# Groundwater Quality Analysis With Parameters Of Manganese (Mn), Nitrate (NO3–), PH, TDS, and *Escherichia Coli*

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## Abstract.

The need for water supply at University X still depends on groundwater. The use of groundwater as a source of water at University X as sanitation for students and academic workers. The purpose of this study is to identify the quality of groundwater in all faculties at the University X with parameters nitrate (NO3-), manganese (Mn), pH, TDS, and *Escherichia Coli* and to investigate the correlation between distance of wells and septic tank with quality of groundwater especially *Escherichia Coli*. Chemical parameter of groundwater was analyzed by Standar Nasional Indonesia (SNI) method, and biological parameter by using Most Probable Number method and compared with the regulation Minister of Health of the Republic of Indonesia No. 32, 2017. The research was conducted by taking samples of well by tap water to see physical, chemicals, and biological parameters. Analyzing showed that TDS has no significant number that exceed the regulation standard. Other parameters, such as pH has 18,52% of samples fulfil the regulation standard. Mangan (Mn) has 45.68% of groundwater samples contaminated and Nitrate (No3-) has 12.35%. E. coli parameters has 25-points sample that contaminated the water quality. In conclusion, Final result of statistic analyzing correlation between water quality and distance between septic tank and well indicates has no significant correlation.

**Keywords:** groundwater, quality, distance, wells, and septic tank

## 1. Introduction

Groundwater is one of the most reliable water sources and the most widely used natural resource, which is about 20% of the world's freshwater supply, and about 0.61% of the world's water (Alsalme et al., 2020). The deterioration in groundwater quality is generally caused by human activities that cause pollution, although the quality of groundwater naturally without human interference is not necessarily clean (Prilia & Kamil, 2017). The increasing number of populations in urban and rural areas will also increase the need for clean water (Baird et al., 2017).

In accordance with one of the goals of the Sustainable Development Goals (SDG) in the environmental sector. By 2030 clean water is designed to be universally used and applies to low, middle and high income countries (WHO, 2017). Evaluation of

groundwater quality allows it as a reference for developing a level of water safety and sustainable use of groundwater.

In previous studies, the value of the manganese (Mn) parameter at X University exceeded the quality standards set by the Republic of Indonesia Government Regulation No.82 of the year, namely manganese of 0.15 mg/l. Accumulation of heavy metals in the human body can interfere with health because they are carcinogens (Belle et al., 2020). The short-term impact of exposure to water containing heavy metals iron and manganese can cause respiratory system disorders. Another effect can increase overreaction in asthmatics because it irritates the vessels in the throat (Sunarsih et al., 2018). In the research conducted by (Dayanti et al., 2018) found the fact that all groundwater samples analyzed had a number of *E.coli* above the standard so it is recommended not to be consumed directly. E. Coli is included in heterotrophic bacteria that obtain food in the form of organic substances from their environment because they cannot compile the organic substances they need (Umar et al., 2019). So, it is necessary to control and treat clean water so that it cannot be used according to its designation, so it is necessary to control and treat clean water.

### 1.1 Objective

Identifying the quality of groundwater in all faculties at University X with parameters Nitrat (NO3-), manganese (Mn), pH, TDS, and Escherichia coli (E.Coli) and assess the relationship between groundwater quality and distance between wells and septic tanks.

## 2. Material And Method

### 2.1 Study Area

The research was conducted at a university located in West Java, Indonesia. The time of the research was carried out in the time span from December 2020 to March 2021 for field observations and collecting secondary data. Primary data collection in the form of groundwater sampling, groundwater quality testing, was carried out in the span time from January 2021 to March 2021.

### 2.2 Sample and Water Analysis

This groundwater sampling can be done through a water tap connected to the groundwater flow and stored in a container that has been prepared. The research sample in this study is groundwater located at University X. The population in this study is groundwater boreholes located in all faculties at University X. The total population of groundwater wells for all faculties at University X is 78 points.

Determination of the sampling point is done by using purposive sampling method where the researcher determines the sampling by setting specific criteria, namely the location of the well and septic tank. Sampling in this study was carried out based on SNI 6989.58:2008 Groundwater Sampling Method. In testing the sample in this study will use a method in accordance with each parameter. For chemical parameters such

as pH and TDS, sample testing on-site. Other parameters such as Nitrate (No3-) and Manganese (Mn) will be tested in the laboratory according to Standard Methods for The Examination of Water and Wastewater using a UV-Visible Spectrophotometer. Biological parameters such as Escherichia Coli bacteria will also be tested in the laboratory using the Most Probable Number (MPN) tool.

