Analysis of dug well water imminity in Sikapas Village, Mandailing Natal District

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Abstract *Research has been conducted on the analysis of water impurity dug wells in Sikapas Village, Mandailing Natal Regency which is located at coordinates 1° 10 '42.25 "North Latitude and 98° 56' 47.81" East Longitude. This research aims to determine the quality of dug well water based on the electrical conductivity level, salinity, temperature, turbidity and mineral content contained in well water in Sikapas Village by using the conductivity method. Sampling was done by taking 10 samples of dug well water starting from the dug well closest to the beach to a community settlement with the reference point is the beach. The results showed that the dug well water in Sikapas Village was still not intruded by seawater (pure) and was suitable for use as clean water. It is known that based on the value of the electrical conductivity, the measurement results do not exceed the allowable conductivity value is ≤ 200 μmho/cm, 25°C. The electrical conductivity of dug well water in Sikapas Village ranges from 17.53 - 76.87 μmho/cm, 25°C, salinity ranges from 9.26 - 41.1 ppm with a quality standard of 200 ppm, temperature range of 26.6 - 26.8 °C with a quality standard of ± 3°C, turbidity ranges from 0 - 1.73 NTU with a quality standard of 25 NTU and magnesium mineral content ranges from 1.4 - 3.6 mg/L with a quality standard of 150 mg/L, iodine ranges from 0.9613 to 5.1545 mcg/gr with a quality standard of 18 mcg/L, iron ranges from < 0.009 - 0, 09 mg/L with a quality standard of 1 mg/L, and chloride levels ranged from 5.91 - 20.3 mg/L with a quality standard of 600 mg/L.* [ANALYSIS OF DUG WELL WATER IMMINITY IN SIKAPAS VILLAGE, MANDAILING NATAL DISTRICT] ***(J. Math. Nat. Sci., 1(1): 25 - 29, 2021)***

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Water Quality, Electrical Conductivity, Conductivity, Mineral Content

Introduction

Water plays an important role in water supply for both ecosystem function and human welfare (Ali, 2013). Water maybe could be the most valuable natural resource after air. Where is the surface of this earth mostly composed of water, only a partially small part of the usable surface of the earth to be inhabited by humans.

Water normally used by humans is surface water, such as fresh water and water pureland. Groundwater is a resource nature which is renewable, because groundwater is a component that cannot be separated from the hydrological cycle on earth (Situmorang, 2019).

In some areas, the alternative that humans use to meet water needs including household or industrial needs is to use groundwater, because groundwater is easy to obtain and also very economical. However, the use of groundwater which continues to be used all the time and, increase in the number is thought to cause seawater to enter the aquifer layer so it can produce impure water. This impurity is shown by the increase in community wells, which were originally fresh to slightly salty. The entry of sea water into aquifers can cause water to become polluted and have an impact on aspects of life, including health problems, environmental disturbances, degradation of land functions, etc. (Saputra, 1998).

In addition, human activities can produce products that are useless or not good for health which are commonly called waste, such as waste of liquid waste, solid waste and gas waste. Waste is divided into several groups, that are domestic, agriculture, marine pollution and nuclear power (Situmorang, 2017). Later, this waste can pollute groundwater which has an impact on reducing water quality. Sikapas Village that is located in Muara Batang Gadis District, Mandailing Natal regency. This village is located on the coast which allows seawater intrusion.

Given the important role of water, it must be used carefully. The organism's need in water varies widely, therefore suitability both in terms of quantity and quality, it must be stopped before used. Other than that, water sources should be monitored regularly to determine if the water is still healthy or not to be used. Bad conditions of the water can lead to damage to the environment, not only that, but also become a threat to the ecosystem. In the industry, improper water quality can lead to danger and even severe economic loss. Based on this, pay attention to water quality indispensable for good human life in environmental and economic aspects (Roy, 2018).

Water quality must meet standards health according to the Ministerial Regulation Health of the Republic of Indonesia Number 32 Year 2017 concerning health quality standards environment as well as water health requirements. Water clean must be free of contaminants, while the water conforms to that standard has been established such as physical, chemical as well as requirements biologically can be used as drinking water, if these standards are not met then it can cause distraction on health (Boekoesoe, 2010).

The method used for predicting the impurity of dug well water is by using the method conductivity and engaging other agencies to know the mineral content contained in water.

Based on the problem is carried out research on the impurities of dug well water to know water quality based on parameters physics and chemistry.

