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Research Paper

Study Area Groundwater Potential Coastal Marine By Application Program Ip2win

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ABSTRACT:- Exploitation of groundwater in the Coastal Region Jember-Indonesia increased quite sharply when coastal areas are very vulnerable to sea water intrusion. If this is being neglected will threaten the sustainability of groundwater as well as all existing groundwater become brackish coastal region. In the exploitation of groundwater in the coastal area Jember should first be identified Potential Groundwater flow so that the exploitation or the removal equal to recharge or replenishment. Estimation of the potential for groundwater can be done with a geoelectric measuring method Vertical Electrical Sounding - VES using Schlumberger configuration. The steps being taken in this research is the collection of data, geoelectric measurement, analysis with the help of software IP2Win, geological interpretation of rock, determination and the determination of the potential for groundwater aquifer. From the results of the study showed that the potential for groundwater flow rates in approximately 1477.44 liters / sec through 295 groundwater wells. In order for the preservation of groundwater maintained the utilization of groundwater only for social purposes, education and industry with a maximum of 250 wells groundwater discharge taking an average of 5 liters / sec.

KEYWORDS:- groundwater, region, coastal, discharge

I. INTRODUCTION

1.1.Background

Exploitation of groundwater in the region Jember increased sharply from 800 liters / sec in 2004 to 1600 liters / sec in 2014 (Source: Department of Industry and Trade Jember 2015). Exploitation is done through the drilling of groundwater at some point either by individuals, private and government agencies. As a result, the current trend is a decline in water flow and decrease in groundwater level at some point in the well drilling one belonging taps on the discharge decision Jember 30 liters / sec to 25 liters / sec while the water level decreased to 1.00 meters in 2012 (Source : PDAM Jember in 2012). At this time the tendencies taking groundwater in coastal areas is likely to increase sharply as a result of agricultural activities, fisheries, port and medium scale industries.

In the coastal areas, the number of residential areas residential areas increased from 8 in 2000 to 35 residential areas in 2011 (Source Office of Human Settlements Jember) while the number of educational facilities Educational institutions increased from 20 in 2002 to 102 educational institutions in 2012 . Based on the description above, as a result of exploitation of groundwater will increase whereas coastal areas are very vulnerable to sea water intrusion. If this is being neglected will threaten the sustainability of groundwater as well as all existing groundwater airtanahnya become brackish coastal region so that it can no longer be used for the supply of raw water communities, agriculture and other activities.

1.2. Identification and Problem Solving Plan

In the exploitation of groundwater in the coastal area Jember should first be identified Potential Groundwater flow so that the exploitation or the removal equal to recharge or replenishment. The balance water can lead to the preservation of underground water reserves can be maintained and the impact of drought can be solved. Efforts to estimate the potential for groundwater to be supported by them is the availability of data on potential aquifer as a storage medium in the water under the earth's surface. But until the moment, the potential availability of groundwater stored in aquifers below the surface of the earth in Jember is not well understood, because of the spread and the position and dimensions of the aquifer and the connectivity between aquifers are

not well understood. The geoelectric method has been widely used to estimate soil water bearing aquifers below the earth's surface.

Geoelectric survey can be used to indirectly determine the presence and position as well as the dimensions of the geological material below the surface, for example: the depth of the surface material, the depth of groundwater, fault location, thickness and evaluation of sediment gravel or clay layer (John M. Reynolds, 2003) , Geoelectric method is believed to be the best method in an attempt subsurface hydrogeological investigation. Geoelectric method principle that each has a geological material having electrical resistivity different. Resistivity of geological material is influenced by the ability of the rock to store water, soil water content, porosity and water quality and type of the material itself. Furthermore, the interpretation of the results of the rock conditions to do the estimation of potential groundwater which can then be estimated balance of water, so it can be determined the maximum limit groundwater discharge decision so that the sustainability of ground water can be maintained and protected from the intrusion of sea water.

