Available online at http://proceeding.rsfpress.com/index.php/ess/index
LPPM UPN "Veteran" Yogyakarta Conference Series
Proceeding on Engineering and Science Series (ESS)
Volume 1 Number 1 (2020): 96-102

Groundwater Prediction Using Pole-Pole Configuration in Batulicin Area South Kalimantan

Ajimas Pascaning Setiahadiwibowo, Muchamad Ocky Bayu Nugroho, Eko Wibowo

Universitas Pembangunan Nasional Veteran Yogyakarta
E-mail address: ajimas@upnyk.ac.id

Abstract

The quality and quantity of groundwater in the Batulicin area decreased since they had a high growth population. The effort to get good groundwater is to predict the aquifer layers in the study area with their carrying depth and lithology. The geoelectricity method using pole-pole configuration was performed to get the resistivity model of fluids and lithology to obtain an overview of the subsurface sections. Aquifers layer was predicted using 2 section model resistivity along 1200 meter intersect each other—the lithology of the aquifer in the research area dominated by quartz sandstone with minor limestone. The aquifer is predicted in 125-175 meters of depth with 10-30 Ohm.m resistivity value. This result could be technical references for good drilling to get good quality and quantity water for the public.

Keywords: Groundwater, pole-pole, geoelectric, Tanjung Formation, Batulicin

I. INTRODUCTION

Uncontrolled groundwater utilization impacting to the quality and quantity of that. The poor hydrogeological system's stability is the decreasing infiltration capacity due to improper land use resulting in a lower groundwater table (Todd,1980). In the Batulicin area, South Kalimantan has a high growth population for three decades earlier. High human activity parallel to high water consumption. To find a good aquifer (Groundwater exploration) can be through several methods, such as the Geoelectrical method that analyze resistivity properties (Hendrajaya dan Arif,1990).

The aim of the study is of this research is to obtain an overview of the subsurface rock layers based on the difference in resistivity value so that it can be known as a water-bearing layer (aquifers) can know the depth and thickness to determine the location of a point groundwater drill. According to (Loke,2004), the resistivity value of groundwater is varying between 10 – 100 Ohm.m. The results of this study are expected to contribute to the community around the research area regarding the potential for groundwater in the form of maps and the distribution of aquifer patterns to support the needs of clean water consumption.

II. LITERATURE REVIEW

Recently, Batulicin Area is located in a coastal area where the fluvial system is dominantly working. The lithology of an area is composed of sandstone and claystone of Tanjung Formation with structure geology dominantly as anticline, syncline, and minor strike-slip fault (Rustadi, et.al.1995)The target of aquifers is quarternary sand and Tanjung Fm. Sandstone with fault and fractures as supported porosity (Figure 1). Basically, the geoelectric method uses the assumption that the earth is an isotropic homogeneous rock. The rock resistivity value obtained at the time of measurement is considered as the actual rock resistivity value. But actually, the earth is a homogeneous anisotropy rock.

The resistivity value at the time of measurement is considered as a *rho apparent* (ρα). At the same time, the actual resistivity value will be greatly influenced by the measurement spacing (Loke, 1999). In order to determine the actual resistivity value below the surface, an inversion of the apparent resistivity value is performed using a computer program.

