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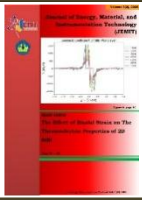

Initial Study of Intrusion on The Serambi Nusantara Coast Using Geoelectrical Methods

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Abstract

The Serambi Nusantara area, based on geological conditions, has alluvial formations with sand that almost dominates, interspersed with clay rock throughout the location with swamp conditions in most parts of the area. Morphologically, Serambi Nusantara is a coastal area. Most of the population in this area uses groundwater to meet their water needs due to the increasing intensity of use so groundwater is decreasing and there is emptiness in the well cavities, this results in seawater seeping from these cavities and mixing with groundwater which causes water problems in this area, especially the salinity of the water quality. This research was carried out to determine the quality of groundwater using the Induction Polarization (IP) method, in the Serambi Nusantara area where the research stage included geological mapping of the area with results according to the description above, checking water quality data and geoelectric measurements of induced Polarization (IP). In the research results, it was found that the cross-sectional chargeability value at a depth of ± 20 m showed low chargeability (-10 msec), indicating an indication of seawater intrusion in the research area. This value is similar to previous research.

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Abstrak

Kawasan Serambi nusantara berdasarkan kondisi geologi memiliki formasi alluvial dengan pasir yang hampir mendominasi disisipin oleh batuan lempung diseluruh lokasi dengan kondisi rawa hampir di sebagian daerah secara morfologi serambi Nusantara merupakan kawasan pesisir. Sebagian besar pendudukk pada kawasan ini penggunaan air tanah untuk memenuhi akan kebutuhan air akibat intensitas penggunaan meningkat sehingga air tanah semakin berkurang dan dan terjadi kekosongan pada rongga-rongga sumur hal ini mengakibatkan terjadi rembesan air laut dari rongga-rongga tersebut dan bercampur dengan air tanah yang menimbulkan permasalahan air di kawasan ini terutama pada kualitas air salinitas. Penelitian ini dilakukan untuk mengetahui kualitas airtanah dengan menggunakan metode Induksi Polarisasi (IP), di Kawasan serambi nusantara dimana tahap penelitian meliputi pemetaan geologi daerah dengan hasil sesuai pemeparan diatas, pengecekan data kualitas air dan pengukuran geolistrik induksi Polarisasi (IP), Pengujian air sumur dilakukan di Sembilan titik dengan hasil yang diperoleh meliputi salinitas, konduktivitas, PH, TDS kemudian dilanjutkan dengan pengukuran geolistrik dengan konfigurasi wenner-schlumberger sehingga. Pada hasil penelitian didapatin nilai chargeability cross-sectional dengan kedalaman ± 20 m yang menunjukkan chargeability rendah (-10 msec) menunjukkan adanya indikasi intrusi air laut pada daerah penelitan, nilai tersebut serupada dengan penelitian terdahulu

1. Introduction

Serambi Nusantara, or what is often known as Penajam, is astronomy located between 116°19'30" and 116°56'35" east longitude and between 00°48'29" and 01°36'37" south latitude. Based on its geographical position, North Penajam Paser Regency has the following boundaries: North – Kutai Kartanegara Regency; South – Paser and Makasar Strait Regencies; West – Paser Regency and West Kutai Regency; East – Balikpapan City and the Makassar Strait (Widjayatnika et al., 2018). The Makassar Strait, which separates Penajam from Balikpapan, means that most of the Serambi Nurantara area is coastal. The Penajam Coastal area is strategic. This will increase the population of

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the Penajam area by 8,806 people by 2022; with a large total population for their own clean water needs, they use groundwater as a source of clean water. Groundwater is the part of water in nature that is found below the land's surface. The formation of groundwater follows the cycle of water circulation on Earth, which is called the hydrological cycle. This natural process occurs in nature and undergoes sequential and continuous movement of places. (Salsabila & Nugraheni, 2020).