1.3. Research Purposes.

The objectives of this study are:

a. Knowing the distribution or groundwater conditions zones coastal areas in Jember.
b. Knowing the potential for groundwater availability densely populated areas in the coastal areas in Jember.
c. To identify and study of the total groundwater usage and exploitation of densely populated areas in the coastal areas in Jember.
d. Knowing the water balance and maximum limit exploitation of groundwater thus ensuring the sustainability of groundwater awake and anticipate the intrusion of sea water.
e. As a basic reference in the utilization of space or spatial planning in coastal areas in Jember.
f. As directives in conducting land and forest conservation and preservation of the groundwater at the Watershed in Jember.

II. RESEARCH METHODOLOGY

2.1 Stages of Research

The methodology in this study as follows:

a. Geoelectric survey at some point the observation by the method of Vertical Electrical Sounding - VES using Schlumberger configuration.
b. The collection of maps and geological hydrogeological study area.
c. Processing data from multiple points geoelectric survey observations
d. Geoelectric interpretation results of the investigation with the help of software IP2Win
e. Study of potential groundwater flow using the equation darcy

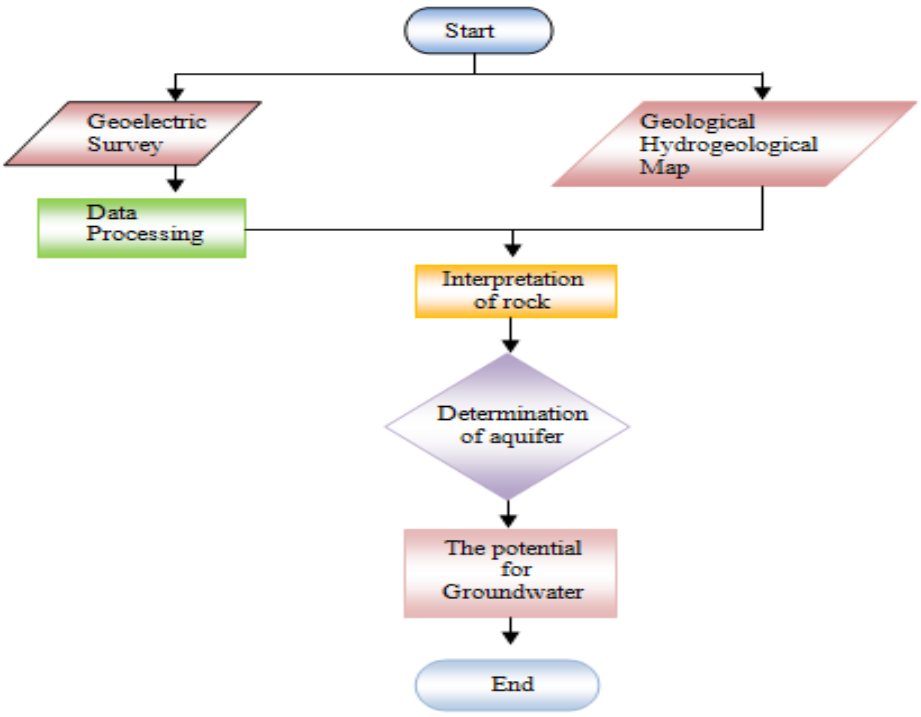


Figure 1. Flow chart of study

In this investigation, will be collected primary data and secondary data. For secondary data include maps of the study area, geological maps and regional hydrogeological maps beach. The primary data obtained by geoelectric measuring method with the method Vertical Electrical Sounding - VES using Schlumberger configuration. This method is used to determine the resistivity value changes for each layer at a measuring point. While the measurement is done by setting up four pieces of electrodes (second current electrode and a second electrode potential) is placed parallel in a straight line. with a wide range / specific spaces. In the data retrieval methods Schlumberger VES this configuration, the equipment used is Resitivity-meter Tigre brand Campus, 4 rool cable with a length of each about 600 meters, current electrode and the electrode potential of each 2 pieces.

