Schlumberger's Rules of Geolistric Resistivity Survey for the Study of Ground Water in Agricultural Land Palawija

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Abstract. Marpoyan Damai sub-district has the potential as a palawija agricultural land. The obstacle faced by farmers is the difficulty of getting water when it is dry. Therefore, a study is needed to see potential and presence of groundwater in that location. This study aims to identify the depth of the subsurface structures around the agricultural area. The data were taken from two routes in Marpoyan Damai District, namely at coordinates 0°26'44.232" LU, 101°26'4.866" BT and at coordinates 0°26'44.210" LU, 101°26'4.092" BT. Data processed from the progress software shows that at coordinates 0°26'44.232" LU, 101°26'4.866" BT, there is one aquifer layer in the fourth layer having a resistivity value of 80.76 Ωm with a thickness of 6.52 m and at coordinates 0°26'44.210" LU, 101°26'4.092" BT, there is one aquifer layer in the second layer having a resistivity value of 80.45 Ωm and a thickness of 9.99 m. The lithology data of each path shows the water flow pattern flowing from line one to line two. The results of this interpretation indicate that this research area can be used for agricultural areas.

1. Introduction
The geoelectric method has been widely applied for the investigation of underground water [1], subsurface geological structures [2], subsurface rock types [3], as well as the Investigation of Geothermal. Potential [4]. The development of geoelectric studies is also applied to analyze the potential of a land for agricultural purposes [5].

Surface water systems are almost the same as groundwater systems, having a hydrological system or an input and output system [6,7]. Water absorption from the surface is an input system [8], while springs or water absorption leading to the ocean is an output system. Many of the existing agricultural rice fields use groundwater as a source of irrigation for their rice fields. By doing suction using a borehole. Residents use groundwater by taking shallow groundwater.

Karta ma street, Marpoyan Damai District is one of the areas where most of the population works as farmers. The palawija agricultural lands in the area are located in various places, such as, between residential areas, on the edge of the highway, in the cemetery, and behind the school. Currently, the Peranian land in the area has used many drilled wells which are located in the middle of agricultural land. Drilling wells is one way of taking water from the ground to be channeled to agricultural land when rainfall decreases or the dry season.
The existence of housing, schools and cemeteries around agricultural land also affects the quantity and quality of groundwater in the area. Because the use of groundwater is large from shallow ground water through water that comes out of making wells [9]. The small ditches around the agricultural land have no water because the existing water is directly absorbed by the soil. The thickness of the aquifer greatly affects the available water reserves. The water content contained in the aquifer will increase during the rainy season and will decrease or even not exist at all during the dry season, it is necessary to analyze the thickness of the aquifer on agricultural land in the sub-district of Marpoyan Damai.

The depth of the aquifer can be determined by the resistivity method in order to know the resistivity value of the rock. Each sounding point is correlated with other sounding points in the data obtained so that an aquifer pattern in the area will be formed. After knowing the depth pattern of the aquifer at each datum point so that the distribution of the aquifer pattern is obtained [10]. This research is to make it easier to obtain water sources. Geoelectricity is an appropriate method for detecting groundwater, by detecting rock layers containing water below the ground surface. From the vertical geoelectric survey, information on the state of the subsurface rock layers is obtained, namely the depth, thickness and absorption of rock layers [7]. In this study, geoelectrical measurements of the resistivity of the Schlumberger configuration were carried out [11]. The results of this study can be used for groundwater drilling [12].

2. Methodology
This research was carried out in Kartama street, Marpoyan Damai Subdistrict, Maharatu Village, Pekanbaru City, Riau Province and the data processing was carried out in the Earth Physics laboratory, Faculty of Mathematics and Natural Sciences, Riau University. Geoelectric data measurements were carried out in Marpoyan Damai District, Pekanbaru City using the Schlumberger configuration. There are 2 measurement points with a line length of 100 meters each. The first data processing uses Microsoft Office Excel to determine the geometry factor (K) and apparent resistivity (ρα). Further data processing using software progress v3.0 The research steps are shown in Figure 1.

![Figure 1. Research steps](image-url)
3. Results and Discussion
Line 1 and line 2 are located at the coordinates of 0°26′44.232″ North Latitude, 101°26′4.866″ East Longitude and the coordinates of 0°26′44.210″ North Latitude, 101°26′4.092″ East Longitude, and the stretch direction is successively extending from the south to the north and from the south to the north with a length of 100 meters each. The results of calculations and data processing with software progress v3.0 for the Schlumberger method obtained the Root Mean Square-error values of 9.5969% and 6.8452%, respectively, with a layer depth that was read by the software up to 20 meters and 31 meters, respectively. The modeling of the distribution of the resistivity values of the subsurface material along the successive paths is shown in Figure 2 and Figure 3.

