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ANALYSIS OF SHALLOW GROUNDWATER QUALITY FOR DRINKING WATER NEEDS

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Abstract

This research is based on water conditions in the Village of 19 November. There are some wells that do not meet the standards of clean water issued by the Ministry of Health of the Republic of Indonesia Number 492/Menkes/Per/IV/2010. The purpose of this study was to determine the quality of shallow groundwater (wells) in 19 November Village. Based on regulations, the parameters measured consist of physical and chemical parameters. Physical parameters consist of odor, color, taste, temperature, and total dissolved solids, while chemical parameters consist of pH, BOD, and COD. The data in this study were collected using observation techniques and laboratory analysis. Furthermore, the data is analyzed using descriptive statistics and the storet method. Based on the results of the analysis, it was found that the quality of shallow groundwater in 19 November Village was in the moderately polluted class and did not meet the standards. This is because the concentration of physical and chemical parameters has exceeded the set threshold.

Keywords: *Water Quality; Shallow Gorundwater*

A. Introduction

Shallow groundwater is groundwater that is above the first impermeable layer, usually not too deep below the ground surface. Groundwater is formed because there is an infiltration process of water from the ground surface (Sutrisno, 2010). Water naturally flows from the surface into the ground through a seepage process (Bower, 1978 in Iskandar et. al., 2022). Shallow groundwater is usually found at a depth of 15 meters. The existence of shallow groundwater (wells) for the community does not necessarily guarantee that the quality of the water is good. This is because the groundwater used is shallow groundwater (wells) which in fact is

groundwater that is easily contaminated through seepage. Generally, seepage originates from landfills or disposal sites for human and animal waste.

The problem that arises is that it is often found that the quality of groundwater used by the community does not meet the requirements as healthy drinking water. Even in some places included in the category unfit for drinking. According to the Regulation of the Minister of Health of the Republic of Indonesia Number 492/Menkes/Per/IV of 2010, water that is suitable for drinking has certain standards, namely physical, chemical and bacteriological requirements. So if there is only one parameter that does not meet the requirements, the water is not suitable for consumption. The use of drinking water that does not meet these quality standards can cause health problems, both directly and quickly, and indirectly (Sutrisno, 2010).

Sometimes people are forced to use water that is of poor quality due to the lack of other alternative water sources. This condition can have a negative impact on public health both in the short term and in the long term. Poor quality in the short term can cause diarrhea, cholera, typhoid or dysentery. This can occur in conditions of poor environmental sanitation. If groundwater and surface water are polluted by dirt, the germs will automatically spread to water sources used for household purposes. In the long run, poor quality water can cause porous disease, tooth corrosion, anemia and even kidney damage. This is due to the presence of heavy metals which are toxic.

According to Novran (2009), the distance of the well to the pollutant source, the construction of shallow wells and the structure of the soil are factors that can influence the occurrence of well water pollution. The closer the horizontal and vertical distance between the well and the pollutant source, the greater the possibility that the groundwater in the well will be polluted. Meanwhile, the coarse soil structure has large pores and has very little inhibition against contaminants. This allows contaminants to flow quickly and into the well. Conversely, a fine soil structure has a great ability to hold contaminants from entering the well because it has small pores. The location of shallow wells with other pollutant sources also tends to be more prone to contamination with pollutant materials (Keman 2005).

Problems related to shallow groundwater quality also occur in 19 November Village, Wundulako District, Kolaka Regency, Southeast Sulawesi Province. Based on the results of direct interviews with several people in November 19 Village who consume shallow groundwater (wells), it is known that people often experience digestive diseases. There are some people who have contracted kidney disease caused by the high content of lime in the water. Meanwhile, based on the results of initial observations, the condition of shallow groundwater (wells) in 19 November Village varies quite a bit in several wells. There is water that is less clear because it contains yellow precipitates in the water reservoirs and the presence of lime in the water they consume. This is exacerbated during the rainy season, where the condition of shallow groundwater (wells) gets worse. This phenomenon raises concerns for the people in 19 November Village who use shallow groundwater (wells) for consumption. In addition, this condition is also very contrary to clean water standards issued by the Ministry of Health of the Republic of Indonesia.

B. Methodology

This research is a type of descriptive research. Qualitative research is aimed at describing and describing existing phenomena, both natural and human-made, which pay more attention to characteristics, quality, and interrelationships between activities (Sukmadinata, 2011). In addition, descriptive research does not provide treatment, manipulation or changes to the variables studied, but instead describes a condition as it is. The only treatment given was the researcher himself, which was carried out through observation. This study describes systematically the facts and characteristics of the object under study precisely, namely the quality of shallow ground water (wells) for drinking water needs in the 19 November Village, Wundulako District, Kolaka Regency, Southeast Sulawesi Province.

