THE RELATIONSHIP BETWEEN THE HOUSEHOLD WASTEWATER DISPOSAL SYSTEM AND THE QUALITY OF WELL WATER IN THE PURI ANGSA ASRI 2 HOUSING AREAS IN MUARO JAMBI

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Abstract

Water is a basic human need that is used for various household purposes, so the availability of clean water that is safe and suitable for consumption has a great effect on public health. In Puri Angsa Asri 2 Muaro Jambi Housing, the community uses dug well water as the main source of clean water, but the quality of dug well water is greatly influenced by the household wastewater disposal system. Non-standard sewage disposal systems, such as direct discharge into the ground or open channels without treatment, have the potential to cause groundwater pollution. This study aims to analyze the relationship between the household wastewater disposal system and the water quality of dug wells. The research was conducted with a quantitative approach through the analysis of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), turbidity, and coliform parameters, and tested using Chi-Square with Fisher's Exact Test. The results show that most wastewater disposal systems do not meet the standards of the Indonesian Minister of Health Regulation No. 2 of 2023 concerning Environmental Health Requirements to be pollutant-free. Most of the samples also did not meet the quality standards of the Minister of Health Regulation No. 2 of 2023 concerning water for hygiene and sanitation purposes and Government Regulation No. 22 of 2021 for class I water. Statistical analysis showed BOD values (p=0.067), COD (p=0.300), turbidity (p=0.183), and coliform (p=0.183). Although the statistical relationship is not significant, there are indications that non-standard wastewater treatment systems contribute to increased organic and microbiological contamination of dug well water.

Keywords: *wastewater disposal system, water quality, dug wells, environmental sanitation.*

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1. Introduction

Water is a basic need for human life because it is used for various daily activities such as drinking, cooking, washing, and maintaining environmental cleanliness. The availability of clean water that meets health requirements greatly determines the degree of public health. In many areas, including in Puri Angsa Asri 2 Muaro Jambi Housing, people generally use groundwater through dug wells as the main source of clean water (Kemenkes RI, 2023). Dug wells are widely used because they are simple to manufacture and relatively inexpensive, but their existence is very vulnerable to pollution of the surrounding environment. One of the factors that has great potential to affect the water quality of dug wells is the household wastewater disposal system. Domestic liquid waste from washing, bathing, and kitchen activities is often discharged directly into the ground, yard, or open channels without going through the treatment process first. This condition can cause the infiltration of pollutants into the soil and eventually contaminate the shallow groundwater layer that is the source of water from dug wells (Permenkes No. 2 Tahun 2023).

The results of initial observations at Puri Angsa Asri 2 Housing show that most households still implement a simple wastewater disposal system that does not meet sanitation standards, thus allowing sewage seepage into groundwater. Previous research by Igusman (2014) showed that poor sanitation systems are associated with a decline in the quality of shallow well water, characterized by increased levels of turbidity and microbiological contamination. These findings reinforce the suspicion that poor domestic waste management contributes directly to the decline in the water quality of dug wells. Based on this, it is important to conduct research on the relationship between the household wastewater disposal system and the quality of dug well water in Puri Angsa Asri 2 Muaro Jambi Housing. The results of this study are expected to provide a scientific picture of the influence of wastewater treatment systems on well water quality, as well as become the basis for efforts to improve environmental sanitation and sustainable clean water management.

2. Method

2.1 Types of Research

This study is descriptive using a quantitative approach with an observational design to analyze the relationship between aspects of household wastewater disposal systems and dug well water quality.

2.2 Research Locations

The research was carried out at Puri Angsa Asri 2 Housing, Muaro Jambi Regency, from June 16 to July 11, 2025. Water quality testing was carried out in two laboratories, namely the Alkane Laboratory for the analysis of chemical parameters including *Biochemical Oxygen Demand* (BOD), *Chemical Oxygen Demand* (COD), and turbidity, and the Microbiology Laboratory of the Faculty of Science and Technology, University of Jambi for the analysis of bacteriological parameters (total *coliform*) based on the quality standards of the Minister of Health Regulation No. 2 of 2023 *concerning water for sanitary hygiene* purposesand additional parameters, namely chemistry (BOD, COD) based on Government Regulation No. 22 of 2021 for raw water *for class I water.*

