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Analysis of the Quality and Quantity of Ngade Lake as a Source of Clean Water in Ternate City

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ABSTRACT

The Ngade Lake, located on Ternate Island is usually used as a tourist destination and fishing activity. This affects the lagoon's water quality, so measuring the water pollution parameters is necessary. This is because the lake can be used as a source of clean water. The research was conducted to determine the availability of Ngade Lake as a source of clean water in terms of quality and quantity. The research method used in this study is experimental descriptive by conducting experiments and tests on the quality of Ngade Lake water and determining the amount of lake water through calculation from the measurement data. The water quality tests are carried out directly in Ngade Lake and the Laboratory physically and chemically. Physically includes taste, odor, temperatures, and temperatures. Chemical tests are conducted through COD, DO, pH, TDS, Density (CaCO3), metals (copper, iron, manganese), and other minerals. The results show that the quality testing of lake water meets the quality standards according to Permenkes No. 32 of the Year 2017, where the water in the middle of the lake has better water quality than the water on the lake's edge. The amount of water in Ngade Lake is measured at 3.394.744.000 litres. PDAM currently uses a pump with a discharge of 5 litres/second while the discharges of the water that is the reserve of water resources for Ngade Lake of 45 litres/second, so the water of the Lake of Ngade deserves to be used as a clean water source in terms of quality and quantity.

Keywords: Quantity, Quality, Water, Lake, Analysis

1. INTRODUCTION

One of the lakes on the island of Ternate is Lake Ngade. It is between the Fitu and Ngade Plains in Ternate, North Maluku Province (Taylor, 2018). Apart from being a tourist destination, the communities use this lake for fishing business. The impact of fishing rods and urbanization factors raises new problems, especially the discharge of waste into the waters that causes water quality to decline and cause eutrophication problems because water plants cover the lake's surface (Suresh et al., 2023). Such excess organic waste increases H_2S, ammonia, and increased nutrients (N and P) and decreases dissolved oxygen due to decomposition (Mohammed et al., 2022). The quality of this water needs to be investigated to determine the availability of Ngade Lake's water for clean water requirements in the town of Ternate (Hanim, 2018).

The inhabitants of Ternate nowadays sometimes have trouble getting clean water(Ahmad, Umar, et al., 2023). The causes of this water availability crisis include available water resources that cannot be optimised because of the water source capacity that mostly comes from drilling wells(Ahmad, Faedly, et al., 2023). The percentage of service is already high enough, but the continuity and capacity of service cannot be met(Chakkaravarthy, 2019).

The surface water (lake) administered by the Drinking Water District Company (PDAM) is used by the government of Ternate City to meet the water needs of the people of the south of the city(Susetyo & Rachman, 2020). As the quality of groundwater is declining, the PDAM cannot provide water in sufficient quantity and quality to the town's population(Chakkaravarthy, 2019; Umar, 2020). As a result, people will be looking for alternative water sources through surface water treatment(Development Bank, 2013).

Ngade Lake has become an alternative to being used as a source of clean water on surface water. It is reason to do this research to know the quality of the water of Ngade Lake and how much water can be used as the source of pure water(Vigny, 2003). The purpose of this article as information on quality water and worthiness used as drinking water and domestic needs for activity.

2. RESEARCH METHOD

The research was conducted in Ternate, specifically on Ngade Lake. The research began in February 2023 to October 2024. Inspections and measurements were carried out in Ngade Lake directly, and some tests were conducted in the Khairun University Laboratory. The location of the research can be seen in Figure 1.