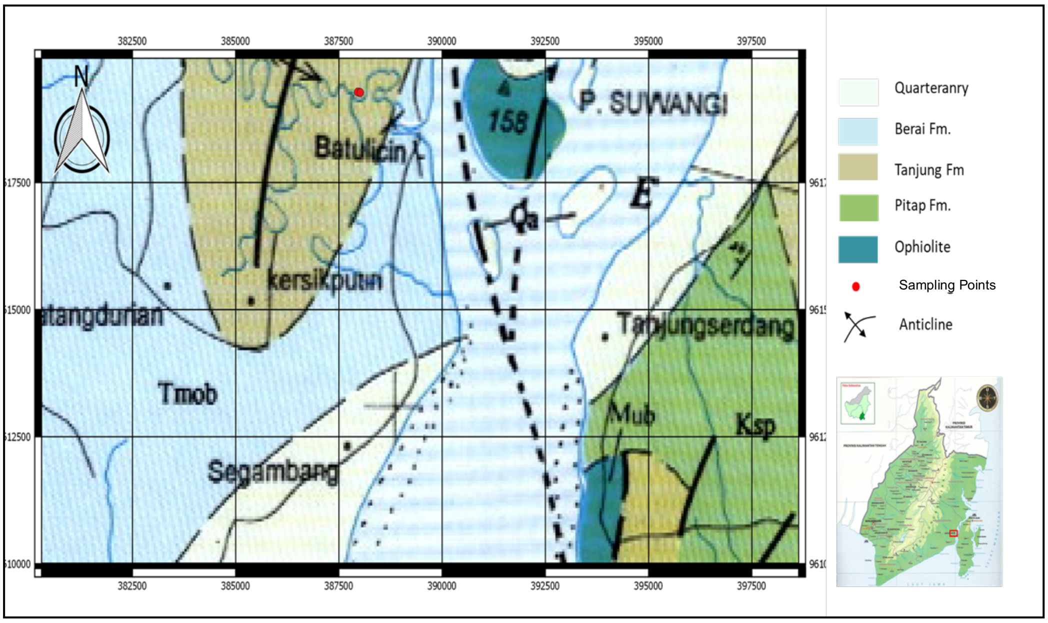

Figure 1. Geological Map of Batulicin Area (Rustadi, et.al. 1995)

Geoelectrical methods are used extensively in groundwater mapping for investigation of the vulnerability of aquifers and shallow aquifers themselves. The vulnerability of aquifers is closely related to the heterogeneity of the clay cap. The clay content of the form defines the electrical formation resistivity, with clayish less permeable formations showing low resistivities and sandy permeable formations showing high resistivities. The geoelectrical method is capable of mapping both low and high resistive formations and, therefore, a valuable tool for vulnerability studies (Christensen dan Sørensen 1998), (Sørensen et.al, 2005). A geoelectrical measurement is carried out by recording the electrical potential arising from current input into the ground with the purpose of achieving information on the resistivity structure in the ground.

The Pole – pole configuration in the resistivity method is a configuration whose measurements have mapping or mapping properties, meaning that two-dimensional components are measured (horizontal distance and depth); this configuration is used in exploration that requires very deep penetration. By using the installation scheme of two current electrodes and two potential electrodes, the two outer electrodes (C_2 and P_2) are installed at least 20 times the space used between C_1 to P_1; this is necessary in order to get a good resolution of the data. The ideal distance will be at the outer electrode, which will allow data retrieval at a great depth (Loke,2004) The primary issue with using the pole-pole array is space—a problem that makes it far less common than both the dipole-dipole array and the pole-dipole array. The two infinity electrodes are stationary, but you need to place them far out in opposite directions, and you may have to get permission to place them on someone else's land. You also have to consider hazards like traffic, creeks, or brush when handling the connecting wire. A large MN may pick up plenty of cultural, SP, and telluric noise.

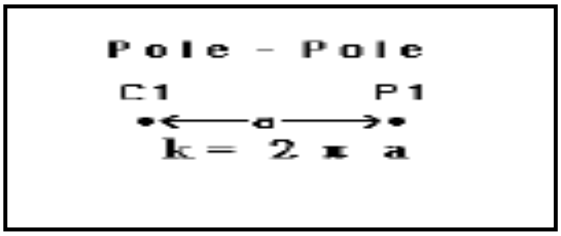

Figure 2. Pole – Pole Configuration (Loke,2004)

Figure 2 showing a way of installing the pole - pole configuration, with the two outer electrodes (C_2 and P_2) statically mounted at a certain distance to get deep penetration. The movement of the two electrodes inside (C_1 and P1) follows the distance adjusted to the data layer taken. Measurement of resistivity with the configuration of the poles also needs to pay attention to the amount of current that is injected into the earth (Loke,2004)

