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Groundwater Level and pH Assessment for Drinking Water Suitability in Mulyaguna Village, Gelam Bay District

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Abstract

Mulyaguna is a lowland area with sloping relief where most of the area is peatland. People in this area use dug wells to get clean water which is used for their daily consumption needs. Along with the progress of the times the need for clean water in this area also increases while the available water is limited with water quality on peatlands that are not too good. Water that is good for consumption is one that has a pH of 7, neither acidic nor alkaline. Most of the wells made by the community are murky, brownish in color and smelly. This raises the question of whether the water in these wells is suitable for consumption or not and the condition of the water table. By measuring the groundwater level and taking water samples to measure the pH of the water, it is hoped that the well water consumed is feasible or not and the direction of water flow to determine the availability of water in this area. Sampling used a random sampling method where the pH of the water at the 12 research locations that had been measured ranged from 5.5-6 which indicates that the water is acidic and unfit for consumption and has a shallow to The groundwater level (depth to groundwater) ranges from 26.2 to 44.8 m, where The direction of groundwater flow is toward the north–northwest.

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1. Introduction

Water is a basic need for human life, but water suitable for consumption is very limited. Of all the water on earth, only around 0.61% is accessible as groundwater that can be used, making sustainable water resource management a global challenge as human, industrial, and agricultural activities increase (Fetter, 2018; Baloch et al., 2021).

Indonesia still uses groundwater as the main source of drinking water supply and for domestic needs of the community in many areas, especially in rural areas that have limited access to piped water. Groundwater quality is affected not only by local hydrogeological conditions but also by land use and anthropogenic activities such as agricultural activities and inadequate sanitation (World Bank, 2023; Herawati et al., 2024).

Groundwater level is an important hydrogeological parameter that reflects the condition of the aquifer. Variations in groundwater level elevation on the Earth's surface. Groundwater pH is one of the chemical parameters measured in groundwater quality assessments. Studies show pH values vary within a natural range and should be monitored as part of water quality evaluations. Changes in pH can be associated with shifts in groundwater chemistry relevant to human consumption (Kasim et al., 2023; Chen et al., 2024).

Mulyaguna Village is located in a lowland peat swamp area where rainwater accumulates. The peat swamp acts as a reservoir for absorbing water from the surrounding area. However, the quality and availability of water in the peatlands are not suitable for consumption due to their high heavy metal content, low pH (acidic), and light to dark brown color (Said et al., 2019).

The lack of data on groundwater levels and groundwater quality parameters, such as pH, makes it difficult to assess the sustainability and safety of groundwater sources for local communities, especially given their heavy rainfall dependence. The generally acidic nature of swamp environments can also affect the quality of groundwater used by the community. Several studies have shown that groundwater level measurements in community wells are used to map groundwater flow patterns, while hydrogeochemical parameters such as pH are analyzed in groundwater quality studies for domestic use (Pinayungan et al., 2025; Masitoh et al., 2025; Fadilah et al., 2025). Therefore, this study measured groundwater pH and levels to determine the distribution and direction of groundwater flow in community wells in Mulyaguna Village and to assess their suitability as consumption water sources.

2. Materials and methods

This research was conducted in Ogan Komering Ilir Regency, specifically at groundwater wells in Mulyaguna Village, Teluk Gelam District, with a research area of approximately 25 m² (Figure 1). To determine the flow direction and quality of groundwater, this study used several methods, including groundwater level and pH measurements and data processing and analysis using a Geographic Information System (GIS).

Groundwater level measurements were carried out directly in residents' wells using measuring tapes, following the method for measuring groundwater levels in shallow aquifers. To determine the groundwater level, a Global Positioning System (GPS) tool was used to measure the ground surface elevation, and a measuring tape was stretched into the well to determine the distance between the ground surface and the groundwater level. The groundwater level value was calculated using Equation (1). The groundwater level elevation was calculated by subtracting the groundwater level depth from the ground surface elevation, as is the standard method in hydrogeological studies (Freeze & Cherry, 1979; Todd & Mays, 2005).

$$H = h - \Delta h \dots \dots \dots \text{(Equation 1)}$$

Based on equation 1, H is the groundwater level elevation (m), h is the ground surface elevation (m), and Δh is the depth of the groundwater level from the ground surface (m). The groundwater level data obtained is then plotted at each observation location to produce a map of the distribution and direction of groundwater flow using GIS-based contour and flow direction analysis.