2.3 Sample Determination

The sample determination technique was carried out by *purposive sampling* based on certain criteria, namely households in Puri Angsa Asri 2 Muaro Jambi Housing that still use dug wells as the main source of clean water, active wells in use for at least the last six months, have their own domestic wastewater disposal system, and respondents are willing to become research participants. The number of samples was set at 10 households with limited time, cost, and laboratory capacity. The well water sampling points are determined at 10 locations with the mapped coordinates can be seen in Figure 1. Sampling was carried out referring to SNI 6989.58:2008 concerning groundwater sampling methods, using sterile containers that were transferred to laboratory sample bottles.
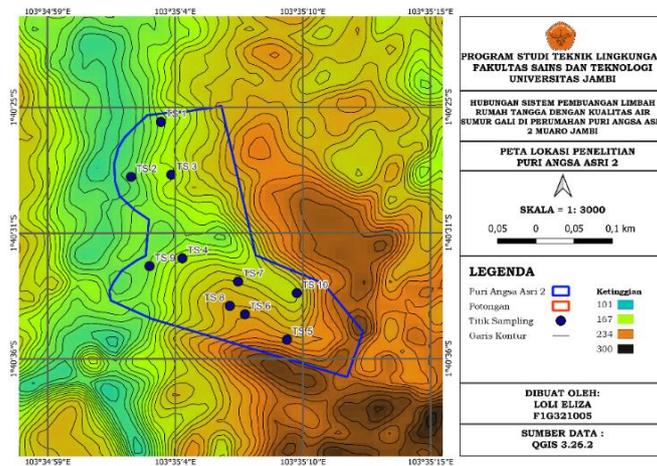

Figure 1. Contour Map of Sampling Point Location

The research area is delimited by a blue polygon, indicating the administrative boundaries or study area that is the focus of the research. Within these boundaries, 10 sampling points (TS1-TS10) are marked with dark blue dots, indicating the locations of dug wells whose water quality was tested. This map uses elevation contours depicted by contour lines and color gradations. Light green to dark green indicate areas with lower elevations (approximately 101-167 meters above sea level), while yellow, orange, and dark brown indicate higher areas (approximately 234-300 mdpl).

Based on the contour pattern, the eastern and southeastern areas of the research site are higher, while the western and northwest areas have lower elevations. This difference in elevation has the potential to influence the direction of surface water flow and groundwater filtration, which could ultimately impact the water quality of dug wells at these sampling points. Each sampling point was placed following the distribution of settlements within the study area, with most points located in areas with relatively steep contours, particularly TS5, TS6, and TS10, which are located at higher elevations. Meanwhile, TS1, TS2, and TS3 are located at lower elevations and therefore potentially receive runoff from higher elevations.

2.4 Data Analysis

The data analysis technique used in this study is statistical analysis which includes univariate and bivariate analysis. The observation data was analyzed by referring to the

Permenkes No 2 of 2023 concerning *Environmental Health Requirements* which states that water for hygiene and sanitation purposes must be free from pollutants, as well as SNI 03-2916-1992 as an additional reference. Univariate analysis was used to describe the characteristics of household wastewater treatment systems and bivariate analysis was performed to determine the relationship between household wastewater treatment systems and dug well water quality. The statistical test used is the Chi-Square test (χ^2) with *Fisher's Exact Test* as an alternative to *Chi-Square.* If P < α = 0.05, then the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted, meaning that there is a relationship. If P > α = 0.05, then the null hypothesis (Ho) is accepted and the alternative hypothesis (Ha) is rejected meaning that there is no relationship.

3. Results and Discussion

The results of the study showed that the household wastewater disposal system in Puri Angsa Asri 2 Housing has mostly not met the applicable sanitation requirements. This condition has the potential to affect the water quality of dug wells, both in terms of physical, chemical, and bacteriological parameters. The incompatibility of the wastewater disposal system is caused by various factors, including the low level of knowledge of homeowners regarding the negative impact of poorly managed wastewater disposal and lack of attention to the cleanliness of the environment around the well. As a result, there is potential pollution in the water source of the dug well. Based on the results of laboratory examinations, the values of water quality parameters which include *Biological Oxygen Demand* (BOD), *Chemical Oxygen Demand* (COD), turbidity, and the amount of coliform in the water of the dug well in Puri Angsa Asri 2 Muaro Jambi Housing are presented in the following Table 1.