III. RESEARCH METHODOLOGY

The research was conducted in three-stage; they are acquisition, data processing, and interpretation. The acquisition was carried out using the geoelectric method with a total of 2 lines of acquisition that were designed according to geological conditions and surface water. Each line has a 600-meter length with 30 points electrodes. In a pole-pole survey, one receiver electrode is also moved to infinity, but additionally, one of the potential electrodes is moved to infinity in the opposite direction. In other words, in a pole-pole array, you have a stationary infinity electrode on either side of the survey area. The direction of the river and the dip of the rock layers to the west are the basic determination of each point. Data from the acquisition was corrected and processed with the pole-pole configuration. They are building the section for each line and the interpretation of the resistivity value for lithology and aquifer prediction either vertically and horizontally distribution.

IV. FINDING AND DISCUSSION

Quartz sandstone as an aquifer comes from the Tanjung Formation (Todd,1980) which is geologically deposited in a delta environment. These quartz sandstones are known to have good porosity and permeability so that they can be candidates for aquifers. The source sediment from Schwaner complex crystalline rock and distant sediment transport were the determining factors. What needs to be examined in more detail is the continuity of the quartz sandstones, where the deltaic deposits will have lithological variations with claystone. Claystone can be a barrier or breaker of the continuity of the sandstone so that the aquifer has a wide distribution, either vertically or horizontally. The developing geological structure is a large anticline that will form a dip rock layer, which will become a container for groundwater. Secondary porosity and permeability can be found in areas close to faults where fractures are most well developed. The acquisition result data is processed using software, and a cross-section is made in each path.

IV.1. Section Line 1 Pole – Pole

Section 1 has a resistivity value range between 100-2600 Ohm.m, a high resistivity value range at a depth of more than 200 meters is interpreted as dry quartz sandstone and limestone, while moderate resistivity values are interpreted as rocks that have fine and dense grains (mudstone), a low resistivity value below the surface visualized with a blue gradient is interpreted as an aquifer. This section is used to determine the continuity of low resistivity contours, which are also present in the Schlumberger configuration measurement. The depth of the blue closure that is thought to be an aquifer is 125 - 175 meters; this large thickness value is a false thickness value due to poor vertical resolution with the distance between data layers up to 30 meters, so that thin layers (less than 30 meters) between layers will not be detected. Due to this poor vertical resolution, the above section cannot show a low resistivity pattern near the surface (free aquifer).

IV.2. Section Line 2 Pole – Pole

The sections above are used to show the horizontal continuity of low resistivity, which is possible as an aquifer Figure 4. Cross-section 2 has a range of resistivity values ranging from 5 - 100 Ohm.m; the different resistivity value ranges between lanes 1 and 2 are more due to the measurement of the pole path - the first pole measurements are made after heavy rain occurs so that the current injected into the medium will be good. They are continued below the surface without attenuating so that the potential response obtained is greater than the measurement on this second track. High resistivity values at a depth of more than 200 meters are interpreted as dry quartz sandstone and limestone, while moderate resistivity values are interpreted as rocks that have fine and dense grains (mudstone), low resistivity values below the surface visualized with blue gradations are interpreted as aquifers. . The depth of the blue closet that is suspected to be an aquifer is 75 - 175 meters, this large thickness value is a false thickness value due to poor vertical resolution with the distance between data layers up to 30 meters, so that thin layers (less than 30 meters) between layers will not be detected. Due to this poor vertical resolution, the above section cannot show a low resistivity pattern near the surface (free aquifer).