### 2.3 Statistical Analysis

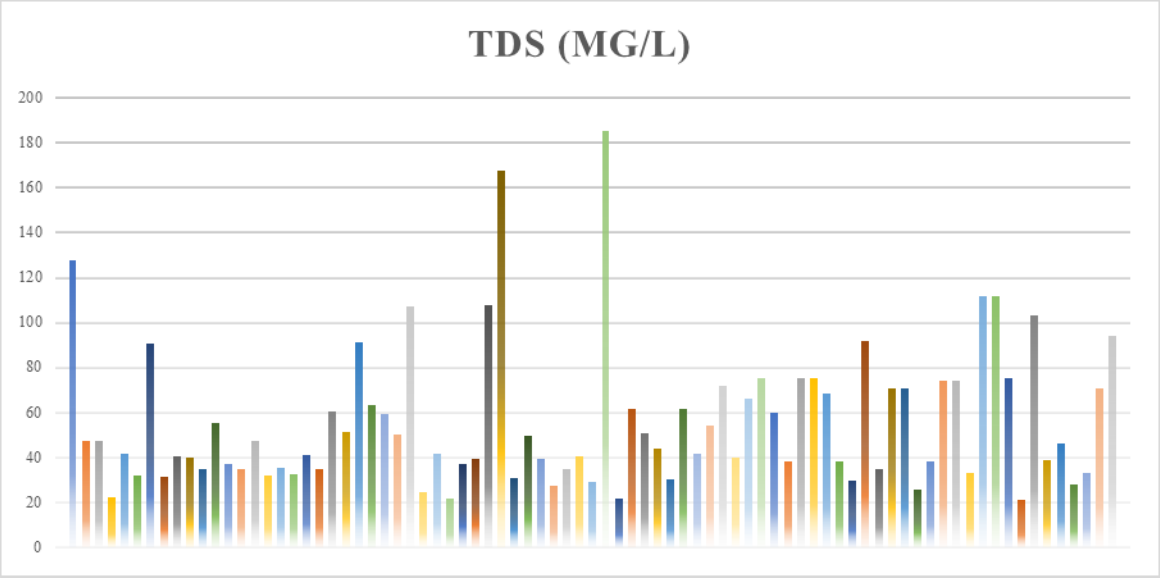
All statistical analyzes were performed using IBM SPSS version – 21. Statistical analyzed first step is goodness-of-fit test use *Hosmer and Lemeshow* test and followed by Logistic Biner Regression method called *Wald* test for the final result.

## 3. Result and Discussion

### 3.1 Groundwater Quality

Observation of groundwater quality at X University with chemical and biological parameter which are TDS, pH, Manganese (Mn), Nitrate ($NO3^-$) and *Escherichia Coli*. Some evidence indicates its role in heart diseases and hardness of 150-300 mg/l and above may cause kidney problems and kidney stone formation (Sarala & P, 2012). Analysis the groundwater quality of the TDS parameters, all sample points at X University produced the result that none of the groundwater points exceeded the quality standard (Figure 1). Approximately value of TDS in University X is 55.74 mg/l. while the standard limit for TDS is 1000 mg/l (Menteri Kesehatan Republik Indonesia, 2017).

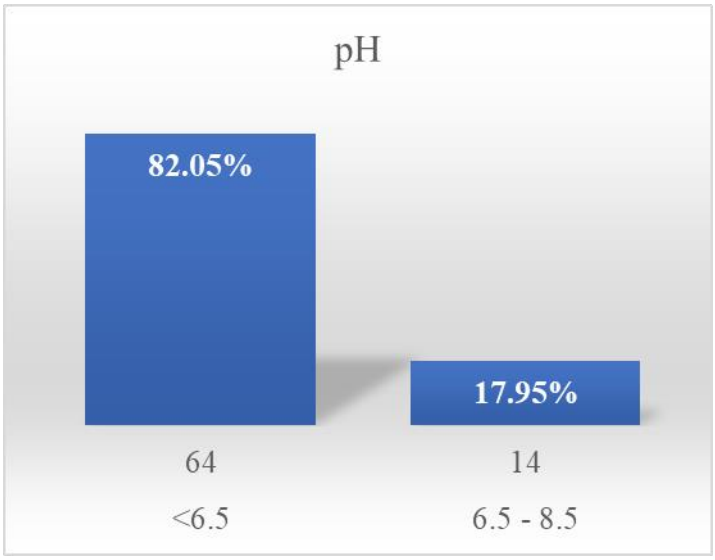
*Figure 1: The value of Total Dissolved Solid (TDS)*




