) graduates as much as 30%, high school (SMA) graduates as much as 40%, and college (S1) graduates as much as 20%. The majority of respondents have a high school level as many as 4 people. The education level of respondents can be seen in Figure 7.

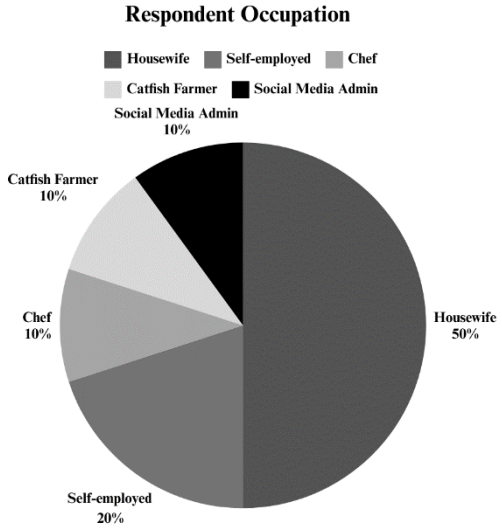

Figure 7. Respondent Characteristics Questionnaire Results regarding occupation

For the next questionnaire, there are several criteria for respondents' jobs, namely housewives as many as 5 people (50%), private as many as 2 people (20%), chef as many as 1 person (10%), catfish farmers as many as 1 person (10%), and social media admin as many as 1 person (10%). This questionnaire shows the number of respondents' jobs, most of whom are housewives.

3.2.2 Respondents' Responses to the Quality of Water Received from the PDAM

As a result, there are 10 people (100%) who use PDAM water only. The source of water used by the community can be seen in Figure 8.

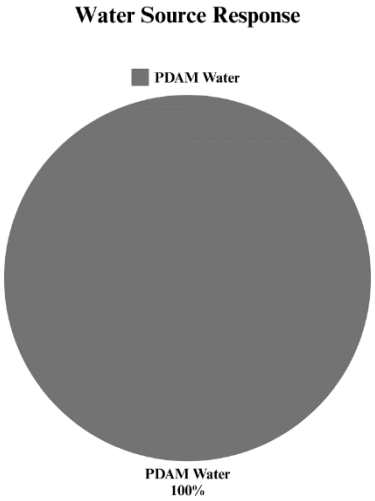

Figure 8. Results of respondents' questionnaire responses regarding water sources

The next question about the quality of PDAM water in Handil Bakti Village received by customers received a response of 8 people (80%) answering cloudy but slightly, and 2 people (20%) answering very cloudy. Figure 9 displays the results of this water quality response.

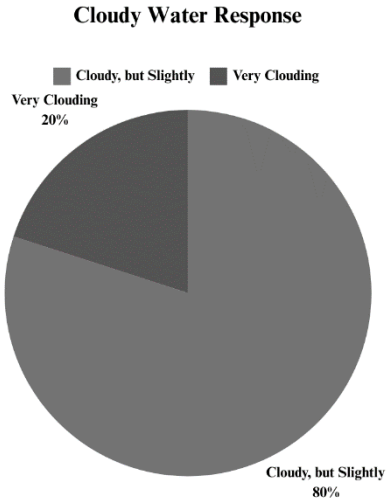

Figure 9. Questionnaire results respondents' responses regarding cloudy water

Then regarding the smell of water, half of the 10 respondents answered that it smelled as many as 5 people (50%) and did odorless as many as 5 people (50%). Figure 10 displays the results of the answers about this water quality.

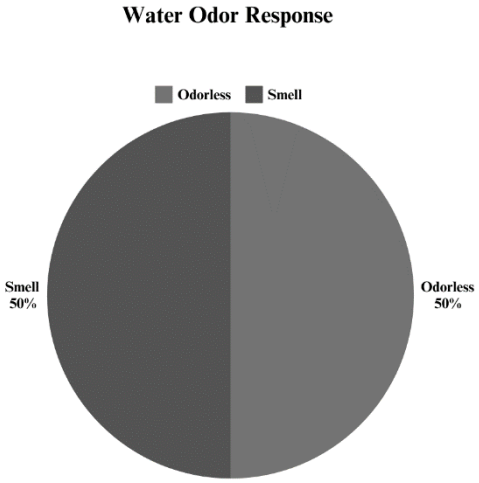

Figure 10. Questionnaire results respondents' responses regarding water odor

For crusty or chlorinated water, 6 people (60%) answered crusty, 3 people (30%) answered not crusty, and 1 person (10%) answered unsure or undecided. Figure 11 displays the results of the answers regarding this water quality.