Materials and Methods

Location and time of research. The place where the research was carried out was in the village. The cycap is geographically located between 1° 10' 42.25" North Latitude and 98° 56' 47.81" Longitude East. The research location is shown in Figure 1.

Sampling technique. Sampling starts from dug wells closest to the shore (reference point) until away from the beach.

Data analysis.

a. Multiple linear analysis

The The research was conducted by measuring the level of electrical conductivity in water. Then analyzed by using linear regression method multiply by the equation:

$$\hat{Y} = b_0 + b_1X_1 + b_2X_2 + \cdots + b_kX_k$$

b. DHL water well dug analysis

For DHL data analysis, data processing measurements can be made at temperature which is equal to 25°C, using equation:

$$DHL\left(\mu\frac{mho}{cm}, 25°C\right)\frac{25}{t_{air}}\,DHL_p$$

Figure 1. Research location.

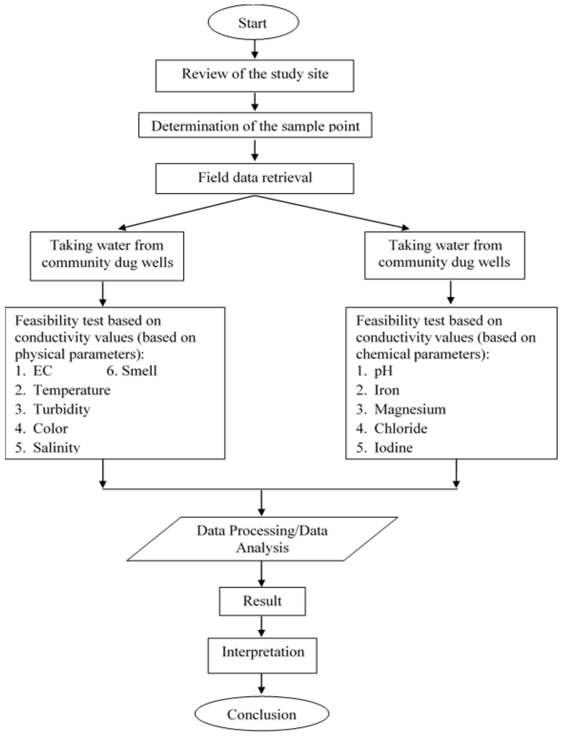

Figure 2. Road map the research.

Results

Sampling of dug well water in the village Sikapas were carried out at 10 points with a distance of 126 m from the waterfront as far as 174 m. Result research in Table 1.

Table 1. Measurement results based on parameters physics.

Sample Code	Distance (m)	Depth (m)	EC (µmhos /cm)	Salinity (ppm)	Temperature (˚C)	Turbidity (NT)
SK 1	126	6	25.9	13.2	26.8	1.15
SK 2	131	5	82.1	41.1	26.7	0.74
SK 3	135	6	64.5	32.2	26.8	0.93
SK 4	139	5	75.9	38.0	26.7	0.82
SK 5	148	5	25.4	12.7	26.6	1.24
SK 6	151	6	51.3	25.4	26.7	0.88
SK 7	155	5	48.0	24.1	26.6	0
SK 8	163	5	30.7	15.3	26.7	1.73
SK 9	169	5	26.9	13.5	26.6	0
SK 10	174	5	18.65	9.26	26.6	0

Table 2. Measurement results based on parameters chemical.

Mineral Content	Standard Quality	Sample Code		
		SK 1	SK 5	SK 10
pH	6.5 – 8.5	7.38	6.75	6.94
Iron (mg/L)	1	<0.009	0.09	<0.009
Magnesium(mg/L)	150	3.6	1.4	3.4
Chloride(mg/L)	250	7.88	5.91	20.3
Iodine (mcg/gr)	18	2.004	5.15	0.961

Discussion

Multiple linear regression analysis. The dug well water electrical conductivity measuring point has different distances and depths, so that to find out the effect of distance and the depth of the well dug together to Electrical Conductivity (EC) then analyzed using linear regression method multiply by equation (1). Based on calculations obtained:

$$Y = 271{,}9828 - 1{,}02628\, X_1 - 13{,}9679\, X_2$$

So that the multiple linear equation is obtained, in:

The coefficient of determination (R^2) obtained at 0.409023807 which means that the variable distance from shore and the water depth wells simultaneously affect the electrical conductivity (EC) of 40%. And the value of Multiple Correlation is 0.6395497. So from the results of multiple linear regression, it can be concluded that the variable distance and depth of the dug well has a close relationship with the variable of electrical conductivity. The relationship between the distance and depth of dug well water to the electrical conductivity value can also be presented in the form of a contour map. The contour map of the distribution of electrical conductivity at the research location can be seen in Figure 3 and Figure 4 below.