The standard pH value is based on Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017, namely about 6.5 to 8.5. The 78 data samples tested, there were 14 points that met the quality standard (Figure 2). Then the 82.05% do not fulfill the quality standards. The rest of samples tend to be acidic.

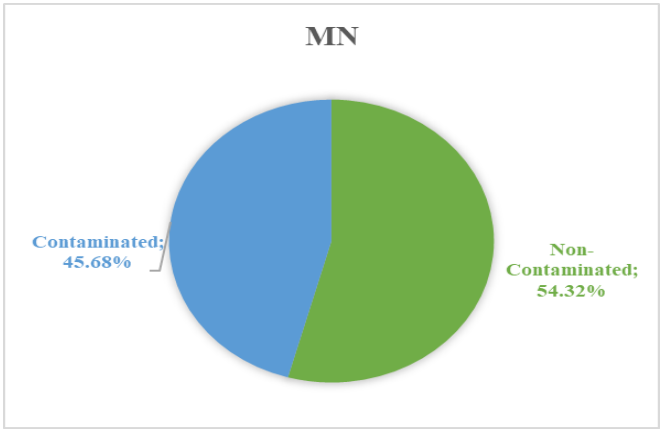
Drinking water with low pH could also cause gastrointestinal irritations. The lower than permissible pH range obtained from the different water sources may be linked to the geology of the study area (Owamah et al., 2020). The acidic water also could be cause a corrosive situation for the pipeline distribution.

*Figure 2 : pH values percentage*



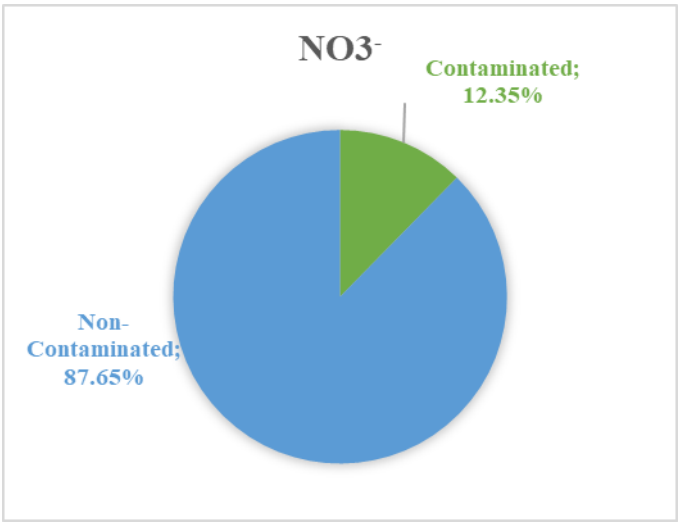

The mean value of manganese in this study is 0.57 mg/l. Laboratory test showed that 45.68% groundwater study's sample contaminated by manganese (Figure 3). The lowest value is 0.2 mg/l and the highest is 4.8 mg/l while the standard limit for Mn based on ministry health regulation is about 0.5 mg/l. The highest score of manganese happened due to the tap water conditions during sampling. The faucet has corrosion and the water was muddy. The condition of distribution's pipe can be also be a factor of contamination of groundwater. The maintenance of wells and pipe is needed (Alsalme et al., 2020).