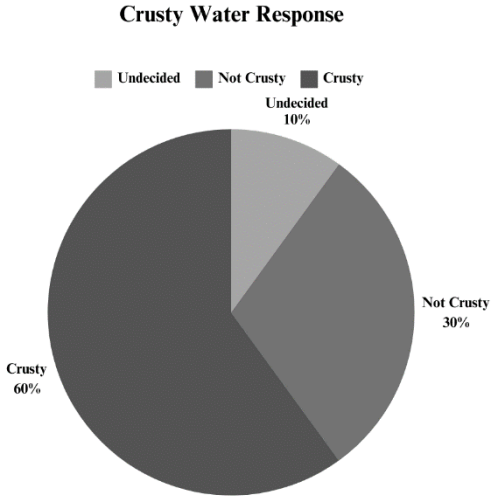

Figure 11. Questionnaire results respondents' responses regarding crusty water

Furthermore, for the taste of water, 8 people (80%) answered that it was tasteless, and 2 people (20%) answered that it was bitter taste. Figure 12 displays the results of the answers about this water quality.

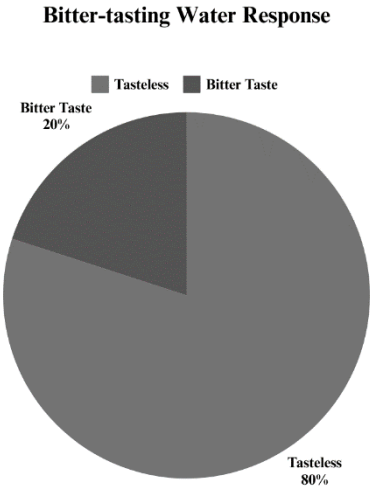

Figure 12. Respondents' questionnaire results on water taste

The next question was about the pressure of the water coming out of the tap, 6 people (60%) answered that the water was flowing, 3 people (30%) answered that the water was flowing powerfully, and 1 person (10%) answered that it was not flowing. Figure 13 displays the results of the answers about this water quality.

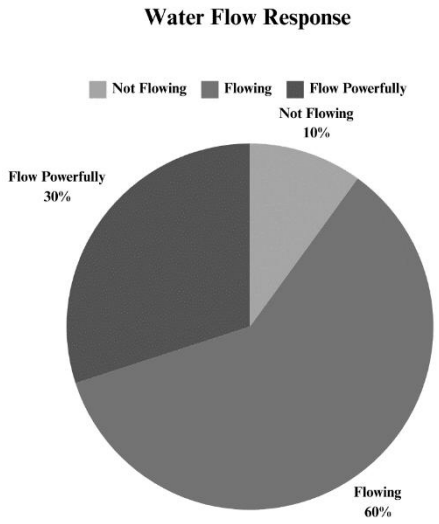

Figure 13. Questionnaire results respondents' responses regarding flowing water

For the last question regarding the adequacy of water received by customers for daily needs, 4 people (40%) answered not enough, 4 people (40%) answered fair, and 2 people (20%) answered very sufficient. Figure 14 displays the results of the answers regarding water quality.

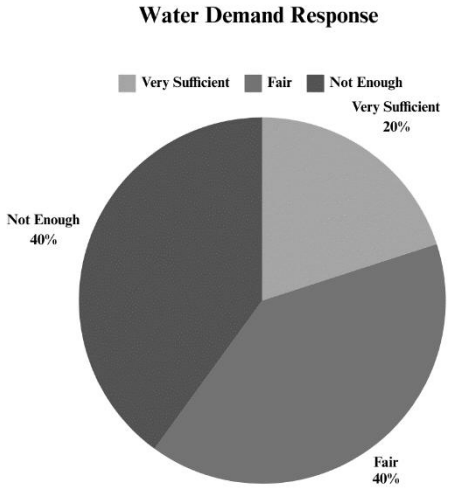

Figure 14. Questionnaire results respondents' responses regarding water demands

CONCLUSION

The conclusions of this research are as follows:
1) The quality of tap water of PDAM customers from a total of 10 respondents or water samples, including 3 parameters tested and are at the quality standard level of the Minister of Health Regulation No. 492/Menkes/Per/IV/2010 concerning Drinking Water Quality Requirements, namely the parameters of temperature, pH, TDS, odor and taste of water still meet the quality standard limits set for the standard use of drinking water consumption. 2) From the results obtained, which if we take from the majority response rating scale, the result is that the water

received can be stated that as many as 8 people responded that the water was cloudy but slightly, 5 people responded that the water was not smelly, 6 people responded that it was not crusted, 8 people responded that the water did not taste bitter, 6 people responded to running water flowly, and 4 people responded that the water was fair for daily needs. Each data from these responses is based on the assessment of 10 respondents.

Therefore, based on the results of this investigation, PDAM Barito Kuala Regency, especially from the Alalak District unit and its surroundings would be beneficial to: 1) Pay attention to the supply of water distributed to the homes of PDAM customers so that it can be more massive and evenly distributed, considering that some respondents responded to the lack of water received. 2) The need for regular and continuous management so that the quality of water in the PDAM for customers becomes better. With attempts to examine the result of drinking water quality management obtained from PDAM in a household area, the research findings are significant and connected to geospatial science in the reference location. With the approach that has been accomplished, it is intended that this research will eventually be useful as a resource for education and improvement of existing water quality management.

AUTHOR CONTRIBUTIONS

The author made substantial and independent contributions to the conception and design of the study, data acquisition, analysis and interpretation of data, as well as drafting and revising the manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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