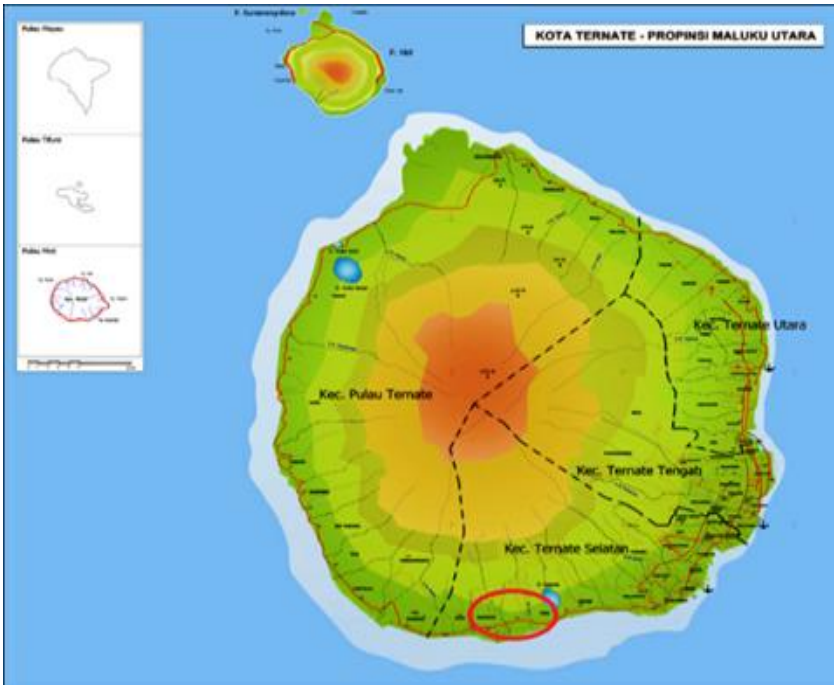

Figure 1. Map of Research Location

The locations in Ngade Lake were carried out at four points on the lake's edge and four points in the middle. At one point, three measurements were made. Point determination and sampling are done randomly using the Simple Random Sampling method.

The equipment used in this study is a water sampler, cool box, ice box, bottle, pH meter, analytical scale, pH meter, multiparameter water quality test device, TDS meter, spectrophotometer, and other water quality testing devices. Substances used in the study include Ngade lake water,

phenolphthalein indicator (pp), mix indicators (BCG-MR), chloric acid (HCl), sodium carbonate (Na_2CO_3), and sodium hydroxide (NaOH).

The research method uses a descriptive, experimental method by conducting experiments and tests on the quality of Ngade Lake water and the quantity of lake water. The research is carried out through steps according to Figure 2.

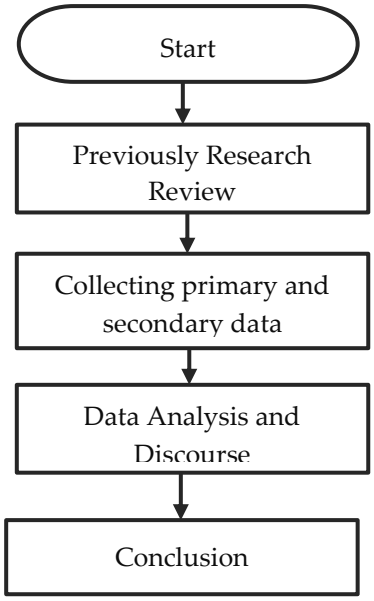

Figure 2. Research Steps

3. RESULTS AND ANALYSIS

3.1. Water Quality of Ngade Lake

Water quality inspection is done directly at Ngade Lake and the Lab. physically and chemically. Physically includes taste, odor, turbidity, and temperature inspection. Chemical inspection involves COD, DO, pH, TDS, Density ($CaCO_3$), Metals (Copper et al.), and other minerals. The details are shown in Table 1.