*Figure 3: Manganese Percentage*



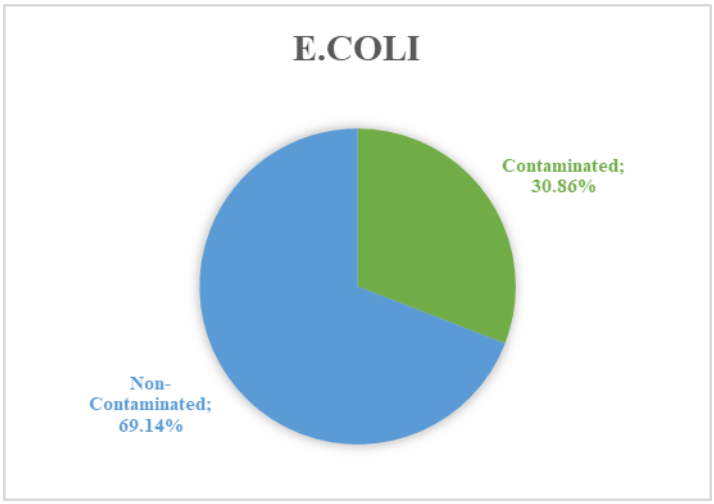
The average score for nitrate study showed 5.7 mg/l. The nitrate parameter is less contaminated than manganese. The nitrate was recorded between range 1.1 mg/l to 25.9 mg/l. the standard limit for Mn based on ministry health regulation is about 10 mg/l. Previous studies have stated that the potentially occurrence and distribution of nitrate contamination in the groundwater mainly excess the application of inorganic nitrogenous fertilizers, sewer leakage from the septic tanks, and municipal sewage (Adimalla & Taloor, 2020).

*Figure 4: Nitrate percentage*




Based on Ministry Health's regulation, the maximum permissible level of Escherichia coli is 0 for the amount per 100 ml sample. E. Coli is also a water quality indicator bacterium because its presence in the water indicates that the water is contaminated with feces, which may also contain other pathogenic enteric microorganisms (Radji et al., 2010). In this study, E. coli contaminated 30,86% of groundwater in University X. One of the sample has the highest number of E. coli, 930 CFU/100ml. The surrounding area where the point of sample taken was near by an old septic tank. However, contamination of this groundwater makes the water unsuitable for domestic use like drinking and washing (Chibuogwu & Eze, 2015).

*Figure 5: E.coli percentage*




### 3.2 Analysis of The Distance Between Septic Tank and Well

Analyzing the relationship between the distance between the well and the septic tank have been carried out using statistical software called SPSS. Analyzing the relationship carried out of all parameters both chemical and biological. The test results indicate no significant correlation between the distance of well and septic tank with the contaminated water. TDS is in safe line of ministry of health regulation standard. So, for statistical analyzing, TDS will not include in the further statistical test.

*Table 1: Result Goodness-of-fit Test*

| Parameter | *df* | sig |
|---|---|---|
| ph | 8 | 0.776 |
| Mn | 8 | 0.612 |
| No3- | 8 | 0.165 |
| E.Coli | 8 | 0.769 |

The Hosmer and Lemeshow statistics were used to test the goodness-of-fit of the data to log-normal distribution. According to the test, all the variables are log-normally distributed with 95% or higher confidence (Shrestha & Kazama, 2007). H0 is rejected if Sig value is <0.05. After analyzing Sig Value for parameter Nitrate (No3-) is 0.165 (Table 1), which is >0.05. That statement means Failure to reject H0, then the model is appropriate for next step analyzing.

*Table 2: Final analyzing – Wald method*

| Parameter | *df* | sig |
|---|---|---|
| ph | 1 | 0.393 |
| Mn | 1 | 0.350 |

| | | |
|---|---|---|
| No3- | 1 | 0.937 |
| E.Coli | 1 | 0.509 |

The Wald Statistics were one of a regression logistic biner method used to analyzed the next step. The result of significant value of all parameter shows in Table 2. H0 is rejected if value of Sig is <0.05. As seen in the table 2 that both of chemical parameters and biological parameter has no significant correlation of the distance between well and the septic system.

## 4. Conclusion

Groundwater quality in and around University X has been analyzed in the present work. The groundwater is acidic because the mean value of pH is 5.6 while the ministry of health regulation is about 6.5-8.5. All of TDS number in University X groundwater is 55.74 mg/l far beneath the regulation limit. Nitrate unexpectedly has the average value down the limit which is 5.7 mg/l while the limit is 10 mg/l. For Manganese and Escherichia Coli mean value is more than the regulation limit. The number is respectively 0.57 mg/l and 14.61 CFU/100ml. Therefore, the limit is 0.5 mg/l and 0 CFU/ml for Escherichia Coli. Result of this research shows that there is a weak correlation between the number of E. coli bacteria with distance of well to septic tank in University of X.

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