

Magnetic and Gravity Methods to Analysis Geological Structure and Its Correlation to Groundwater Potential Zone in Lebakwangi Kuningan West Java

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Abstract: *Lebakwangi District is one of the subdistricts located in the eastern part of Kuningan city that often have scarcity of groundwater problem. Geological structures encountered in the research area in Lebakwangi District, Kuningan Regency, West Java Province, is a symptom of regional dispersal of structures. The purpose of this research is to know the effect of geological structure on the aquifer in the research location and to analyze the influence of geological structure to groundwater flow in the research location. From Gravity and Magnetic data processing, it can be obtained that there are indication of structure in research location, pattern of structure (fault) and straightness that have direct relative northwest-southeast, which is similar to the pattern of straightness and its regional structure. The recharge zone is estimated to be located in the west of the research location (ciremai mountain area) flowing into the discharge zone in the eastern area (research location) but the difference in groundwater condition is suspected to be related to the presence of existing structures at the study site*

Keywords: Gravity Method, Magnetic Method, Groundwater, Geological Structure

1. Introduction

Kuningan Regency is located on the coordinates of 108⁰23'-108⁰47' East Longitude and 6⁰47'- 7⁰12'south latitude with an area of 1,178.57 km² (117,857.55 Ha). Administratively in the northern part of Kuningan regency is bordered by Cirebon regency in the east, Brebes Regency of Central Java Province, in the south bordering with Ciamis Regency (West Java) and Cilacap Regency (Central Java), and Regency of Majalengka in the west .Kuningan Regency consists of 32 districts, 361 villages, and 15 villages. The landscape of Kuningan Regency is largely hilly and mountainous with the highest peak of Mount Ciremai with 3,078 m elevation.

Water supply system reaches only a small portion of the people of Kuningan Regency. There are still many other people who have not been served so using water resources potluck or even experiencing shortages. Lebakwangi District is one of the districts that often scarcity water especially during the dry season. Lebakwangi District is one of the districts located in the eastern part of Kuningan city. Geological structures encountered in the research area in Lebakwangi District, Kuningan Regency, West Java Province, is a symptom of regional dispersal of structures. The structure of Java Island in general is west-east, the Bogor Zone is restricted by a Northwest-trending fault-based faults. The research area includes the eastern tip of the Bogor Zone which is folded strongly to produce an anticlinorium that trails west-east. In addition there is a fault - a cesarean that causes a shift from anticline axes and occurs after the deposition of Halang Formation.

Geophysical method is the study of the earth by using physical measurements on the surface of the earth. Geophysicists study all the earth's contents both visible and not directly visible by measuring physical properties with adjustments generally on the surface [3].

Geophysical methods commonly used for groundwater exploration [1] [2] [3][5][7]. This effectiveness can reduce cost for exploration.

Groundwater exploration is one of the solutions to the problems mentioned above, but the lack of data on the groundwater resources in Kuningan District becomes one of the obstacles, therefore the estimation of the potential of ground water resources in Kuningan Regency is needed as a reference for the development of groundwater resource potential InKuningan Regency in the future

The purpose of this research is to know the correlation of geological structure to aquifer in the research location and also to know the relation of geological structure to groundwater flow in the research location.

2. Theory

Regional Geology

The area of Kuningan Regency is largely composed of sedimentary and volcanic rocks, the rest being alluvium deposits that have been deposited since the Miocene. Stratigraphically and grouping from old to young, the rock consists of a Pemali Formation with a thickness of 500 m spread over the southwest and southeast; Formation

Rambatan with 300 m thick, narrow spread in the south; Formation of Lawak with 150 meters thick, spread in the east; Formation Beetles with thickness close to 2000 m spread in the south; Halang formation with a thickness of more than 400 meters, spread over the south and east; Members of LebakwangiHalang Formation with narrow spreading in the center and southeast; Members of Mount HuripHalang Formation with thickness 200 - 400 meters spread in the southwest; Ciherang Formation scattered in the north and center; Gintung Formation with thickness of 800 meters spread in the north; Cipedak Lahar sediment which is estimated as a result of the eruption of old Ciremai Mountain, spread in the middle around the valley of the river Cisanggarung; The results of the undiminished Old Fires are scattered in the north and south of Mount Ciremai; Breccia The result of the Old Firm spreads extending from the west to the middle; Lava Result of Old Fires scattered in the northern and southern slopes of Mount Ciremai; Unexplained Young Lava Lava that spreads in the west to the middle; Lava Young Apes are spread sporadically in the east and south; River steps with a thickness of less than 20 meters, spread over the east; Alluvials are sporadically scattered around the Darma Reservoir, the Cisanggarung River valley, and the Cijangkelok River valley [12].