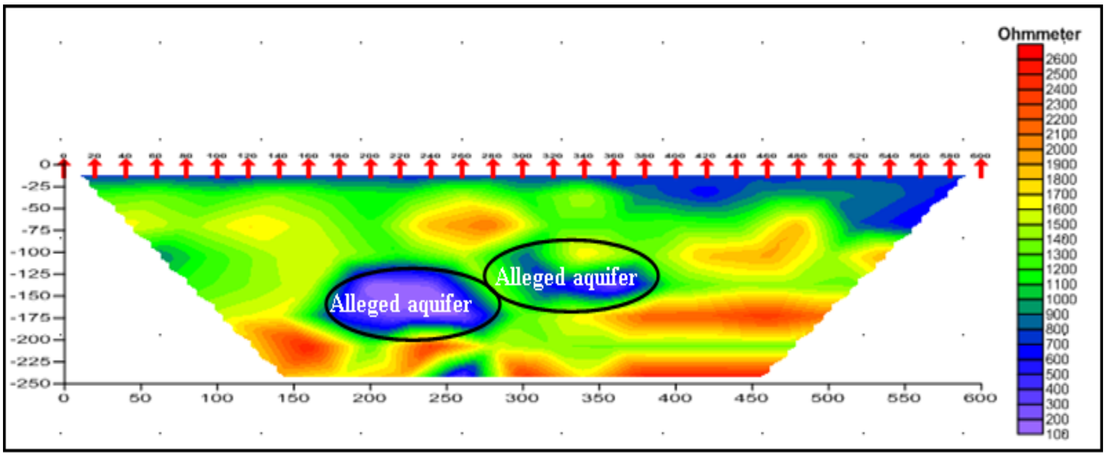

Figure 3. Section Line 1

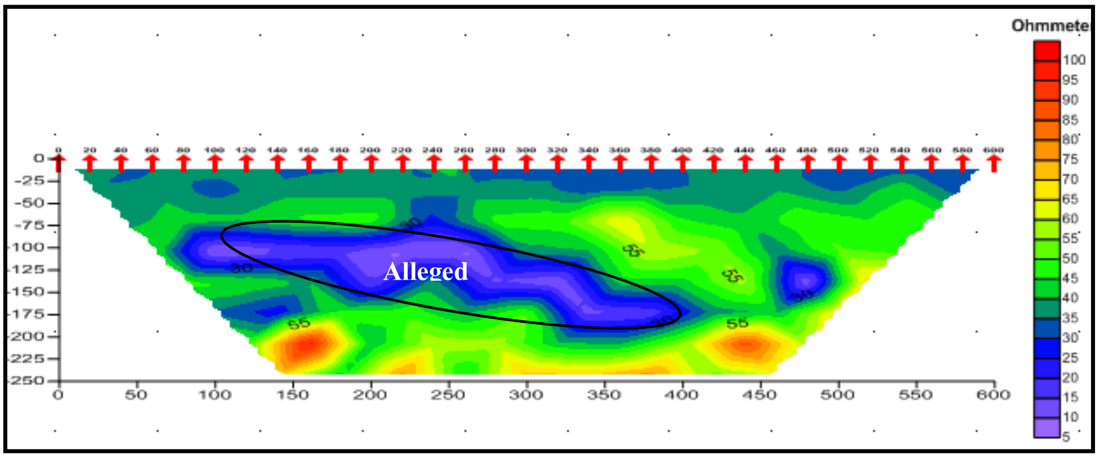

Figure 4. Section Line 2

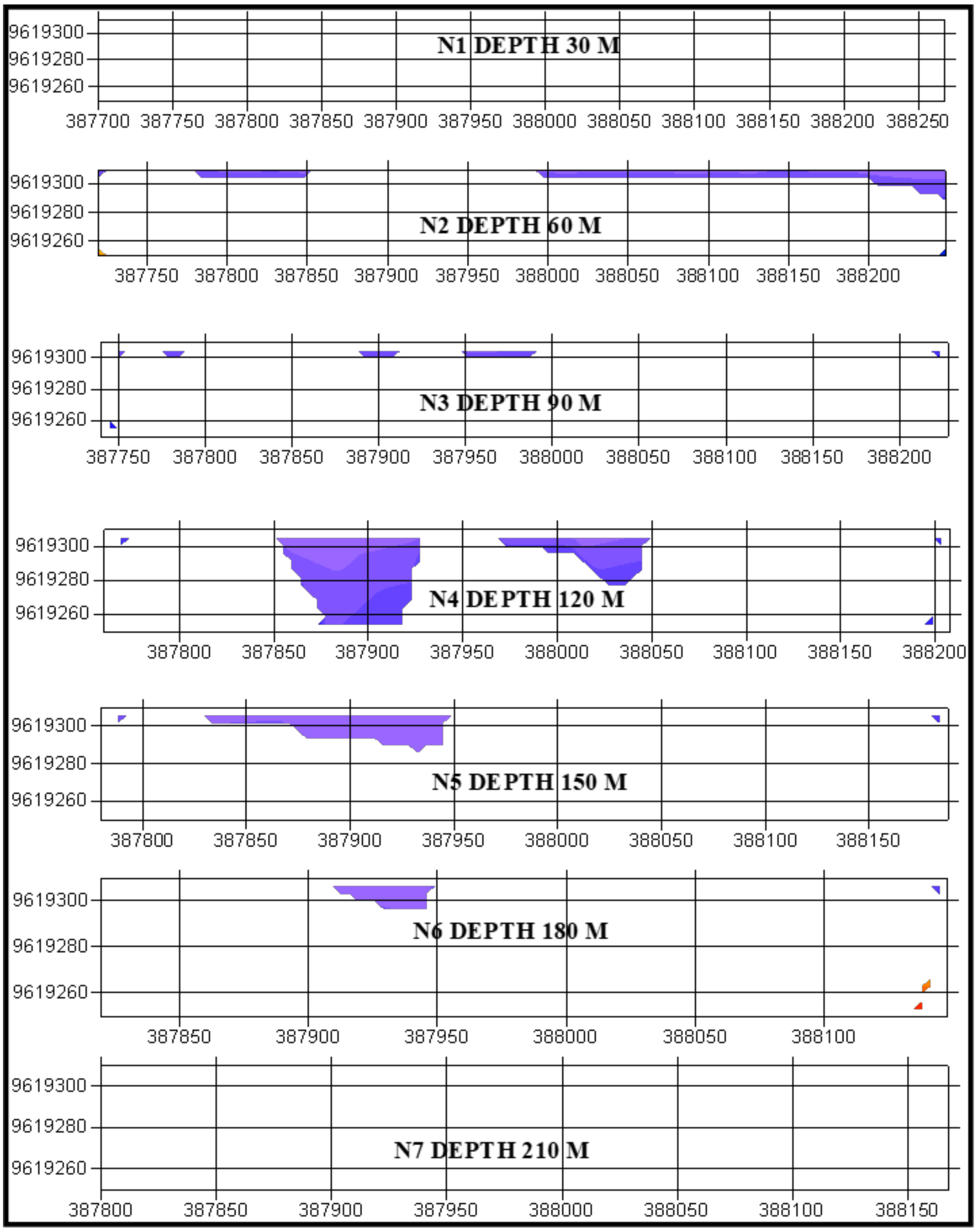

Figure 5. Slicing model pole – pole configuration

Figure 5 is a slicing map of two pole-pole resistivity sections showing the distribution and distribution of the estimated aquifers at the study location, the aquifer distribution at N4, or a depth of about 120 meters, which looks bigger than the slicing at other depths. Cut off resistivity used in the map above is 10 – 30 Ohm.m. The thing to note is that this slicing uses only two pole - pole paths so that the resolution is not maximal.

V. CONCLUSION AND FURTHER RESEARCH

Based on the interpretation, the lithology of the aquifer in the research area is dominated by quartz sandstone, but it does not rule out the form of limestone that had resistivity value between 10 - 30 Ohm.m. According to the results of data processing on the configuration of the poles, it is suspected that there are one base aquifer layer and two confined aquifer layers. The distribution of aquifers based on the results of the pole-pole slicing section shows the aquifer is more developed in the northern part of the area. The recommended drilling point is located on meter 360 from the measurement of the first pole; its due to has a continuity of low resistivity values that are thick and also continuous results from 2D cross-section. The next research could be continuing with the pressure well test and water test.

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