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Analysis of Groundwater Quality Distribution in Pare-pare Region, South Sulawesi Province

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ABSTRACT

Administratively, the study area is located in the town of Pare-Pare, Pare-Pare Municipality of South Sulawesi Province. Geographically located at coordinates 119°37'04" - 119°38'50" East Longitude and 04°03'10" - 04°25'05" South Latitude. This study aimed to determine the quality of groundwater in the area of research and aims to obtain information about the condition of potable water consumed by residents in the area of research. Water Quality Standards Governor of South Sulawesi Decree 2003, Regulation of the Minister of Health No.492, Ministry of Health 2010 concerning Drinking Water Quality Requirements, and Water Quality Classification and Criteria (Government Regulation No.82 of 2001 article 8) the groundwater in the study area can be classified into several groups (classes) of water that is group (class) A(1) in the sample wells with a record reduction in levels of S01 BOT, group (class) B(2) in the sample wells S03 and S05 to record the reduction in the levels of BOT and Zeng, group (class) C(3) in the sample wells S02 and S04 to record the reduction of levels of BOT, Zeng, and specifically in the sample wells lead S02, as well as reducing levels of BOT, Zeng, and turbidity levels in wells sample S04. Based on the results of measurements of the depth of the well and then cross-sectional profiles can be interpreted that the direction of groundwater flow in the study area is North Northeastern – South Southwestren Watangpulu namely in areas where water quality up to Bacukiki group (class) C(3) located at an altitude of 50 – 125 meters and water quality group (class) B(2) located at an altitude of 25 – 50 meters and water quality group (class) A (1) located at an altitude of 0 – 25 meter.

Keywords: Groundwater, Groundwater Quality, Pare-pare

1. INTRODUCTION

Pare-pare is a coastal area that is widely used as a residential area. The high population in the city of Pare-Pare will also increase the consumption of clean water for drinking, industry, and agriculture as well as other uses (Karsidi, 1999).

Therefore the authors conducted this study to determine the level of groundwater quality in the study area. The purpose of this study is to determine the level of water quality in the study area. The aim is to obtain information about water conditions suitable for consumption by residents in the study area.

This geological research was carried out by limiting water quality problems associated with water quality standards in accordance with the Governor of South Sulawesi's Decree of 2003, Permenkes No.492 Menkes of 2010, and Government Regulation No.82 of 2001 article 8, Lvovitc (1970) and concealing geological area research.

This research was conducted in October 2010 which is located in the city of Parepare with an astronomical position between 4°3'10" - 4°25'05" South Latitude and 119°37'04" - 119°38'50" East Longitude. Research Map location is shown in Fig. 1.

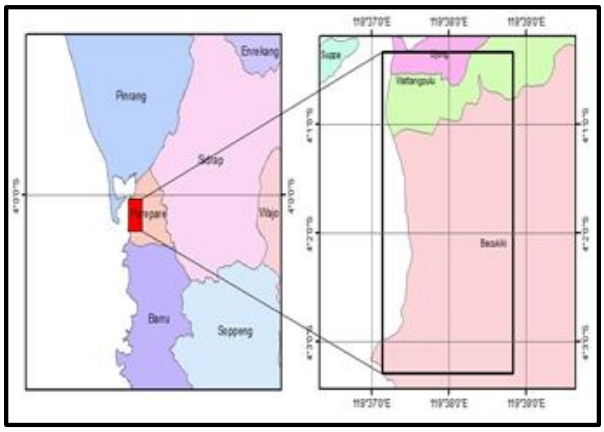

Figure 1 Research map location

The research location can be reached by using a four-wheeled or two-wheeled vehicle from Makassar City to the Municipality of Pare-Pare.

2. GEOLOGICAL SETTINGS

According to M. Fauzi Arifin (1985) in the Geology of the Pare-Pare Region, the morphological units of Pare-Pare City can be classified into two (2) morphological units, The Moderate Relief Morphological Unites and The Low Relief Morphological Units.

Moderate Relief Morphological Units, is located in the southern part which covers a quarter of the study area with a height of between 100 meters and 375 meters. Bulu Batu is located in the North which extends from North-South with a peak height of 126 meters, where the slope in the South is between 300-600, while in the North the slope is between 100-250. Because the hills are sloping to the North, while the South slope is a cliff. B.Tolong is located in the South which extends from the Northeast-Southwest with a peak height of 285 meters. To the east lies B. Lakakiki which extends from north to south with a peak height of 375 meters (M. Fauzi Arifin, 1985).