Table 1. Results of Examination of BOD, COD, and Turbidity Content in the Water of the Excavated Well in Puri Angsa Asri 2 Housing

No	Parameter	Unit	Sample					Quality Standard
			1	2	3	4	5	
1	BOD	mg/L	5,99	5,59	2,99	1,60	2,19	2
2	COD	mg/L	49,05	41,52	16,21	7,11	11,30	10
3	Turbidity	NTU	5,30	14,66	9,03	2,04	9,49	< 3
4	Coliform	CFU/100mL	29	54	25	0	2	0

No	Parameter	Unit	6	7	8	9	10	Quality Standard
1	BOD	mg/L	3,59	2,39	2,79	3,19	2,00	2
2	COD	mg/L	38,13	11,81	11,9	18,71	11,06	10
3	Turbidity	NTU	20,78	4,31	2,21	25,86	2,88	< 3
4	Coliform	CFU/100mL	30	0	27	48	0	0

Based on Table 1, the results of the study show that most of the water samples from the dug well in Puri Angsa Asri 2 Housing do not meet the clean water quality standards. A total of eight out of ten samples had a BOD concentration exceeding the threshold of 2 mg/L with the highest value of 5.99 mg/L, namely in sample 1, while the

lowest value of 1.60 mg/L in sample 4 still met the standard based on Government PP 22 of 2021, the BOD quality standard for class I raw water. COD parameters also show similar results, where nine samples exceeded the quality standard of 10 mg/L, with the highest value of 49.05 mg/L in sample 1 and the lowest value of 7.11 mg/L in sample 4. On the turbidity parameters, seven out of ten samples had values above the 3 NTU quality standard (Permenkes No. 2 Tahun 2023), with the highest value of 25.86 NTU in sample 9. Meanwhile, bacteriological test results showed that seven positive samples contained coliform above 0 CFU/100 ml, with the highest value of 54 CFU/100 ml in sample 2. These findings indicate that the majority of dug well water has been contaminated physically, chemically, and bacteriologically, which may be caused by domestic activities and the infiltration of household waste around water sources. For more details, it can be seen in the form of univariate and bivariate analysis.

3.1 Univariate Analysis

Based on the data in Table 2, it is known that in the aspect of the household wastewater disposal system, out of 10 respondents, there are 3 households (30%) that have a wastewater disposal system in the decent category, while the other 7 households (70%) are classified as unfeasible. These findings indicate that most of the communities in the research site still experience limitations in the implementation of domestic liquid waste management systems that are in accordance with environmental sanitation standards. Household waste that is not properly managed can contain a variety of pollutants, such as pathogenic bacteria, organic matter, and chemicals from detergents or soaps. These substances can pollute water bodies and disrupt groundwater quality, which in turn can negatively impact public health, household waste contributes 47.62% to groundwater pollution, which can lead to a decrease in water quality and increase the risk of water-related diseases (Widiyanyo *et al.,* 2015).

Table 2. Frequency Distribution Based on Household Wastewater Disposal System in Puri Angsa Asri 2 Housing

SPAL (Wastewater Disposal System)	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Proper	3	30.0	30.0	
Not Eligible	7	70.0	70.0	100.0
Total	10	100.0	100.0	

An unsuitable wastewater disposal system is characterized by the absence of a special channel that is separate from the rainwater channel or is not directed to a safe disposal site, thus potentially contaminating the surrounding environment, as has been observed showing that almost all of the 10 samples do not have closed drainage and at sample point 2 there is a drainage seepage that allows the entry of pollutants into the uncovered well.

Figure 2. The condition of wastewater that is discharged into open drainage and seepage occurs

Table 3. Frequency Distribution Based on Water Quality of Dug Well BOD Parameters in Puri Angsa Asri 2 Muaro Jambi Housing

BOD	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Qualify	2	20.0	20.0	
Not Eligible	8	80.0	80.0	100.0
Total	10	100.0	100.0	

Table 3 shows that out of 10 samples of dug well water, there are 2 samples (20%) that meet the quality standard standard, which is below ≤ 2 mg/L and 8 samples (80%) that do not meet the quality standard requirements, namely above 2 mg/L based on *the Biochemical Oxygen Demand* (BOD) parameters, according to Government Regulation No. 22 of 2021 class I raw water, The BOD quality standard for clean water is ≤ 2 mg/L. High BOD values at 8 points of dug well water samples, which means that the samples show organic pollution which generally comes from household waste such as kitchen waste, bath waste, or pollution from *septic* tanks. Microorganisms contained in the waste will multiply and actively decompose organic matter, thereby increasing oxygen consumption and increasing BOD values (Fadillatur Ro & Aini Dahalan, 2024). This condition is in line with the statement Alfatihah *et al.* (2022) that the magnitude of the BOD value indicates a decrease in water quality due to the high load of organic matter that requires oxygen to break down biologically.