2.2. Data processing

Data obtained pitch geometry correction according to the distance / spacing track. And data processing is done using Computational Software IP2Win - Sounding Resistyvity Interpretation of Moscow State University. Results obtained in the form of data processing resistivity value for each layer at certain depths. The field data were obtained from the acquisition process be used as input to the geoelectric processing software. Color image depicting resistivity distribution provides information about the content contained in the subsurface structures. From the results of data processing using software IP2Win be described dispersion lithology and groundwater aquifers using software Rock Work 2006 from Rock Ware Incorporated besides also using this software can get the volume of the aquifer layer, so it can be estimated how much water content.

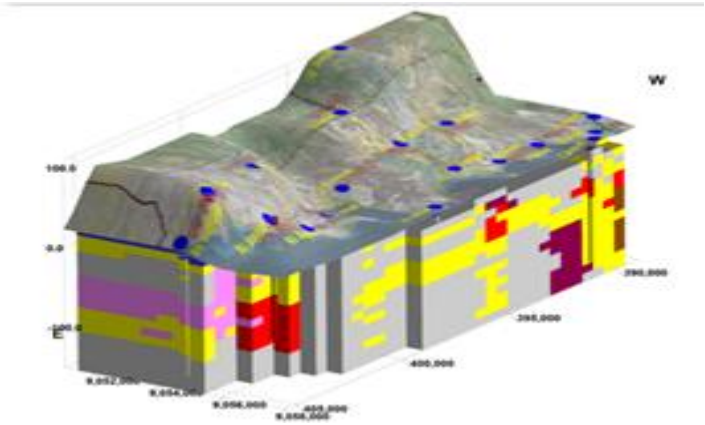


Figure 2. The interpretation of rock 3D Model with IP2Win

2.3. Phase Analysis

Having obtained the distribution of rock lithology and then determined the amount of the potential for groundwater flow. Furthermore, the water balance calculation by comparing the magnitude of the potential for groundwater discharge to the amount of groundwater exploitation needs. The difference is the amount of groundwater reserves threshold amount of groundwater that can be taken.

2.4. Location Research

The research location is geographically located at coordinates 6 ° 27'9 "- 7 ° 17'30" east longitude and 7 ° 59'6 "- 8 ° 33'56" south latitude, while the administration is located in District Wuluhan, District Puger, and the District of Jember Kasian bordering on the south of the South Sea.

III. RESULTS AND DISCUSSION

3.1. Data Retrieval

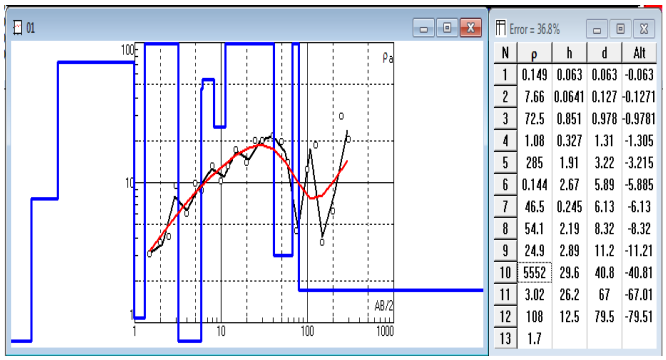
Data retrieval research carried out in the free zone and away from the densely populated area, but the region is still in the urban and the administration section is located in the Coastal Zone Jember. Use tool for estimating groundwater Geolistrik with data processing using software IP2Win. In the estimation using geoelectric tool set estimation at one point by a distance interval data capture at a distance of 25 m, 50 m, 100 m, 200 m and 500 m.