Low Relief Morphological Unit, is covering three-quarters of the study area which is partly located between B.Tolong and B.Lakakiki, starting from Mangimpuru Village in the south to the northern part of Lapede Village (See Geomorphological Map). This area is a stretch of hills with rounded peaks, where there are two known peaks, namely B. Lemabang (67 meters) and B. Sikarangtuluwe (86 meters), with a slope of between 50-100. Meanwhile, another distribution of this unit is located in the western part, starting from Baru 2 Village to Banrong Village, and along the coastline where it is generally composed of alluvial units and tuff units. In the western part of Pare-Pare City you can find Pare-pare Bay which has a depth of between 5 – 700 meters (Arifin, 1985).

From the results of research according to Arifin (1985) in the Geology of the Pare-Pare Region, Pare-Pare City area, it is known that the rock units found in the study area are divided into 4 (four) types of rock units which are sorted by age from the youngest to the oldest as follows:

1. Alluvial Unit,
2. Volcanic Breccia Unit,
3. Igneous Rock Unit, and
4. Tufa Unit

- Tufa Unit

Based on the lithology equation and geographical distribution which is very close to the type location, it can be correlated with the Walanae Formation with exposed unit thicknesses in the study area of more than 800 meters (Arifin, 1985).

- Andesite Igneous Unit

This unit is found in the Tanjung Tonrang area to the north of Lumpue. The age of this unit is estimated to be the Lower Pliocene, namely after the formation of tufa rock units, where intrusive contacts were found from these two units in Lemoe Village which only tuff units intruded (Arifin, 1985).

- Volcanic Breccia Unit

Based on the similarity of the lithology and geographical distribution which is highly related to the type location, it turns out that the volcanic breccia units and the Pare-Pare volcanic rock can be correlated, and were deposited in a terrestrial environment. So in

terms of regional stratigraphy, volcanic breccia units are the same as Pare-Pare Volcano rocks that are Pleistocene (Arifin, 1985), where the relationship between these rock units and the limestone units below them is not aligned.

- Alluvial Unit

In the study area this unit consists of coastal deposits and river deposits. In general, this unit is composed of gravel, sand and clay. This unit is located out of alignment with the underlying rock. Unconformity contacts are found on river banks in the form of angular misalignments. The spread of this unit is generally in coastal areas, with a thickness of between 1.5 – 2.5 meters

The geological structure of the research area is a fault structure of the type of shear fault, namely the Karajae fault

Based on previous hydrogeological mapping conducted by Mudiana (1983) and Subdin GSDM Sulsel (2002) Pare-Pare City can be divided into 4 (four) aquifer areas based on Kruesman (1994) and Suyono (1993), namely:

- Moderate Productivity Aquifer Region

Medium productivity aquifers are composed of alluvium units of beach deposits, river deposits and lake deposits consisting of silt, silt, sand and gravel deposits.

- Medium to High Productivity Aquifer Areas

This area is composed of sandy limestone, tuffaceous limestone and Pare-Pare volcanic rock with moderate to high rock graduations. Whereas in sandy limestone and tuffaceous limestone it depends on the number of gaps or fractures.

- Small to Rare Productivity Aquifer Areas

This area is composed of Camba volcanic rocks, and trachite and andesite intrusive rocks.

- Rare Groundwater Areas

This regional unit occurs in a local pattern in Pare-Pare City with a narrow distribution in the southern part, to be precise in the western part of Lumpue (Bulu Batu) which is composed of intrusions in andesitic igneous rocks.

3. METODOLOGY

This experimental research was carried out by Sampling and physical analysis of well water and collection of geological data. The sample of this study was chosen by using purposive sampling. This research was carried out in the Groundwater and was carried out in 5 (five) locations, namely: sample S01 around Kullangge, sample S02 around Abatuangge, sample S03 around Lumpue, sample S04 around Lemubbeng, and sample S05 around Pojoale. To determine the water quality in the area above, a water quality test was carried out on samples taken using predetermined parameters (Nace, 1971; Sanders, 1998; Linsley, 1996; Kodoatie, 1996; Sujudi, 1995)

3. RESULT AND DISCUSSION

Based on the results of laboratory analysis of each water sample, it can be described as follows:

3.1 Well S01

Well 01 (Photo 3.1) with a depth of water surface to ground surface is 8 m and is located in a rock unit area in the form of volcanic breccia and is included in a low relief morphological unit with a height of between 0 – 25 meters. Based on the laboratory test results, the S01 sample is categorized as follows:

a. Turbidity level, pH, Sodium (Na), Lead (Pb), Zeng (Zn), Manganese (Mn), Nitrate (NO_3), Nitrite (NO_2), Sulfate (SO_4), Total Hardness, Chloride (Cl-) of the sample S01 includes Class A and Class 1.

b. The Total Organic Matter (BOT) of sample S01 has exceeded the threshold and class 4.

c. Well S01 is included in the moderate to high aquifer area.

Figure 2 Photograph view of the S01 Water Sampling Well in the Lumpue area, photographed towards N90°E.