Table 1. Water Quality Standard

No	Parameters	Unit	Quality Standard (Permenkes No. 32 Tahun 2017)	Examination Sample	
				Lake Middle	Lake Edge
Physical Examination					
1	Taste	-	Tasteless	Tasteless	Tasteless
2	Odor	-	No Odor	No Odor	No Odor
3	Turbidity	Skl NTU	Max. 5	3,5	4,2
4	Temperature	^oC	Air Temp. $^oC \pm 30$	30,3	29,5
Chemical Examination					
5	COD	mg/L	Max. 25	4,8	5,1
6	DO	mg/L	Max. 5	8,2	7,5
7	pH	-	6,5 – 8,5	7,18	6,9
8	Copper (Cu)	mg/L	Max. 2,0	0,13	0,15

No	Parameters	Unit	Quality Standard (Permenkes No. 32 Tahun 2017)	Examination Sample	
				Lake Middle	Lake Edge
9	TDS	mg/L	Max. 500	22	40
10	Hardness ($CaCO_3$)	mg/L	Max. 500	47	50
11	Zinc (Zn)	mg/L	Max. 15,0	13,5	14
12	Chloride (Cl)	mg/L	Max. 600	10	12
13	Nitrate (NO_3)	mg/L	Max. 10	2	4
14	Iron (Fe)	mg/L	Max. 0,3	0,18	0,21
15	Manganese (Mn)	mg/L	Max. 0,5	0,06	0,07
16	Chromium	mg/L	Max. 0,05	0,02	0,03
17	Nitrite (NO_2)	mg/L	Max. 1.0	0,1	0,2

Source: Examination Results

Table 1 shows that all inspection results are by water quality standards according to Minister of Health Regulation No. 32 of 2017 concerning water health quality standards. Comparison of data collection on water quality at the edge has results close to quality standards.

Some parameters are going up and down. The rises and drops can be seen from the middle of the lake to the edge. At the physical examination in the middle of the lake, the water is not felt, but it is more felt in the area by the water. This is due to domestic waste and fishing activities around the lake, resulting in unrest on the lake's banks.

The severity was measured with a turbidimeter, and it was found that there was an increase in severity from the middle to the edge of the lake because there was much activity among citizens who kept fish. High turbidity caused increasing total suspended solids (TSS), a sign that the quantity of nutrients and organic matter in the lake is fairly high, which creates contamination in the lakes(Piranti et al., 2018).

The donation of fish pellets and domestic garbage thrown away makes the lake edge more rugged than in the middle of the lake. The pH measurement at four points on the edge yields an average pH of 6.9. The measurements at these four points are done at two points near the fish pond and in areas that are not fish ponds.

Measuring the pH in the middle of the lake found that the average pH produced was 7.18. The measurements showed that the pH was higher than the pH obtained from the pH measurement at the lake's edge. This indicates that the water in the lake's centre was more basal, and the water at the river's side was more acidic. As an outcome of Devangee's (2013) research, it met the pH range required for approval and was found safe for people to consume(Shukla, 2013).

Similarly, with dissolved oxygen (DO) data, which has decreased from 8.2 mg/L to 7.5mg/L, this is due to lower levels of Oxygen on the lake side than in the middle of the lake—low oxygen levels due to the presence of domestic wastes affecting the level of oxygen. The more domestic waste, the more oxygen is needed to decompose organic matter in the lake water so that the oxygen solved becomes less(Leiria et al., 2023). This deficiency is influenced by an increase in the COD from 4.8 mg/L to 5.1mg/L. The increase in Chemical Oxygen Demand (COD) leads to a decline in water quality because much of the organic material is oxidised. According to Naili (2023), One of the most significant variables to gauge the degree of water contamination is Chemical Oxygen Demand (COD) (Alam, 2010). The COD score measures the amount of organic pollutants in the water that, according to science, can be oxidised by microbial activities and lowers the amount of oxygen dissolved in the water(Alam, 2010).

The highest decrease percentage from the lake's edge to the middle of the lake is nitrites and nitrates. This is because, on the lakeside, there are fish holdings in caterpillars that use fish feed for fish feed. This triggers an increase in nitrates and nitrides(Suresh et al., 2023).