Groundwater level data obtained at the observation location were used to generate a map of groundwater flow distribution and direction using GIS-based contour and flow direction analysis. Groundwater pH was measured using litmus paper as an initial method for assessing water quality. Water sampling was conducted using a random sampling method at each resident's well. Water samples were then dipped into litmus paper until a color change occurred, which was compared with a universal pH indicator to determine the groundwater pH (APHA, 2017). The results of these pH measurements were used as the basis for an initial evaluation of groundwater suitability for consumption against applicable drinking water quality standards (WHO, 2017).

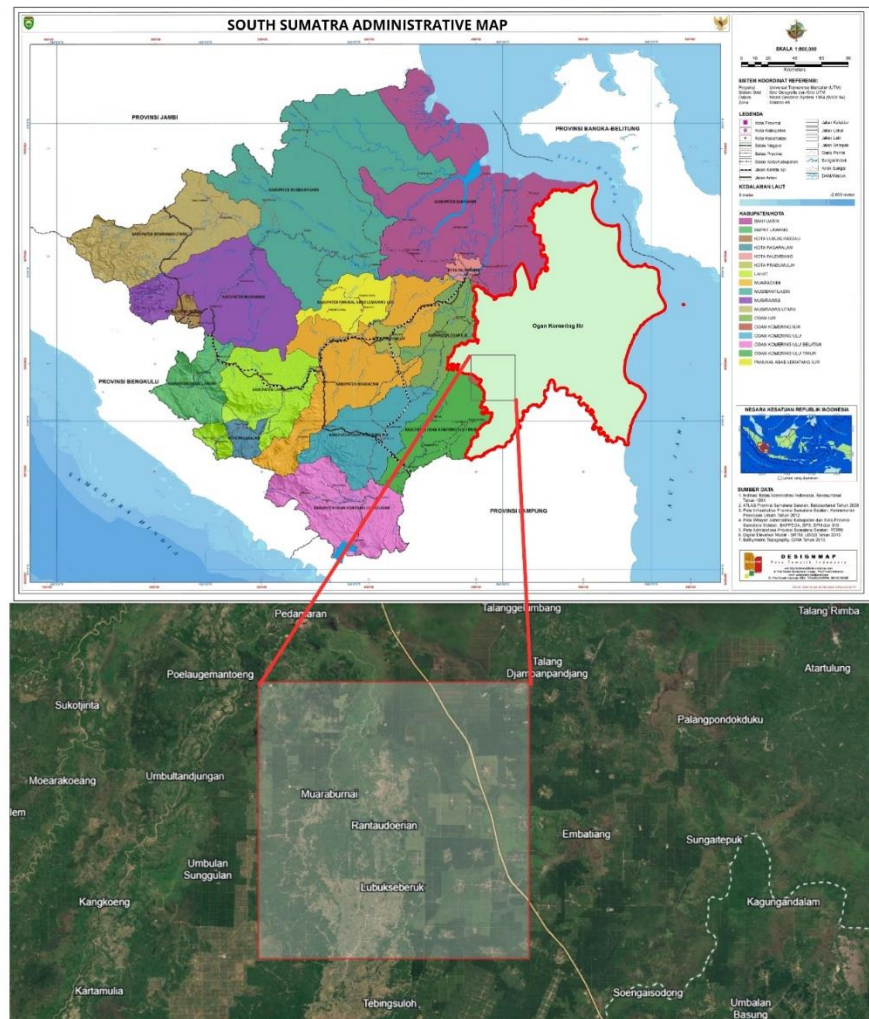


Figure 1. The observation location is located in a lowland with a peat swamp environment.