![Figure 2](image_url)

**Figure 2.** The results of modeling the subsurface layers of the earth on line 1

![Figure 3](image_url)

**Figure 3.** The results of modeling the subsurface layers of the earth on line 2

The results of the interpretation of the subsurface lithology of the earth based on Figure 2 can be seen that there are six layers, with a maximum depth of 20 meters. The subsurface layer is generally dominated by sandy layers, from this it can be said that this area has the potential to be developed into agricultural land because it can store water which is very useful for plant growth. The potential depth of this sand starts from a depth range of 0 meters to 2.65 meters, then underneath there is a layer of clay that can function to hold water so that the infiltration process into the soil becomes slow. The depth of this clay starts from a depth of 2.65 meters to 7.85 meters so that this potential can withstand water infiltration longer in the layer to be utilized by plants in the growth process. The potential for this clay is also mixed with sand, especially at a depth of 3.62 meters to 7.85 meters, this can result in...
infiltration of surface water into the soil, so that even this can be utilized by plants to obtain a deeper water system in the process of plant growth. The interpretation results show that the aquifer or shallow groundwater is at a depth of 13.48 meters to 20 meters, this can be used by the community for groundwater extraction for agricultural purposes as well as for daily needs which is called borehole. The complete result of this interpretation can be seen in Table 1.

Table 1. Subsurface geological information based on interpretations of line 1.

| Layer | Depth (meters) | Thickness (meters) | Resistivity (Ωm) | Rock type | Information         |
|-------|----------------|--------------------|------------------|-----------|---------------------|
| 1     | 0.00-0.68      | 0.68               | 637.36           | Sand      |                     |
| 2     | 0.68-2.65      | 1.97               | 145.32           | Sand      |                     |
| 3     | 2.65-3.62      | 0.97               | 15.79            | Clay      |                     |
| 4     | 3.62-7.85      | 4.23               | 118.89           | Clay      |                     |
| 5     | 7.85-13.48     | 5.63               | 197.56           | Sandy clay|                     |
| 6     | 13.48-20       | 6.52               | 80.76            | Sand and Gravel | Aquifer           |

Figure 3 shows the results of the geoelectric modeling of the Schlumberger rule. Based on Figure 3, it can be seen that there are six subsurface geological layers with depth spans ranging from 0.00 meters to 31 meters. The underground water potential under line 2 is less than the information from line 1, this is indicated by the type of lithology under line 2 is dominated by clay. However, the potential for underground water is still available due to the sandy clay conditions, so this area can still be used for agricultural areas, because the availability of groundwater is very good for plant growth.

Geological conditions based on Figure 3 show that the water quality in this area is better than from line 1. The information obtained from Figure 3 shows that the aquifer system is at a depth of 21.01 meters to 31 meters. The depth of the aquifer in the position of line 2 is deeper than line 1 with a depth difference of 11 meters. Information on the results of the interpretation of subsurface geology based on geoelectrical measurements on line 2 is shown in Table 2.

Table 2. Subsurface geological information based on interpretation of Line 2.

| Layer | Depth (meters) | Thickness (meters) | Resistivity (Ωm) | Rock type   | Information         |
|-------|----------------|--------------------|------------------|-------------|---------------------|
| 1     | 0.00-1.57      | 1.57               | 89.06            | silty clay  |                     |
| 2     | 1.57-5.26      | 3.69               | 129.63           | Sandy clay  |                     |
| 3     | 5.26-5.70      | 0.44               | 17.71            | Sandy clay  |                     |
| 4     | 5.70-10.10     | 4.4                | 189.66           | Sandy clay  |                     |
| 5     | 10.10-21.01    | 10.91              | 1233.50          | Dry Gravel  |                     |
| 6     | 21.01-31       | 9.99               | 80.45            | Sand and Gravel | Aquifer           |

4. Conclusion

Based on the results of the measurement of resistivity values at the research site, it is interpreted for path 1 the value of the soil layer ranges from 637.36 m to 80.76 m with a maximum depth of 20 meters and a Root Mean Square-error of 9.5969%. The aquifer layer on line 1 has a resistivity value of 80.76 m and a thickness of 6.52 m. Line 2 has a soil layer resistivity value ranging from 89.06 m to 80.85 m with a maximum depth of 31 meters and a Root Mean Square-error of 6.8452%. The aquifer layer on line 2 has a resistivity of 80.45 m and a thickness of 9.99 m. Line 1 is interpreted as a lithology of sand, clay, sandy loam, and layers of sand and gravel (aquifer). Line 2 is interpreted as a lithology of silt clay, sandy loam, dry gravel (aquifer), and sand and gravel (aquifer). The groundwater
pattern of line 1 and line 2 is located on a layer of sand and gravel, line 1 is located on layer 4 and line 2 is located on layer 4. The results of this interpretation indicate that this research area can be used for agricultural areas.

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