Some parameters have experienced increased temperature from the lake's edge to the lake's centre. The temperature at the lake's edge is 29.5 degrees, while it is 30.3 degrees in the middle. In the midst of the lake, the sun is so hot in the day that the temperature is higher.

The pH data on the outskirts of the lake is more acidic, while in the middle of the Lake, it is more neutral because there are plenty of fish on the shores, and some residents who live near the lake throw their domestic waste into the lake(Putra & Yulia, 2019). It affects the pH of the lake water. Similarly, with dissolved oxygen (DO) data rising from 7.5 mg/l to 8.2 mg/L, this is due to lower levels of dissolving oxygen on the lake's edge than in the middle of the lake.

The concentrations of copper (CU), TDS, hardness ($CaCO_3$), zinc (Zn), chloride (Cl), nitrate (NO_3), iron (Fe), manganese (Mn), chromium, and nitrite (NO_2) from the middle to the edge of the lake are constantly increasing(Mohammed et al., n.d.). This increase is due to several factors, such as human activity dumping domestic wastes around lakes, fishermen fishing activities around the lake, many canteens dumping their domestic waste directly into lakes, and soil erosion.

3.2. Water Quantity of Ngade Lake

The quantity of the lake is measured by determining the volume of the Ngade lake. This volume is obtained from the equation 1.

$$\text{Volume of lake water} = \text{Lake area} \times \text{Depth of lake} \quad \text{(Eq. 1)}$$

The area of Ngade Lake was measured to be 183,499.65 m^2, and the depth of Ngade Lake was around 1 meter to 36 meters. The average depth is 18.5 m, so the water volume of Ngade Lake is 3,394,744 m^3 or 3,394,744,000 litres of water. An overview of this data is presented in Table 2.

Table 2. Results of Volume Measurement

Parameters	Measurement Results
Area (m^2)	183.499,65
Depth (m)	1-36 (18,5)
Volume of Water (m^3)	3.394.744
Volume (Liters)	3.394.744.000

Table 2 shows that the water quantity of Ngade Lake is 3.4 billion litres. Meanwhile, the capacity of the centrifugal pump from PDAM used to pump water from Ngade Lake to the Water Treatment Plant (IPA) tank is 5 litres/second. Based on the calculation of the usage period of Ngade Lake water using this pump discharge, it was found that the potential of the lake's water resources can be used for the next 22 years, assuming there is no availability of other water sources. However, if other water resources are available, the water security in Ngade Lake can be used for hundreds of years. This is because, according to data on the availability and security of water in Ternate City, based on the reliable discharge, it is 43 m^3/second or 43,000 litres per second.

Meanwhile, water use or consumption based on domestic and non-domestic needs in Ternate City is only 0.2 per cent. Thus, Ngade Lake is worthy of being used as a source of clean water for the city of Ternate because it meets the requirements in terms of quality. In terms of quantity, it can meet the domestic and non-domestic needs of the people in Ternate City.

4. CONCLUSION

Ngade Lake deserves to be one of the sources of clean water in surface water in Ternate City. All lake water quality inspection results comply with quality standards according to Minister of

Health Regulation No. 32 of 2017 concerning water health quality standards. The results of the water quality inspection in the centre were better than those on the edge of the lake due to the activities of residents when travelling, selling, and fishermen who threw domestic waste onto the river bank. Chemical examination examines COD, DO, pH, TDS, hardness (CaCO3), metals (copper, iron, manganese), and other minerals. The results show that the lake water quality testing meets the quality standards according to Minister of Health Regulation No. 32 of 2017, where the water in the middle of the lake has better water quality than the water at the lake's edge. Meanwhile, measurements of the water quantity in Ngade Lake were found to be 3,394,744,000 litres. PDAM currently uses a pump with a discharge of 5 litres/second, while the mainstay discharge for the water, the reserve water resource for Ngade Lake, is 45 litres/second. Hence, Ngade Lake water is worthy of being used as a source of clean water in terms of quality and quantity.

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