Continuous use of groundwater can result in indications of seawater intrusion in Santoso et al.'s research. Due to excessive groundwater extraction, the groundwater stored in the pores of the aquifer layer will be squeezed out, resulting in shrinkage of the layer and causing land subsidence at the surface. (Santoso et al., 2013) Meanwhile, Ashriyati's research stated that if the rate of groundwater extraction from several wells is much greater than the filling, curves of groundwater level decline between one well and another, causing a decrease in the surface level. Groundwater permanently: if this happens in coastal areas, then the decline in groundwater can result in saltwater intrusion (Ashriyanti, 2011). The spread of seawater intrusion can be detected using the geoelectric method, which is based on changes in resistivity parameter values. This method is used to measure the resistivity of rock layers below the ground surface with a Schlumberger electrode arrangement, especially for the initial exploration of groundwater by studying subsurface geology and estimating the quality of groundwater based on resistivity values and electrical conductivity values in rocks, which are strongly influenced by the content. Water in the medium so that the boundary between fresh water and salt water can be determined (Nisa et al., 2012). In research conducted by Muhardi, it was stated that the resistivity value was 0.19 Ωm to 1.88 Ωm and was at a depth of 2 meters to 26.4 meters. The research results also show that the shallow aquifer layer in the research area is under the topsoil and is interpreted as sand, clay sand, and gravel sand. This layer contains groundwater affected by seawater intrusion (Muhardi et al., 2020) in previous research conducted by Ni Nyoman Pujianiki with the results of rock resistivity values measured at the research location for all paths ranging from 0.35 – 1800 ohms. m. This shows that there has been seawater intrusion in the Candidasa Tourism area, namely in areas where the resistivity is 0.5 - 30 ohm.m. (Pujianiki & Simpen, 2018)

In previous research, using the geoelectric method to measure resistivity had weaknesses, where the resistivity value from the measurement results still had a significant rank, and there were obstacles in distinguishing the resistivity value from other materials. So, in this research, the electric method was used by measuring the polarization induction to determine the chargeability value, which is expected to be able to detect it. In detail, there are indications of seawater intrusion. Apart from that, as a reference for the acquisition design, groundwater parameter data taken from wells at several points in Serambi Nusantara were used, where the groundwater parameter measured was salinity. This research hopes a clear relationship exists between the Induced Polarization method and water parameters, especially conductivity and salinity caused by seawater intrusion.

2. Research Methods

This research includes several stages, which include:

2.1 The first stage of taking well water tests

At this stage, well water data was collected from several locations in the research area and then tested using a water checker. The parameters measured included salinity, conductivity, Total Dissolved Solids (TDS), and pH.

2.2 Second Stage Geoelectric Measurement

At this stage, an initial survey of geological data was carried out so that 9 points were outlined on the salinity map, the data obtained from the well data test results were then carried out by making a track for geoelectric measurements. The specifications for geoelectric measurements include surface geological mapping, installing electrodes in a straight line, measuring the distance AB and AB/2 for iron electrode spacing, measuring MN and MN/2 distances for copper electrode spacing, measuring current strength values, potential differences, location coordinates, and measurement directions and calculating factors. Geometry (Ks) and apparent resistivity (ρapparent) can be seen in the schematic of the working principle of a geoelectric device as shown in the **Figure 1**.

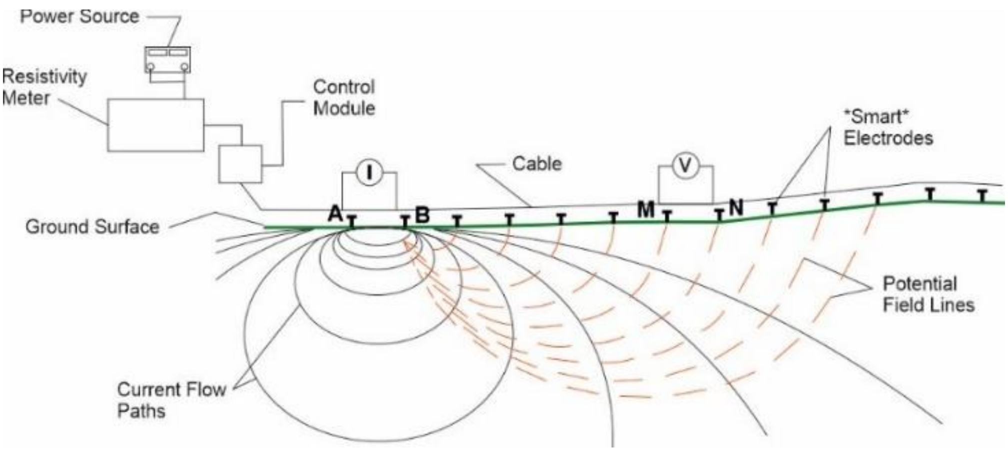

Figure 1. Schematic of the working principle of geoelectricity

2.3 Third Stage Data Interpretation

At this stage, geoelectrical data is interpreted in the form of subsurface chargeability cross-sections, and then, seawater intrusion is identified based on the resulting chargeability values , which are supported by geological data and well-water checking data.

3. Results and Discussions

3.1 Drilled well quality test

Data was obtained from water quality tests with drizzling conditions during water sampling. The test was carried out using a water checker where the parameters measured included salinity, conductivity, Total Dissolved Solid (TDS), and PH, with the results of the retrieval **Figure 2**.