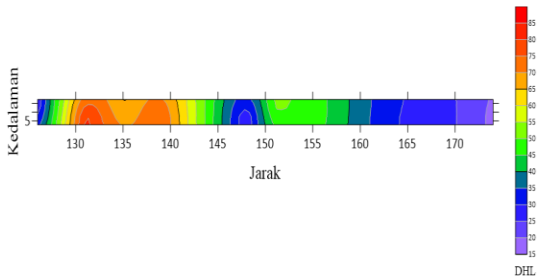

Figure 3. Contour of EC distribution to well distance and depth.

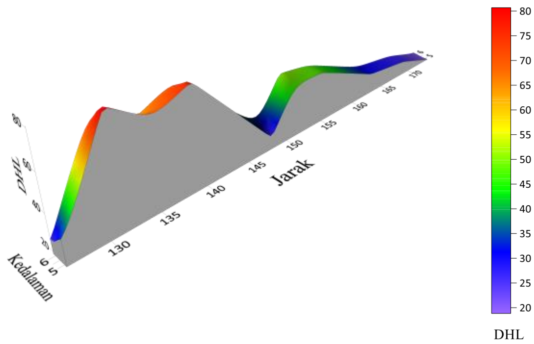

Figure 4. 3-dimensional contour of EC distribution to distance and depth of well.

Electrical conductivity. For data analysis, electrical conductivity is carried out at the same temperature, which is 25°C so that the comparison of electrical conductivity can be carried out. As for how to obtain electrical conductivity data at a temperature of 25˚C, equation (2) is used.

The value of the electric conductivity (DHL) of dug well water obtained in Sikapas Village has different values. The highest DHL value obtained is 76.87 µmho/cm, 25˚C which is at the sampling point with the sample code SK 2. And the lowest DHL value obtained is 17.53 µmho / cm, 25˚C which is at the sampling point with the sample code SK 10. From the analysis results obtained if the theory associated with Davis and Wiest (1996) for all water samples dug well water is not intruded concluded because it does not exceed the quality standard that is 200 µmho/cm, 25˚C.

If the value of DHL underwent significant changes in the water indicates that pollutants may have entered the water or that other problems are occurring meaning that various chemicals and salts have leached into the water and can be bad for health.

Table 3. Results of measurement of electrical conductivity.

Sample Code	Distance (m)	Depth (m)	EC (μmho/cm, 25°C
SK 1	126	6	24.16
SK 2	131	5	76.87
SK 3	135	6	60.17
SK 4	139	5	71.07
SK 5	148	5	23.87
SK 6	151	6	48.03
SK 7	155	5	45.11
SK 8	163	5	28.75
SK 9	169	5	25.28
SK 10	174	5	17.53

Salinity. Salinity generally refers to the amount of salt contained in water. Excessive salinity in drinking water can lead to an increased risk of hypertension. Drinking water salinity has also been associated with the risk of preeclampsia and gestational hypertension. Based on Table 1 above, the highest salinity value was in the SK 2 sample, namely 41.1 ppm and the lowest salinity value was in the SK 10 sample, namely 9.26 ppm. The salinity level of dug well water in Sikapas Village has a standard level which is still suitable for consumption where the good standard is 200 mg/L.

Temperature. In particular, temperature can affect the dynamics of microorganisms in the water distribution system, meaning that temperature affects the disinfection power, how disinfection slows growth and inhibits the survival of microorganisms. Based on the results of water temperature measurements, all samples in Sikapas Village still meet the quality standard requirements set by the Minister of Health in 2017, which is ± 3^{o}C from the air temperature.

Turbidity. Turbidity is a measure of the extent to which water has lost its transparency due to the presence of suspended particles or solids in the water. The main impact when the water is cloudy is that it is aesthetically unpopular with humans and previously suspended particles absorb heat from sunlight, causing the temperature to rise in the water, thereby reducing the oxygen concentration in the water.

Based on the measurement of the turbidity value of each dug well water, it still meets the clean water quality standard because it is still below the maximum level of 25 NTU. The highest turbidity level was found in the SK 8 sample with a value of 1.73 NTU and the lowest turbidity level was in the samples SK 7, SK 9 and SK 10 with a value of 0 NTU.

pH. pH (degree of acidity) shows how much the intensity of the acidity or alkalinity of a liquid or water and represents the activity of hydrogen ions in water. Water that is recommended for consumption should be neutral to prevent leaching of heavy metals and corrosion in water. If the pH is too low or high, it can cause chemical compounds to turn into toxins that are bad for health. Based on measurements, the value of the pH obtained can be presented in Table 4 below.