3.2. Data Processing

Based on the value of resistance or barriers of rocks in the area of measurement, can be searched the value of apparent resistivity at the measurement point at a certain depth (as described in chapter review of the literature). Of apparent resistivity values that have been obtained is processed by software IP2Win to obtain resistivity values in each layer in a certain depth. Results of the measurement point data processing using software IP2Win G1 can be seen in Figure 3. In this image value of each layer at each layer of the soil certain

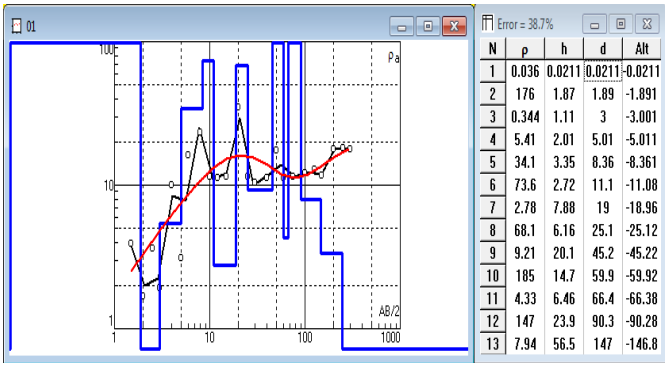
dikedalaman. on the graph shown in 3 colors: black is the measurement data in the field, red is the result of processing synthetic data, and blue is coating at each depth. If the blue color is also on show with figures that are in the right (resistivity in each layer), the numbers show: (layer thickness in each point), and d (the depth of the layer in each point). The values of resistivity or resistivity of each layer obtained will later be interpreted to be a certain rock types.

Point to 1



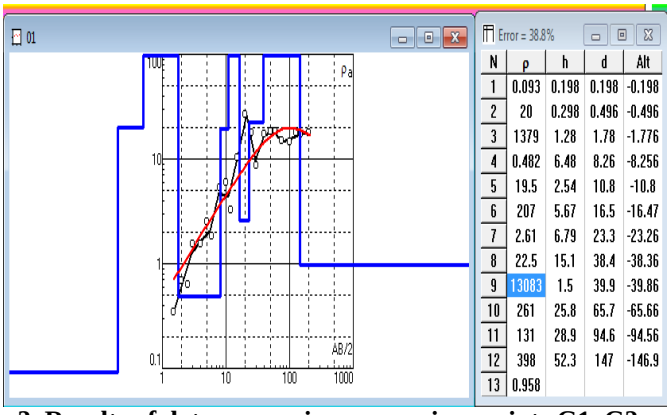
N	ρ	h	d	Alt
1	0.149	0.063	0.063	-0.063
2	7.66	0.0641	0.127	-0.1271
3	72.5	0.851	0.978	-0.9781
4	1.08	0.327	1.31	-1.305
5	285	1.91	3.22	-3.215
6	0.144	2.67	5.89	-5.885
7	46.5	0.245	6.13	-6.13
8	54.1	2.19	8.32	-8.32
9	24.9	2.89	11.2	-11.21
10	5552	29.6	40.8	-40.81
11	3.02	26.2	67	-67.01
12	108	12.5	79.5	-79.51
13	1.7			

Point to 2



N	ρ	h	d	Alt
1	0.036	0.0211	0.0211	-0.0211
2	176	1.87	1.89	-1.891
3	0.344	1.11	3	-3.001
4	5.41	2.01	5.01	-5.011
5	34.1	3.35	8.36	-8.361
6	73.6	2.72	11.1	-11.08
7	2.78	7.88	19	-18.96
8	68.1	6.16	25.1	-25.12
9	9.21	20.1	45.2	-45.22
10	185	14.7	59.9	-59.92
11	4.33	6.46	66.4	-66.38
12	147	23.9	90.3	-90.28
13	7.94	56.5	147	-146.8

Point to 3



N	ρ	h	d	Alt
1	0.093	0.198	0.198	-0.198
2	20	0.298	0.496	-0.496
3	1379	1.28	1.78	-1.776
4	0.482	6.48	8.26	-8.256
5	19.5	2.54	10.8	-10.8
6	207	5.67	16.5	-16.47
7	2.61	6.79	23.3	-23.26
8	22.5	15.1	38.4	-38.36
9	13083	1.5	39.9	-39.86
10	261	25.8	65.7	-65.66
11	131	28.9	94.6	-94.56
12	398	52.3	147	-146.9
13	0.958			

Figure 3. Results of data processing measuring points G1, G2 and G3

3.3. Data Interpretation Geoelectric

Each rock has its own characteristics resistivity values, so rock with one another will have a different resistivity values. By varying the resistivity value of each of these rocks can be used as a reference to determine the specific rock types with specific resistivity value anyway. Data processing using Software IP2Win produce rock resistivity values (soil layer) at a certain depth, the presence of rock resistivity value can be determined what was at one point of measurement.