The observation sample data above shows that several areas have salinity, possibly caused by seawater intrusion. According to the Australian EPA SA, the salinity data can be classified into freshwater types ranging from 0 to 1 ppt and brackish water ranging from 1 to 3 ppt, so the measurements can be seen in the salinity contour (Street et al., 2017).

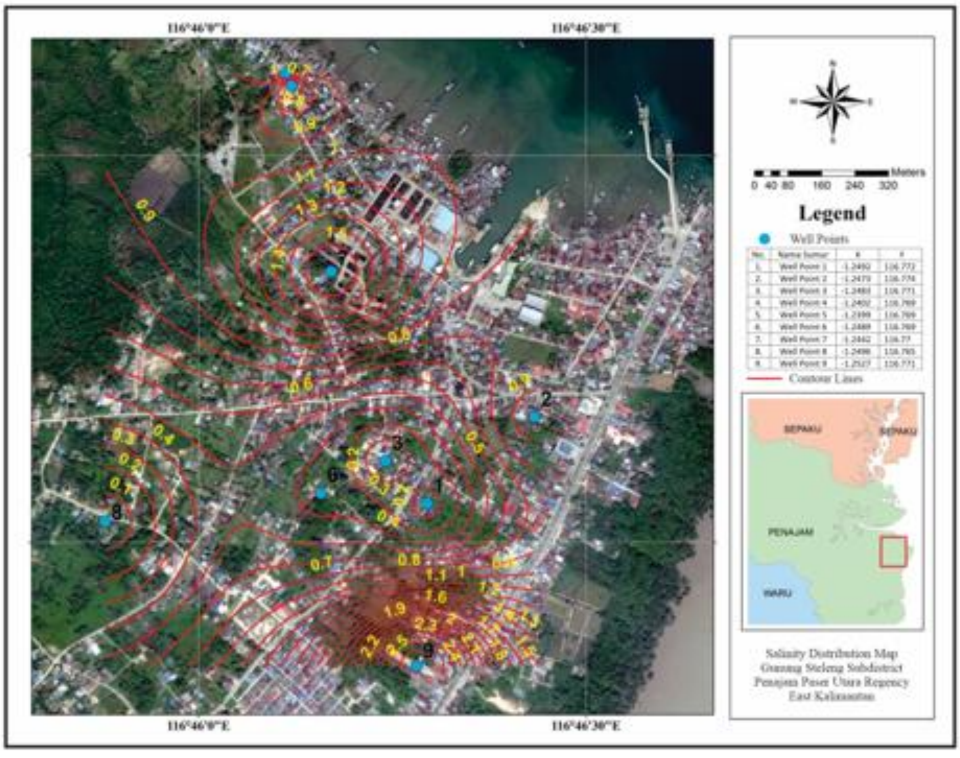

Figure 2. Salinity contour map of the research area

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The salinity map above shows the salinity contours from 9 observation well points with salinity values varying from 0 to 2.57 ppt according to the Australian EPA SA in the previous research area. Suitable ranges from 0.8 to 1, and the unfit group ranges from a value of 1 and above (Street et al., 2017). Based on the data above, it can be stated that the research area has good water quality with values ranging from 0 to 0.5, and above 0.5 is not good.

3.2 Analysis of salinity indications

From the results of the analysis above, we can see in **Figure 3** the measurement results of each charge ability cross-section based on a reference table of charge ability values and drilled well test values , which are then correlated with the geological data of the research area.