The high rate of BOD ineligibility in this study shows that most of the wells dug in Puri Angsa Asri 2 Housing have been affected by domestic activities that have the potential to pollute groundwater. Dug well water pollution not only comes from the existence and number of pollutant sources but is also influenced by the physical condition of clean water sources that do not meet health standards has the potential to become a pollutant entry point, because bacteria or other pollutants can seep through the pores of walls, lips, and parts of the construction of water sources that are not impermeable (Huwaida, 2014).

Table 4. Frequency Distribution Based on COD Parameters in Puri Angsa Asri 2 Housing

COD	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Qualify	1	10.0	10.0	
Not Eligible	9	90.0	90.0	100.0
Total	10	100.0	100.0	

Table 4 shows that in the *Chemical Oxygen Demand* (COD) parameter, only 1 sample (10%) met the requirements below the quality standard, while 9 samples (90%) did not meet the requirements, which was above the quality standard. The COD quality standard for clean water according to Government Regulation No. 22 of 2021 is ≤ 10 mg/L. High COD concentrations in a water body indicate the presence of a large amount of organic pollutants, accompanied by the presence of microorganisms, both pathogenic and non-pathogenic (*Napitupulu et al.,* 2022).

This shows that the water from the dug well at the research site has received pollutant input from the surrounding environment, both in the form of household waste and possible pollutants from other liquid waste. The high COD value in the water of the dug well is suspected to be due to community activities such as bathing and washing. The content of chemicals contained in detergents and soaps such as surfactants, sodium, sulfonates and so on that are difficult to degrade by bacteria cannot be biodegraded so that the decomposition process is through a chemical process, this chemical process requires more oxygen than usual (Alfatihah *et al.,* 2022). Managed liquid waste has the potential to seep into the soil and contaminate the water of the dug well. This condition emphasizes that the quality of dug well water in the research area is mostly not suitable for consumption from the aspect of COD.

Table 5. Frequency Distribution Based on Turbidity Parameters in Puri Angsa Asri 2 Housing

Turbidity	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Qualify	3	30.0	30.0	
Not Eligible	7	70.0	70.0	100.0
Total	10	100.0	100.0	

In Table 5, the results of the turbidity parameter research show that there are 3 samples (30%) that meet the requirements below the quality standard, while 7 samples (70%) do not meet the requirements, which is above the threshold. According to Permenkes No 2 of 2023 regarding Water Quality Requirements for Hygiene and Sanitation Purposes, the maximum limit of the allowable turbidity level in usable water is less than 3 NTU (*Nephelometric Turbidity Unit*). The high turbidity rate in most samples can be affected by the entry of suspended particles such as soil, fine sand, or organic substances from the soil surface or the environment around the well. In addition, the construction of the wells that are not well protected also allows the entry of materials

from the outside, increasing turbidity. A very high turbidity value indicates contamination, either due to soil particle intrusion or poorly managed domestic activities around water sources. Water turbidity that exceeds this threshold can degrade the visual quality of the water (aesthetic aspect), interfere with the filtration or filtration process, and reduce the effectiveness of the disinfection process, as suspended particles can protect pathogenic microorganisms from disinfectant chemicals (Sahabuddin, 2015).

Table 6. Frequency Distribution Based on *Coliform* Parameters in Puri Angsa Asri 2 Muaro Jambi Housing

Coliform	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Qualify	3	30.0	30.0	30.0
Not Eligible	7	70.0	70.0	100.0
Total	10	100.0	100.0	

Table 6 shows that out of 10 samples of dug well water, there were 3 samples (30%) that met the requirements below the quality standard and 7 samples (70%) did not meet the requirements, which were above the quality standard. According to Permenkes No. 2 of 2023, standar baku mutu total *coliform* adalah 0 koloni/100 ml. The standard of total *quality of coliform* is 0 colonies/100 ml. These results show that the majority of the dug well water at the study site has been contaminated with *coliform bacteria*. The presence *of coliform* in well water is caused by contamination from human or animal feces, especially if the distance of the well is too close to the *septic tank* or there is a construction of a well that is not waterproof. This condition indicates that the majority of well water used by the community at the research site does not meet the drinking water quality requirements based on Permenkes No 22 of 2021. Research conducted by Syafarida *et al.* (2022) which states that the construction of dug wells and environmental sanitation conditions are closely related to the high number of coliform bacteria in well water. One of the sources of clean water that is easily polluted by E-coli and *coliform* bacteria is a source of clean water that comes from dug wells (Dappa *et al.*, 2023).