Table 4. Results of pH measurement.

Sample Code	Distance (m)	Depth (m)	pH
SK 1	126	6	7.38
SK 2	131	5	7.09
SK 3	135	6	6.85
SK 4	139	5	6.95
SK 5	148	5	6.75
SK 6	151	6	6.99
SK 7	155	5	6.97
SK 8	163	5	7.12
SK 9	169	5	7.30
SK 10	174	5	6.94

In accordance with the table above, the pH of dug well water obtained is still between the maximum and minimum limits required by Permenkes Number 32 of 2017, namely 6.5 - 9.0 for clean water and 6.5 - 8.5 for drinking water.

Iron (Fe). Iron is one of the earth's resources that are widely found. Iron can also be a chemical that interferes with the supply of drinking water, both soluble iron and water insoluble iron. Water that contains iron when viewed from the color will cause a yellow stain, especially if it is exposed to white clothes it will be more visible, iron can also give a metallic taste and can affect the taste or quality of the food and drink consumed. Iron is important for the body, especially for transporting oxygen in the blood. Based on the Minister of Health Regulation Number 32 of 2017 concerning Water Health Requirements, the maximum level allowed in drinking water is 0.3 mg/L and in clean water is 1 mg/L.

The research which was conducted in Sikapas Village used 10 dug wells, but the ones analyzed in this study were 3 dug wells. With the value of iron content in SK 1, namely <0.009 mg/L, SK 5 is 0.09 mg/L and SK 10 is <0.009 mg/L. This shows that the well water dug in Sikapas Village still meets the requirements for clean water and is suitable for consumption because the iron content found is still very low.

Magnesium. Magnesium is a mineral that plays an important role in the human body. Very high levels of magnesium in the blood can cause heart problems, difficulty breathing, and shock. However, if magnesium levels are met for the body's needs, it will be very good for maintaining body health, especially for bone growth, but also if high magnesium levels can cause nausea and even diarrhea.

The results of the research in Sikapas village were analyzed as much as 3 dug wells. The magnesium content in the sample SK 1 was 3.6 mg/L, the sample SK 5 was 1.4 mg/L and the sample SK 10 was 3.4 mg/L. However, according to the World Health Organization (WHO) international standard guidelines for drinking water, the maximum permissible level is 150 mg/L.

Chloride. Salt (NaCl) we often find in water areas, where in the salt without realizing it there is a chloride component. In groundwater, the presence of chloride comes from soil weathering, seawater intrusion, sewage, agricultural disposal, and geological formations which contain a lot of salt. Too much chloride can cause unpleasant taste and smell problems and cause corrosion, especially if consumed in excess can have harmful effects on health.

Based on the research conducted, the chloride content obtained in SK 1 was 7.88 mg/L, on SK 5 was 5.91 mg/L and on SK 10 was 20.3 mg/L. The analysis shows that the chloride content in the three samples still meets the quality standards for clean water according to the Minister of Health Regulation Number 32 of 2017 concerning Water Health Requirements with the maximum permissible chloride content of 250 mg/L for drinking water and 600 mg/L for clean water.

Iodine. Iodine is a mineral that is naturally found in soil and sea water. This mineral is mostly found in iodized salt. The need for iodine in the body is very important, because this mineral can regulate hormones, fetal development and much more. So that deficiency iodine can cause fatal effects to health.

Based on research that has been carried out in Sikapas Village, data on iodine levels were analyzed in 3 dug wells of water. The data obtained are in sample SK 1 the amount of iodine content is 2.0040 mcg/gr, in sample SK 5 the amount of iodine is 5.1545 mcg/gr and in sample SK 10 is 0.9613 mcg/gr. However, according to the World Health Organization (WHO) the Guidelines for Drinking-water Quality the maximum iodine level is 18 μg/L. Consume iodine in very large doses (a few grams, for example) can cause mouth, throat and stomach burns, fever, abdominal pain, nausea, vomiting, diarrhea, weak pulse and coma.

Conclusion

The Based on the observed physical and chemical parameters, the water sample with code SK 10 is the best sample point compared to all sample points that have been taken with a well distance from the shore as far as 174 meters. This is supported by the average parameter decreasing in level as the distance of the wells increases from the shore

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