Gravity Method

The gravity method is a geophysical exploration method based on the gravity anomaly of the earth field due to the variation of rock mass density in the lateral and vertical direction below the measuring point [9]). The gravity on the surface of the earth shows the magnitude of the attraction of anomalous objects beneath the surface in the direction to the center of the earth and is a derivative of the force generated through Newton's law.

Magnetic Method

In this Magnetic method, the earth is believed to be a gigantic magnetic rod where the earth's main magnetic field is produced. The earth's crust produces a magnetic field much smaller than the magnetic field generated by the earth as a whole. The observation of magnetic fields on certain parts of the earth, usually called magnetic anomalies affected by the susceptibility of these rocks and magnetic remanen. Based on the magnetic anomalies of these rocks, the approximation of the rock distribution is mapped either laterally or vertically.

Groundwater

Groundwater is water that lies in the subsurface below the ground. The depth of groundwater in each place is not the same because it is affected by the thickness or thinness of the surface layer above it and the groundwater layer [10] [11].

3. Methods

3.1 Data Acquisition

A. Gravity

Data collection is done throughout the study area, with points that resemble the track grid (see figure 1.)[9]. These paths are selected to determine the subsurface sections produced in the research location.

B. Magnetic

Data collection is done throughout the study area, with points that resemble the track grid (see figure 2.)[9]. These paths are selected to determine the subsurface sections produced in the research location.



Figure 1: Gravity measurement point

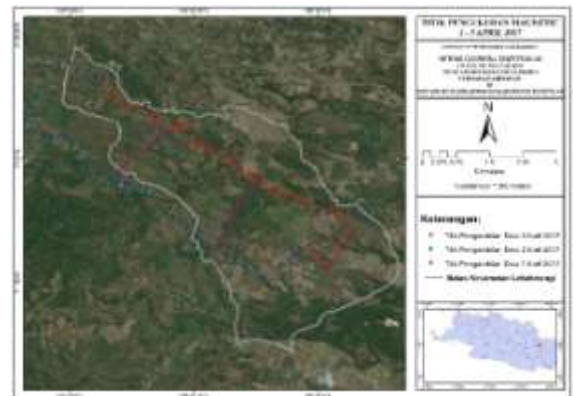


Figure 2: Magnetic measurement point

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3.2 Data Processing

A. Gravity

After obtained the necessary data, then performed data processing. Processing on gravity data is done by performing correction on field data that has been obtained. Further analysis is done using Oasis Montaj software To find out the subsurface condition of Gayaberat survey result data.

B. Magnetic

After obtained the necessary data, then performed data processing. Processing on magnetic data is done by performing correction calculations on field data that has been obtained. Further analysis is done using Oasis Montaj software To find out the subsurface condition of magnetic survey result data.

4. Result and Discussion

A. Gravity

after obtained the necessary data, then performed data processing. Processing on gravity data is done by performing correction-correction on field data that has been obtained. Next is filtered using Oasis Montaj software To find out the variation of gravity anomaly from Gayaberat survey result data.

The results of data processing shows data anomaly bouguer quite varied. The bouguer anomaly value in the study area ranged from 106 mGal - 162 mGal. Regions with low bouguer values are located in the northeast of the study area, marked by a purple to blue value, while regions with high bouguer values are in the southwest of the study area. High bouguer anomaly values in the southwest region are thought to be derived from tertiary-tertiary rocks that are the basement of the study area.

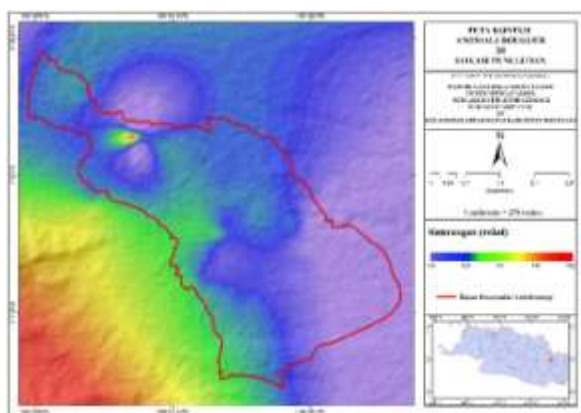


Figure 3: Bouguer Anomaly map of Study Area

B. Magnetic

After obtained the necessary data, then performed data processing. Processing on magnetic data is done by performing correction calculations on field data that have been obtained. Next is filtered using Oasis Montaj software To find out the magnetic anomaly variation from Gayaberat survey result data.