The data collected in this study is primary data consisting of physical, and chemical properties of water. The physical data consists of odor, color, temperature, taste, Total dissolved solids (TDS). The chemical data consists of pH, Chemical Oxygen Demand (COD), and Biochemical Oxygen Demand (BOD). The data collected comes from several samples of shallow groundwater (wells) with the following requirements:

1. Located in a residential area
2. Located in an area directly adjacent to agricultural land and plantations
3. Located in a residential area around which there is a river flow
4. Still used as a source of drinking water

5. The owner of the well who is willing to sample his well.

Data collection was carried out using observation techniques and laboratory analysis. The observation techniques are used to collect physical data in the form of odor, taste, and TDS. Meanwhile, the laboratory analysis was used to collect data on temperature, pH, BOD, and COD. This analysis was carried out in the Kolaka Regency Environment Service laboratory.

The data collected was analyzed using descriptive analysis techniques. This analysis explains the condition of groundwater quality in the research area, namely by comparing the data that has been collected with drinking water quality standards that are used as a reference, namely based on the Regulation of the Minister of Health of the Republic of Indonesia Number 492/Menkes/Per/IV/2010 concerning Drinking Water quality requirements. The requirements that must have for water to be consumed are presented in the following Table 1.

Table 1. The Standar of Drinking Water Quality

No.	Type of Parameters	Unit	Maximum Permitted Level
1.	Physical Parameters		
	a. Odor	-	Odorless
	b. Color	TCU	Colorless
	c. Temperature	°C	30°C
	d. Taste	-	Tasteless
	e. Total dissolved solids (TDS)	mg/l	500
2.	Chemical Parameters		
	a. pH	-	6.0 – 9.0
	b. Chemical Oxygen Demand (COD)	mg/l	10
	c. Biochemical Oxygen Demand (BOD)	mg/l	2

(Source: The regulation of the Minister of Health of the Republic of Indonesia Number 492/Menkes/Per/IV/2010)

Furthermore, the determination of the status of water quality is carried out using the Storet method. This method is carried out by comparing research data with water quality standards according to their designation (Decree of the Minister of Environment of the Republic of Indonesia Number 115 of 2003). Determination of water quality status using the Storet method is carried out with the following steps:

1. Collect water quality data.
2. Compare the measurement data for each water parameter with the quality standard value according to the water class.
3. If the measurement results meet the water quality standard value (measurement results < quality standard) then a score of 0 is given.
4. If the measurement results do not meet the water quality standard values (measurement results > quality standards), then a score is given:

Table 2. The Score of Water Quality Status

Number of Parameters	Score	Parameters		
		Physics	Chemical	Biology
< 10	Maximum	-1	-2	-3
	Minimum	-1	-2	-3

(Source: The Decree of the Minister of Environment of the Republic of Indonesia Number 115 of 2003)

5. The negative number of all parameters is calculated and the quality status is determined from the total score obtained using the value system.

Determination of the status of water quality analyzed by the Storet method is by using the value system of the US-EPA (United States-Environmental Protection Agency) by classifying water quality into four classes, which are presented in Table 3.

Table 3. The Classification of Water Quality

No.	Class	Score	Water Quality	Information
1.	A	0	Meet Quality Standards	Very well
2.	B	-1 to -10	Mildly Polluted	Well
3.	C	-11 to -30	Moderate Polluted	Moderate
4.	D	≥ -31	Heavily Polluted	Heavy

(Source: The Decree of the Minister of Environment of the Republic of Indonesia Number 115 of 2003)

C. Findings and Discussion

1. Findings

Based on the observations, the shallow groundwater samples tested for quality in this study consisted of 6 wells. This is adjusted to the requirements specified in the methodology section. The results of groundwater quality measurements are presented in the following table 4. Based on the table above, there are several parameters that are not in accordance with the standards for water that may be consumed, namely color, pH, COD and BOD. Samples that did not meet water quality standards in terms of color, pH and BOD parameters were only present in one sample. While those that do not meet the COD parameter standards are found in almost all samples.