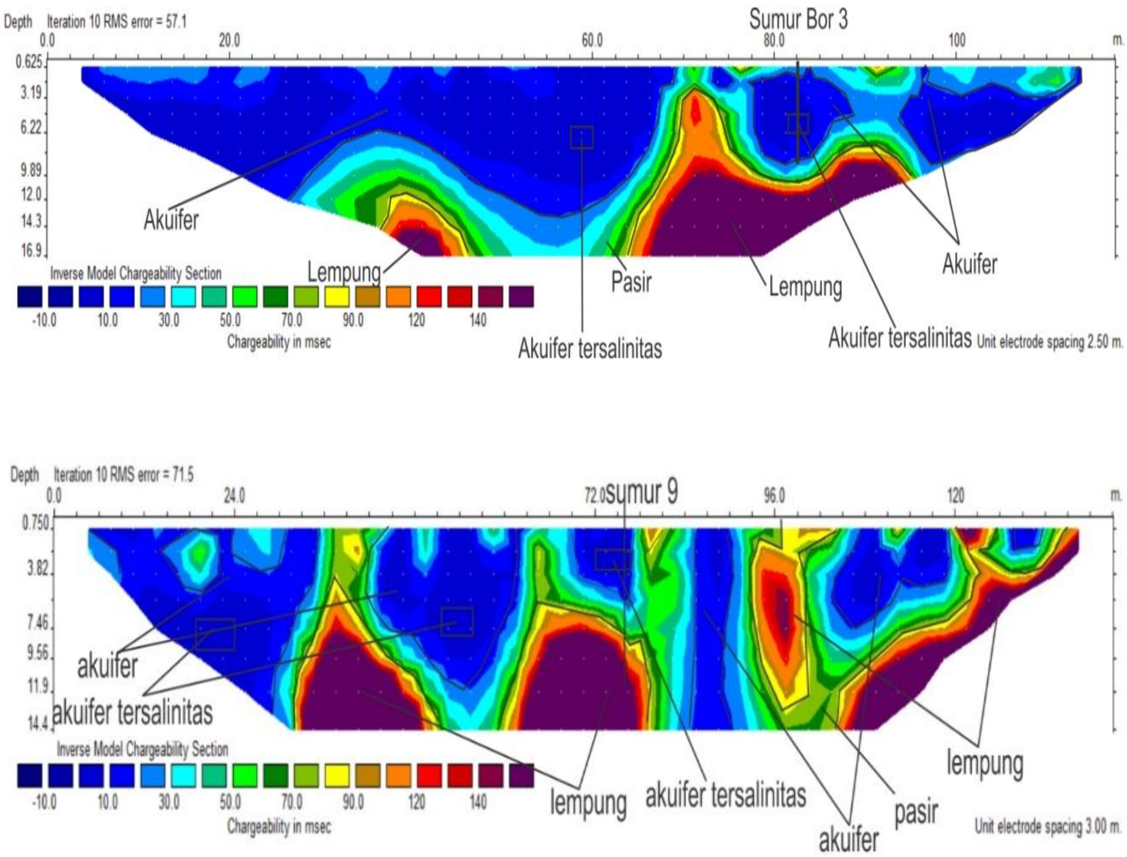

Figure 3. Cross section of Chargeability inversion modeling

The changeability cross-section with indications of rock layers consists of mudstone at a depth of 5.56 to 12 m with a chargeability value ranging from 90 to 140 msec and sandstone at a depth of 0.750 to 14.4 m with a chargeability value ranging from 10 to 90 msec while the indication of the aquifer layer is at a depth of 0.750 to 12 m. with a range of chargeability values -10 to 0 msec. If we look at the rock layer indications, there is a salinized aquifer at a depth of 0.750 to 12 m, which is shown to have negative values ranging from -10 to 0 msec marked in blue if supported by healthy water quality test data in well nine which has a depth of 12 m. with the test results of a Total Dissolved Solid (TDS) value of 2560 and salinity of 2.57 ppt, we can relate this value to the fact that the greater the salinity value, The Total Dissolved Solid (TDS) value will show a significant value, as well as the conductivity value will be high, the type resistance value will be low. This value is the same as previous research (Radityo et al., 2020)

Then, looking at the geological data, the area has a sand layer that dominates; we know that sand is a good aquifer, so there is a high possibility of water in the area and indications of salinity, where the presence of salinity can also be caused by excessive water pumping processes which result in hydrostatic pressure of groundwater. Decreases so that water from the sea will fill the area that was sucked in. If we look at the data above, it can be identified that the area has the potential for salinity and is classified as brackish and in a condition unsuitable for consumption. So, according to the author, with the support of well water quality test data and reviewing geological data, which is then seen from changeability data which shows values of -10 to 0 msec on all trajectories, it can be identified that there is potential for salinity in parts of the Mount Sterling area with a salinity indication depth of ±

20 m which is characterized by low charge ability ranging from -122 to -4.01 in inversion results supported by well test values from the lowest 0.06 ppt and 2.57 ppt with the classification of fresh water suitable for consumption up to brackish water that is not suitable for consumption.

4. Conclusions

In the research area, it was identified that there was moderate salinity with the classification of fresh water to high salinity with the classification of brackish water with the indicated changeability values ranging from -122 to 4.01, which was then confirmed by water quality test data in wells 1 to 9 with water quality test values indicating the presence of low salinity with a test value of 0.06 ppt which is fresh water and high salinity with a test value of 2.57 pp which is brackish water at a depth of 0.625 m to 20 m, this indicates that the Serambi Nusantara area has experienced seawater intrusion.

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