The results of data processing shows the value of the total magnetic anomaly is quite varied. The total magnetic anomaly value in the study area ranged between -300 - 200 nT. Regions with low magnetic anomaly values are located in the southwest of the research area, characterized by purple to blue values, while areas with high total anomaly magnetic values are in the northeast direction of the research area. The low magnetic anomaly value in the southwest region is thought to be derived from tertiary tertiary rocks that are the basement of the study area.

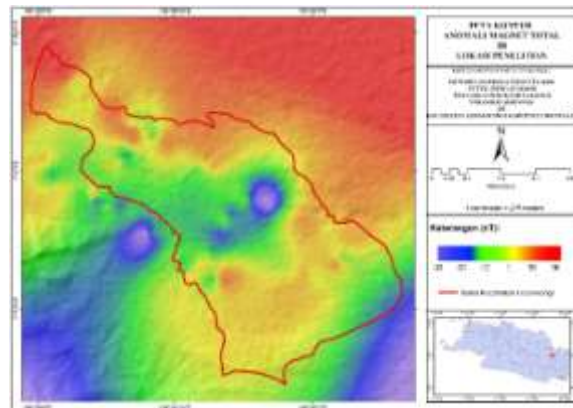


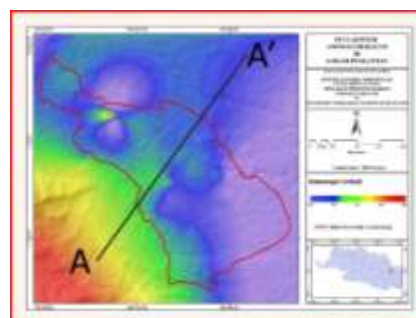
Figure 4: Magnetic Total Anomaly map of Study Area

The results of data processing shows the value of the total magnetic anomaly is quite varied. The total magnetic anomaly value in the study area ranged from -300 - 200 nT. region with a low magnetic anomaly values are in the southwest area of research, characterized by values of purple to blue, while the region with the high value of total magnetic anomaly located in the northeast area of research. The low magnetic anomaly value in the southwest region is thought to be derived from tertiary tertiary rocks that are the basement of the study area.

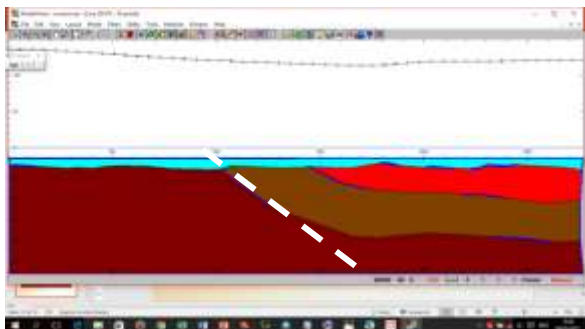
From the two data above can be known in the study area there is a geological structure in the direction of regional geological structure that is northwest-southeast direction. The line of this structure is as if by separating the block located in the southwest with the northeast of the research area. The northeast block is thought to be a foot wall block while the block to the southwest is a block of hanging wall.

Southwest region comprising tertiary sedimentary rocks that experienced the rapture is thought to be the region with very little groundwater availability, this is because the porosity and permeability of the Tertiary age rocks are very small. Meanwhile, the area in the northeast is thought to consist of quarter-aged rocks at the top while in the basement consist of tertiary-tertiary rocks. This area has great groundwater potential.

Recharge zone is located in the western part of the study site (Ciremai mountain area) to flow toward the discharge zone in the eastern area (the study site) but the difference in conditions where groundwater allegedly linked to the presence of the existing structure in the research area.



(a)



(b)
Figure 5: Cross Section (a) Cross section A-A' (b) Geological Structure i.e. Fault structure in study area

5. Conclusion

From result of Gravity and Magnetic data processing, can be obtained information that there are indication of structure at research location, pattern of structure (fault) and alignment that have direct relative northwest-southeast, which is almost same with pattern of alignment and its regional structure

The recharge zone located in the west of the research location (ciremai mountain area) flows towards the discharge zone in the eastern (research site) but the different groundwater condition is thought to be related to the presence of existing structures at the study site

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