3. Results and Discussion

There are 12 observation locations spread from north to south in Mulyaguna Village (Figure 2), determined based on the availability of wells used by local residents for daily consumption. This is done to represent the water consumption.

Across the 12 observation locations, the results showed no significant differences in MAT or pH of the water at each location (Table 1). This is due to the proximity of one location to another with similar water quality.

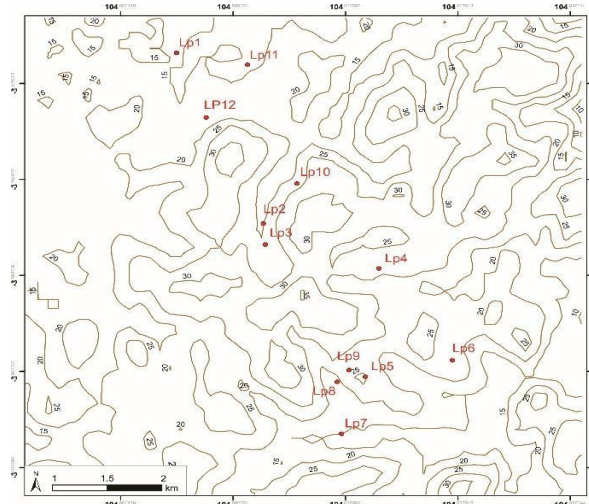


Figure 2. Distribution of groundwater surface locations and water sampling

Table 1. Research location and results of groundwater level and pH measurements

Observation Point	Coordinate	Groundwater level (m)	pH
LP 1	S 03° 34' 027" E 104° 48' 374"	31,85	6
LP 2	S 03° 34' 801" E 104° 48' 419"	33,5	6
LP 3	S 03° 34' 870" E 104° 48' 425"	42,5	5
LP 4	S 03° 35' 932" E 104° 49' 152"	41,5	6
LP 5	S 03° 36' 112" E 104° 49' 115"	43,6	5
LP 6	S 03° 36' 054" E 104° 48' 964"	35,5	6
LP 7	S 03° 35' 905" E 104° 49' 046"	40,3	5
LP 8	S 03° 35' 729" E 104° 48' 633"	44,8	6
LP 9	S 03° 35' 692" E 104° 48' 669"	37	5
LP 10	S 03° 35' 064" E 104° 48' 517"	36,8	6
LP 11	S 03° 34' 444" E 104° 48' 254"	26,2	6
LP 12	S 03° 34' 231" E 104° 48' 170"	26,5	5,5

Groundwater Level

Changes in groundwater levels are generally influenced by several factors, including the underlying rocks of the peat, rainwater, and surface water. At the research site, the underlying rock material of the peat consists of sandstone and siltstone, exposed in wells and rice field irrigation systems around residential areas. During wet months, rainwater fills reservoirs such as lakes and swamps, and irrigation systems, raising groundwater levels. Conversely, during dry months, prolonged dry periods cause surface water to dry out and the groundwater level to drop. Sampling was conducted during dry months, resulting in the groundwater level data shown in Figure 3 below.

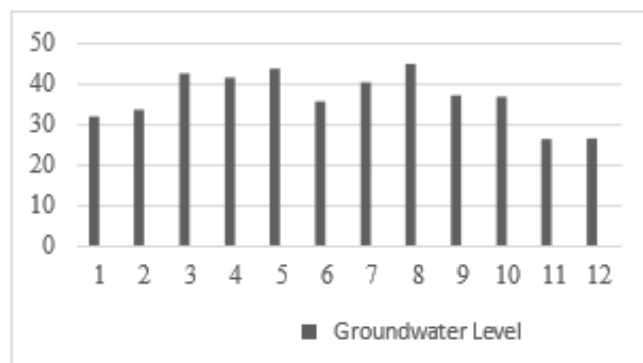


Figure 3. Differences in groundwater levels at 12 groundwater surface locations

Groundwater levels are not correlated with elevation at the location. Figure 4 shows varying groundwater levels at relatively similar elevations. Plotting reveals that the groundwater level becomes shallower toward the north-northwest and relatively deeper toward the south-southeast. This indicates that the shallow groundwater flow is relatively north-northwest.