With rock will be determined location of underground aquifers at one point. Underground aquifers would happen if there was a layer of soil that has a high permeability above or between layers of impermeable. Impermeable soil layers and layers of clay adalahbatuan example that can be drained of water (high permeability) dalah sandstone. Based on the interpretation of each measurement point G1, G2 and G3 can be

seen to have each of which has an error value or a different error levels are: G1 = 36.7%, G2 and G3 = 38.7% = 38.8%. The smallest error at the point G1 while the biggest error in point G3.

Table 1. Results of the interpretation of resistivity value at the measurement point G2

Error = 38.7%

N	ρ	h	d	Alt
1	0.036	0.0211	0.0211	-0.0211
2	176	1.87	1.89	-1.891
3	0.344	1.11	3	-3.001
4	5.41	2.01	5.01	-5.011
5	34.1	3.35	8.36	-8.361
6	73.6	2.72	11.1	-11.08
7	2.78	7.88	19	-18.96
8	68.1	6.16	25.1	-25.12
9	9.21	20.1	45.2	-45.22
10	185	14.7	59.9	-59.92
11	4.33	6.46	66.4	-66.38
12	147	23.9	90.3	-90.28
13	7.94	56.5	147	-146.8

Table 2. Results of the interpretation of the type of rock layers G2 measurement

Resistivity	Depth (m)	Remarks
0.036	0.0211	Top soil
178	1.89	Top soil
0.344	3	Clay
5.41	5.01	Sandy Loam
34.1	8.36	Confined Aquifer
73.6	11.1	Confined Aquifer
2.78	19	Sandy Loam
68.1	25.1	Confined Aquifer
9.21	45.2	Sandy Loam
185	59.9	Bed Rock
4.33	66.4	Unconfined Aquifer
147	90.3	Bed Rock
7.94	147	Sandy Loam

3.4. Hydrogeology Potential Region

Coastal region Jember is pretty much a residential area, educational facilities and expenditures, the number of people in Jember district is also quite large. With a population bersarnya also the accretion amount is certainly need for clean water alone will be massive and will grow. From the information that has been obtained from the Government of Jember Regency, District Wuluhan, Puger and Kasian is an area that is less raw water. Therefore, it is necessary to provide data on underground aquifers that can later be used as a reference for potential groundwater and recommendation if it will do the drilling.

Of the research process in the District Wuluhan, Puger and Kasian Jember Investigating Groundwater Potential to Support Development of Jember region that has been carried out, ranging from the preparation, data collection in the field, and processing the data that has been done has been obtained under the picture surface at any point in the District Wuluhan, Puger and Kasian. Of each picture of the subsurface lithology which have been obtained can be incorporated into the image of the subsurface lithology in the District Wuluhan, Puger and Kasian in two dimensions.

Hydrogeological conditions in the District Wuluhan, Puger and Kasian majority is sandy clay layer and has a free aquifer and stressed that multilayered should this area is an area rich in water, but the water bearing layer in this area is uneven or fragmented in one area (which serves as a water carrier layer is sand). Based on the correlation between measurement data and secondary data obtained, it was found that the water bearing layers (aquifers) with water production was due to the permeability or the connection between the pores in the layer of sand in each District of very different quality between one point to another. At the District Wuluhan, Puger and Kasian is a transition region of the aquifer with high production until the aquifer with production medium. Based on estimated hydrogeological map of water ranges between 5 liters / sec up to 10 liters / sec.