Overall, the results of the univariate analysis provide an initial picture that most of the basic sanitation conditions of respondents' households still do not meet the standards, and the quality of dug well water on several parameters also shows values that exceed the set quality standards. These findings indicate a potential pollution risk and threat to public health, so further analysis is needed to determine the relationship between variables and factors that affect the water quality of dug wells.

3.2 Bivariate Analysis

Based on Table 7 analysis of chi square statistical test with *Fisher's Exact Test*, this study shows that there is no significant relationship between the condition of the wastewater treatment system and the quality of dug well water based on the *Biochemical Oxygen Demand* (BOD) parameter the value obtained is p = 0.067, greater

than the significance of $\alpha = 0.05$. This means that the null hypothesis (H_o) is accepted and the alternative hypothesis (H_1) is rejected.

Table 7. Cross-Distribution between Household Wastewater Disposal System, and Dug Well Water Quality Based on BOD Parameters

Wastewater Disposal System	BOD				Sum		P Value
	Qualify		Not Eligible				
	N	%	N	%	N	%	
Proper	2	0,6%	1	2,4%	3		
Not Eligible	0	1,4%	7	5,6%	7		0,067
Sum	2	20,0	8	80,0	10	100	

Therefore, it can be concluded that there is no significant relationship between the wastewater disposal system and the BOD parameters. The results of this study show that out of a total of ten household samples, 8 households with wastewater disposal systems are not eligible and have water quality with BOD levels that exceed the threshold set at PP No 22 of 2021 class I raw water of 2 mg/l, while only 2 households with qualified wastewater treatment systems, which have water quality below quality standards which means better water quality. These findings indicate that poor wastewater disposal systems increase the risk of organic contamination in dug wells. Domestic waste such as laundry residue, kitchen waste, and mismanaged septic tank seepage has the potential to degrade water quality, which is reflected in the high BOD value (Lestari *et al.,* 2021).

Table 8. Cross-Distribution between Household Wastewater Disposal System, and Dug Well Water Quality Based on COD Parameters

	COD				Sum		P Value
	Qualify		Not Eligible				
	N	%	N	%	N	%	
Proper	1	0,3%	2	2,7%	3		
Not Eligible	0	0,7%	7	6,3%	7		0,300
Sum	1	10,0	9	90,0	10	100	

Based on Table 8 statistical analysis using *Fisher's Exact Test,* a p-value significance value of 0.300 was obtained. Because the value of p (0.300) is greater than the level of significance set ($\alpha = 0.05$), it can be concluded that the hypothesis of zero (H_o) is accepted, while the alternative hypothesis (H_1) is rejected, thus the results of the study show that there is no statistically significant relationship between the household wastewater disposal system and the quality of dug well water based on the COD parameters in Puri Angsa Asri 2 Housing.

The results of this study show that although descriptively there is a tendency for water quality with high COD to be found more in households with inadequate wastewater treatment systems, statistically the relationship is not significant. The COD value in dug well water is not only influenced by the condition of the household

wastewater treatment system, but also by other environmental factors such as the presence of agricultural activities around the research site that use organic fertilizers or pesticides can increase COD levels in groundwater (Said, 2023). Chemical parameters such as COD can be influenced by other environmental factors beyond basic household sanitation, such as geohydrological conditions, distance of the well from pollutant sources, soil permeability, and community activities around the well. Research by Digaletos *et al.* (2023) found that although there is a tendency to increase levels of organic pollutants adjacent to domestic wastewater disposal or septic systems, the relationship is not always statistically significant, especially in regions with different geological variations.

Although there was no statistically significant association in this study, the results still indicate the importance of improving basic household sanitation to prevent potential groundwater contamination. Previous research confirms that good sanitation, including a correct wastewater disposal system, is an important factor in maintaining water quality to keep it in line with environmental health quality standards (Permenkes 2 of 2023 and WHO, 2017).