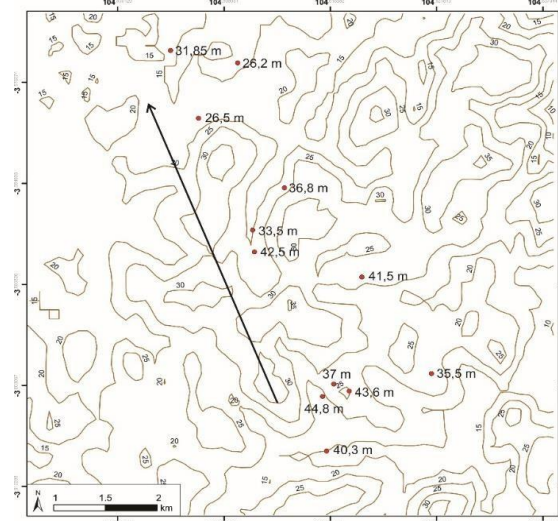


Figure 4. Map of groundwater level distribution

pH of Water

pH is a crucial indicator of water quality for consumption. Water samples taken at 12 observation locations (Figure 5) showed a pH range of 5-6. This is in accordance with the Indonesian Ministry of Health's quality standards, which set the pH threshold for drinking water at 6.5-8.5. This indicates that the water at the research locations does not meet drinking water standards due to its low or acidic pH.

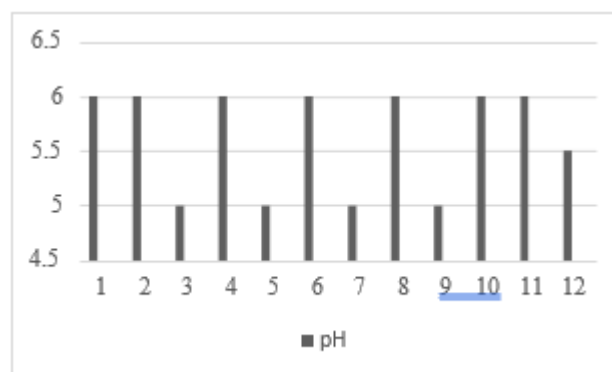


Figure 5. pH of water at the research location

The effect of changes in groundwater levels on water pH is not very significant. As shown in the graph (Figure 6), changes in groundwater levels do not affect water pH. According to Suprihanto (1994) in Suhendra et al. (2012), peat water has a low pH, making it acidic due to its high humic acid content.

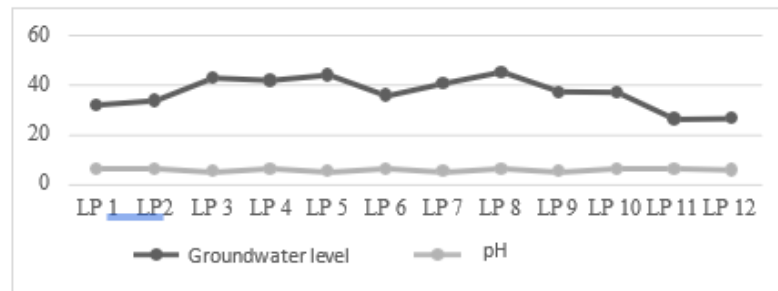


Figure 6. Correlation of Groundwater level and pH of water

4. Conclusions

The research location of Mulyaguna Village, with an area of 25 m² and 12 observation locations, has a shallow to deep groundwater level of 26.2 - 44.8 meters with an average groundwater level of 37 meters, where the direction of shallow groundwater flow is relatively north - northwest and has a pH ranging between 5-6, which is acidic and not suitable for consumption.

5. Competing interests

The authors declare that they have no competing interests.

6. Author's contributions

Luliana carried out data collection, data analysis, and manuscript preparation. Yona Yuwana contributed to study design, data interpretation, and manuscript revision. Both authors approved the final version of the manuscript.

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