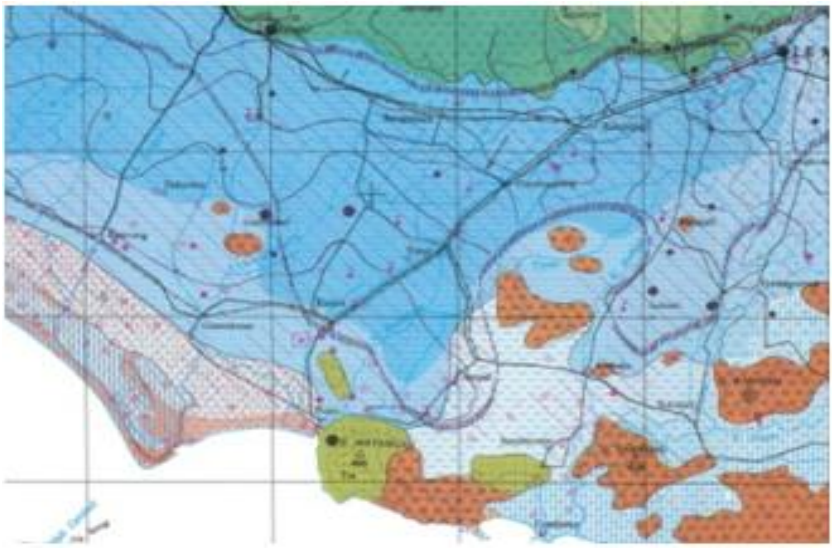


Figure 4. Potential Hydrogeology District of Puger Wuluhan and Kasian

3.5. Water Bearer layer

To describe the condition of the carrier layer or aquifer water is required reconsideration of how and where the groundwater is located, distribution below the soil surface in the vertical and horizontal should be included in the consideration.

Geological zones which greatly affects the groundwater, and its structure in terms of its ability to store and produce water must be identified. Assuming that the hydrological conditions provide water to the underground zone, the underground layers will affect the distribution and movement of groundwater, so the role of geology on groundwater hydrology can not be ignored (Soemarto, 2003). Based on the results and interpretation of geoelectric field estimation result that there aquifer layers are presented in Table 5.

Table 5. The thickness of the layer of water carrier

No	Top Depth (m)	Bottom Depth (m)	Thickness (m)	Remarks
1	8,00	12,00	4,00	Confined Aquifer
2	25,00	55,00	30,00	Confined Aquifer
3	65,00	90,00	25,00	Unconfined Aquifer

3.6. Potential flow rate of land

The magnitude of the potential rate of groundwater can be calculated by the following formula (Bisri, 2003):

$$PA = k. D.L$$

With:
PA = Potential groundwater flow rate (liters / sec)
k = coefficient of soil permeability (m / sec)
D = thickness aquifer layer (m)
L = length of the aquifer layer (m)

The potential for groundwater flow rates are calculated based on test results geoelectric controlled by the hydrogeological map of the area as follows:

PA = k. D.L
$= 1.52 \times 30 \times 10^{-3} \times 32400$
= 1477.44 liters / sec.

IV. CONCLUSIONS

The conclusions that can be obtained from the results of this study are:

a. Distribution or groundwater conditions and potential zones in urban areas in the Coastal Region of Jember Regency is the transition zone of the aquifer into the aquifer with high production medium production, with production capacity of wells up to 10 liters / sec and a minimum of 5 liters / sec.
b. Limitation of the maximum amount of groundwater exploitation in so awake and groundwater conservation anticipates seawater intrusion is approximately 1477.44 liters / sec, assuming a groundwater capture 5 liters / sec in the manufacture of groundwater wells that can be done in the District Wuluhan, Puger and Kasian Jember the maximum is 295 groundwater wells.
c. Patterns of utilization of space or spatial planning in the coastal peisisir Jember associated with groundwater eklpoitasi-zone should consider the production zones of high and low groundwater
d. In order for the preservation of groundwater maintained the proposed groundwater utilization pattern is as follows: The education sector and industry is given permission to land groundwater capture maximum 250 groundwater wells, and if it is not given permission again for taking groundwater. Sector settlement was only given permission to shallow groundwater and the retrieval of the local water company alone.

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