3.2 Well S02

Well 02 (Fig. 3) has a depth of 4 m to the ground surface and is located in a rock unit area in the form of volcanic breccia and is included in a low relief morphological unit with a height of between 25 – 125 meters. Based on the laboratory test results, the S02 sample is categorized as follows:

a. Turbidity level, pH, Sodium (Na), Manganese (Mn), Nitrate (NO_3), Nitrite (NO_2), Sulfate (SO_4), Total Hardness, Chloride (Cl-) from sample SO2 are included in Group A and Class 1.

b. Lead (Pb) from sample S02 has exceeded the required threshold and Class 4.

c. Zeng (Zn) from sample S02 belongs to Group C and Class 4.

d. Total Organic Matter (BOT) from sample S02 has exceeded the required threshold and class 4.

e. The S02 well is included in the moderate to high aquifer area

Figure 3 Photograph view of the S02 Water Sampling Well in the Abanuange area, photographed towards N90°E.

3.3 Well S04

Well 04 (Fig. 4) with a depth of 10 m to the ground surface and is located in a tuff rock unit area and is included in a low relief morphological unit with a height of between 50 – 125 meters. Based on the laboratory test results, the S04 sample is categorized as follows:

a. pH, Sodium (Na), Lead (Pb), Manganese (Mn), Nitrate (NO_3), Nitrite (NO_2), Sulfate (SO_4), Total Hardness, Chloride (Cl-) from sample S04 including Group A and Class 1.

b. The turbidity level of sample S04 is included in Group B and Class 1.

c. Zeng (Zn) from sample S04 belongs to Group C and Class 4.

d. Total Organic Matter (BOT) from sample S04 has exceeded the required threshold and class 4.

e. Well S04 is included in the moderate to high aquifer area.

Figure 4 Photograph view of the S04 Water Sampling Well in the Lemmobeng area, photographed towards N120°E.

3.4 Well S05

Well 05 (Fig. 5) has a depth of 10 m to the ground surface and is located in a rock unit area in the form of tuff and is included in a low relief morphological unit with a height of between 25 – 50 meters. Based on the laboratory test results, the S05 sample is categorized as follows:

a. Turbidity level, pH, Sodium (Na), Lead (Pb), Manganese (Mn), Nitrate (NO_3), Nitrite (NO_2), Sulfate (SO_4), Total Hardness, Chloride (Cl-) from sample S05 are included in Group A and Class 1.

b. Zeng (Zn) from sample S05 belongs to Group C and Class 4.

c. Total Organic Matter (BOT) from sample S05 is included in Group C and class 3.

d. Well S05 is included in the medium to high aquifer area.

Figure 5 Photograph view of the S05 Water Sampling Well in the Lemmobeng area, photographed towards N120°E.

3.5 Well S06

Well 06 (Fig. 6) with a depth of water surface to ground surface is 8 m and is located in a rock unit area in the form of volcanic breccia and is included in a low relief morphological unit with a height of between 0 – 25 meters. Based on the laboratory test results, the S06 sample is categorized as follows:

a. Turbidity level, pH, Sodium (Na), Lead (Pb), Zeng (Zn), Manganese (Mn), Nitrate (NO_3), Nitrite (NO_2), Sulfate (SO_4), Total Hardness, Chloride (Cl-) of the sample S01 includes Class A and Class 1.

b. The Total Organic Matter (BOT) of sample S06 has exceeded the threshold of class 4 and yang.

c. Well S06 is included in the medium to high aquifer area.

Figure 6 Photograph view of the S06 Water Sampling Well in the Lumpue area, photographed towards N95°E.

4. CONCLUSIONS

Based on the depth of the wells in the study area, the direction of groundwater flow in the study area is Northeast - Southwest, namely in the Watangpulu to Bacukiki areas.

Based on the results of laboratory tests on five groundwater samples in terms of the physical and chemical properties of groundwater, the study area is divided into:

1. Class A or class 1 (reduction of BOT content) is used as drinking water in wells S01 and S06 with a depth between the soil surface and water surface of 8 meters where the rock units are volcanic breccias.
2. Class B or class 2 (reduction in BOT and Zeng levels) is used for water recreation infrastructure/facilities, there are S03 wells and S05 wells with a depth between the soil surface and water surface of 10 meters where the rock units are tuffs with different morphological units. low relief and classified as a medium to high aquifer region.
3. Morphological unit with low relief with a height of between 0 – 25 meters and classified as a medium to high aquifer area.
4. Group C or class 3 is used for cultivation and water for irrigating plants is in the S02 well with reduced levels of BOT, Zeng and Lead, the depth between the soil surface and the water surface is 4 meters where the rock units are volcanic breccias with relief morphological units low and located in well S04 with reduced levels of BOT, Zeng, and turbidity levels, the depth between the soil surface and the water surface is 10 meters where the rock units are tuffs with low relief morphological units and classified as medium to high aquifer areas.

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