Table 4. The Results of Shallow Groundwater (Wells) Quality Measurement

No.	Parameters	Unit	Shallow Groundwater Samples Tested					
			I	II	III	IV	V	VI
A.	Phisical							
1.	Odor	-	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
2.	Color	TCU	Yellowish	Colorless	Colorless	Colorless	Colorless	Colorless
3.	Temperature	°C	29	29	29.5	29	29	29
4.	Taste	-	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless
5.	TDS	mg/l	204	206	333	255	308	323
B.	Chemical							
1.	pH	-	6.51	6.23	6.31	5.98	6.14	6.19
2.	COD	mg/l	49.35	8.52	3475.49	451.72	1391.40	267.78
3.	BOD	mg/l	0.40	2.22	1.81	1.21	0.40	0.60

The results showed that the first sample had a yellowish color. While the other samples are in accordance with water quality standards, namely colorless. Likewise on the pH parameter, the results of the study showed that the fourth sample had a pH below the water quality standards. The sample has a pH of 5.98, while the standard pH for water quality is between 6.0 and 9.0. In the BOD parameter, the second sample whose value is above the required threshold. BOD value in the sample is 2.2 mg/l (maximum permitted level is 2 mg/l). Meanwhile, for the COD parameter, only the second sample met the water quality standards, namely below 10 mg/l. Furthermore, the results of the analysis using the Storet method show that all samples have a score between -2 to -4. The results of the analysis using the Storet method are presented in Table 5.

Table 5. The Results of Storet Analysis

No.	Parameters	Score					
		I	II	III	IV	V	VI
A.	Phisical						
1.	Odor	0	0	0	0	0	0
2.	Color	-1	0	0	0	0	0
3.	Temperature	0	0	0	0	0	0
4.	Taste	0	0	0	0	0	0
5.	TDS	0	0	0	0	0	0
B.	Chemical						
1.	pH	0	0	0	-2	0	0
2.	COD	-2	0	-2	-2	-2	-2
3.	BOD	0	-2	0	0	0	0
	Total Score	-3	-2	-2	-4	-2	-2

2. Discussion

Water used for daily consumption is water of good quality. Based on the regulation of the Minister of Health of the Republic of Indonesia Number 492/2010, the parameters assessed to test water quality consist of odor, color, temperature, taste, TDS, pH, COD and BOD. Water suitable for consumption is water that is odorless and tasteless. Based on the odor and taste parameters, all well water samples tested met the water quality standards. Likewise, based on the temperature test results shows that the water is classified as fit for consumption because it has a temperature below 30°C. Temperatures above the Water Quality Standards can cause the content of toxic substances to react with water so that the water becomes polluted. Water temperature is influenced by various factors such as sunlight intensity, season, latitude, altitude, time, air circulation, cloud cover, flow, and depth.

According to Soemirat (2009), water used to meet daily needs must be clear and colorless. Based on the results of the well water test, it is known that the water in the first sample is yellowish in color. This condition is caused by the presence of suspended material particles that give color to the water. The material that gives rise to this color is the result of weathering or decomposition of organic materials such as leaves and wood that enter the water. Apart from causing a change in the color of the water, the results of weathering of organic matter also increase the amount of TDS in the water. This is because these materials are also compounds that can dissolve in water (Fardiaz, 2003). However, the results showed that the TDS contained in all research samples was still in normal condition. This means that the water is still suitable for consumption based on the TDS parameter.

Furthermore, the condition of the water based on the pH value shows that most of the water is suitable for consumption because it still meets the water quality standards (6.0 to 9.0). Water with a high pH (> 9.0) can reduce the killing power of chlorine against microbes, and conversely water with a low pH tends to increase corrosion (Chapman 2000). Changes in water pH can be affected by industrial and household waste. In addition, water gases such as CO_2, concentrations of carbonate, biocarbonate and the process of decomposition of organic matter in water also affect the pH of the water as happened in the fourth sample.

The results of the analysis of the COD parameters of well water in November 19 Village show that the water is unfit for consumption. The average concentration of COD in the research results is above the water quality standards. The high concentration of COD can be caused by the environment around the well, where a lot of organic matter decomposes. Such as wells that are too close to septic tank seepage and other pollutant sources. Meanwhile, based on the concentration of BOD in water, the average concentration of this water is below 2 mg/l. This indicates that the water is suitable for consumption because it meets water quality standards (> 2 mg/l).

Based on the results of storet analysis, it shows that all samples fall into class B with the lightly polluted category. These results indicate that the need for attention from the community in utilizing well water for daily consumption. The community is advised not to consume the well water directly, but it is better to boil it first. This is intended to reduce the negative impact of consuming the water.

D. Conclusion

Based on the results and discussion above, it can be concluded that the quality of shallow groundwater (wells) in 19 November Village is included in class B with the lightly polluted category. Physically, only the color parameter was polluted, in which 1 sample was yellowish in color. Meanwhile, chemically, especially the COD parameter, the quality of shallow groundwater in November 19 Village exceeds the threshold.

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