Table 9. Cross-Distribution between Household Wastewater Disposal System, with Dug Well Water Quality Based on Turbidity Parameters

Wastewater Disposal System	Turbidity				Sum		P Value
	Qualify		Not Eligible				
	N	%	N	%	N	%	
Proper	2	0,9%	1	2,1%	3		
Not Eligible	1	2,1%	6	4,9%	7		0,183
Sum	3	30,0	7	70,0	10	100	

Based on Table 9, statistical analysis with *Fisher's Exact Test* shows that the significance value between the household wastewater treatment system and the turbidity parameter is 0.183. This value is greater than the significance limit of α= 0.05 so that statistically there is no statistically significant relationship between the water quality of the dug well reviewed from the turbidity parameter and the condition of the household wastewater disposal system at the research site. Households with poor wastewater treatment system conditions are more likely to have well water with a turbidity level above the water quality standard threshold in accordance with the Permenkes 2 of 2023 about water quality standards for hygiene and sanitation purposes, which is 3 NTUs. A total of 7 samples of household dug well water that had a poor wastewater disposal system, most of which showed turbidity above the quality standard, which meant that it did not meet the quality standard requirements. Meanwhile, 3 water samples with turbidity parameters below the quality standard, which means that they meet the water quality requirements of the dug well. The high turbidity is often related to an increased risk of biological pollution, as particles in the water can become a medium for microorganisms to attach or reduce the effectiveness of disinfection processes such as chlorination and ultraviolet radiation (WHO, 2017).

Inadequate household sanitation conditions, such as unclosed sewage drains, seepage occurs, allowing the contamination of suspended materials and the flow of waste into the dug well, resulting in an increase in turbidity. The absence of a statistically significant relationship between household wastewater disposal systems and turbidity parameters indicates the influence of other factors such as geological conditions, rainfall, and environmental activities around wells that contribute to the water quality of dug wells.

Table 10. Cross-Distribution between Household Wastewater Disposal System, and Dug Well Water Quality Based on *Coliform Parameters*

Wastewater Disposal System	Coliform				Sum		P Value
	Qualify		Not Eligible				
	N	%	N	%	N	%	
Proper	2	0,9%	1	2,1%	3		
Not Eligible	1	2,1%	6	4,9%	7		0,183
Sum	3	30,0	7	70,0	10	100	

Based on Table 10, the results of statistical analysis using *Fisher's Exact Test* between the condition of the household wastewater disposal system and the quality of dug well water based on the total coliform parameters showed a significance value of 0.183. This value is greater than 0.05, so statistically it can be said that there is no significant relationship between household wastewater systems and water quality based on total coliform. The results of the descriptive analysis showed that households with less suitable wastewater disposal systems had more water quality above the specified quality standard threshold, namely above 0 CFU/100ml, according to Permenkes 2 of 2023 about water quality standards for hygiene and sanitation purposes.

A total of seven wells with total *coliform* exceeding the standard, while in households with better wastewater treatment system conditions, most of the well water meets the requirements of three samples that meet the quality standard with a coliform concentration of 0 CFU/100ml. This shows that although statistically the relationship found is not significant, the household sanitation factor of the wastewater system aspect still plays an important role in the microbiological quality of the water. Research conducted by Indrastuti *et al.* (2021) study of groundwater microbial contamination in Yogyakarta although topography and dug well types have been shown to affect the total presence of coliform and E. coli, the type of sanitation facilities such as the state of sewers, septic tanks and their distance do not always have a significant influence on microbiological contamination, except for small-scale sewer systems that have been proven to be more effective in protecting water sources (Indrastuti *et al*., 2021). Although no statistically significant relationship was found in this study between basic household sanitation and water quality based on total coliform parameters, it does not mean that sanitation does not have an effect on the microbiological quality of water.

4. Conclusion

This study shows that the condition of the wastewater disposal system in Puri Angsa Asri 2 Housing, Muaro Jambi still does not meet basic household sanitation standards.

This has implications for the quality of dug well water, which is mostly unsuitable for consumption, characterized by BOD values, COD, turbidity, and total coliform that exceeds the quality standard threshold. Statistical bivariate analysis with *Fisher's Exact Test* showed no significant relationship between basic sanitation and dug well water quality in the BOD (p=0.067), COD (p=0.300), turbidity (p=0.183), and coliform (p=0.183) parameters. Although the results of the analysis show that there is no significant relationship between the existence of SPAL and the water quality of dug wells, the condition and management of SPAL still need to be considered because it has the potential to be a source of pollutants that can affect water quality.

5.   Ssuggestion

These findings affirm the importance of improving basic sanitation, especially in the aspects of household wastewater systems, as well as continuous monitoring of water quality to prevent the risk of contamination and maintain public health.

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