

Groundwater Characterization of Cihaur Watershed Basin, Batujajar and Adjacent, West Bandung District, West Java, Indonesia

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Abstract. The study was conducted based on data from outcrop, well data, and springs with field orientation method assisted by the use of GPS and measurement tool physical and chemical properties of groundwater. Geological conditions investigated were geomorphology and stratigraphy, geomorphology unit study area consists of four units, namely geomorphology unit of strato volcano body, foot of strato volcano, intrusion units, and plains units and the river drainage patterns are parallel and sub-parallel. Stratigraphy in the study area are volcanic breccia (Qbv), Unit Andesite (Qa), Unit Tuff (Qtf) and Unit Clay Tuffan (Qlt). The characteristics of the groundwater of the study area are in form of the physico-chemical, major elements, and hydrolic parameter of the groundwater aquifers. From 27 locations, the water quality assesment by physico-chemical properties is classified as fresh water category and based on chemical major elements, has been classified 8 facies which are located in the study area. Then, there are two lithologies which act as aquifers ie, tuff and volcanic breccias. Conductivity values in the range of volcanic breccia aquifers respectively 0,128 m/day and 0,288 m/day, transmitivity (T) ranges respectively 1,9296 m²/day and 4,32 m²/day. The value of conductivity in tuff aquifer is 0,063 m/day, transmitivity (T) is 0,95 m²/day. While lithology Qlt (Clay tuffan) is lithology with very low productivity of groundwater or called groundwater rare area (akiklud) and the rock units Qa (Andesite) is a non-aquifer that is the absence of groundwater in these rock units (akifug).

1. Introduction

The need for water resource increases with the times. The use of groundwater increases due to the contamination of surface water. Therefore, the need for in-depth study on the state of subsurface water/groundwater is very important to support the management of water as part of the planning area. In order to know the geological conditions of the research area for the determination of the aquifer typology, the hydrogeological conditions of the study area and the potential of ground water in the area of research.

2. Methodology

The research area is located in Cihaur watershed basin, District Ngamprah, Batujajar, West Bandung Regency. This is an area with abundant groundwater resources, and the area is also deserves to be the area of research on the potential for groundwater around its watershed and surrounding areas. Research is done using Geological Mapping guide in order to assess the geological condition include geomorphology of study area. There 22 locations of wells and 5 location of springs are used as data manifestation of groundwater. Then, physico-chemical properties are known by measurement using a Hanna Multiparameter Probe on these manifestation of groundwater. Physical and chemical properties



of groundwater is measured in the form of EC (Electrical Conductivity), TDS (Total Dissolve Solid), pH, and water and air temperature (in degrees Celsius). The method which used in determining the parameters of groundwater hydraulics, such as transmitivity and conductivity is Neuman Method Wave-Fitling [1] and [2] from drawdown pumping data with the criteria of the single well, unconfined aquifer and the calculation of T (transmitivity) is not required observation wells.

3. Result and Discussion

The results of this study are the details of geological and geomorphological data on the research location. These data will help to analyze and interpret the condition of the groundwater at the site along with the study of physical and chemical components of groundwater itself.

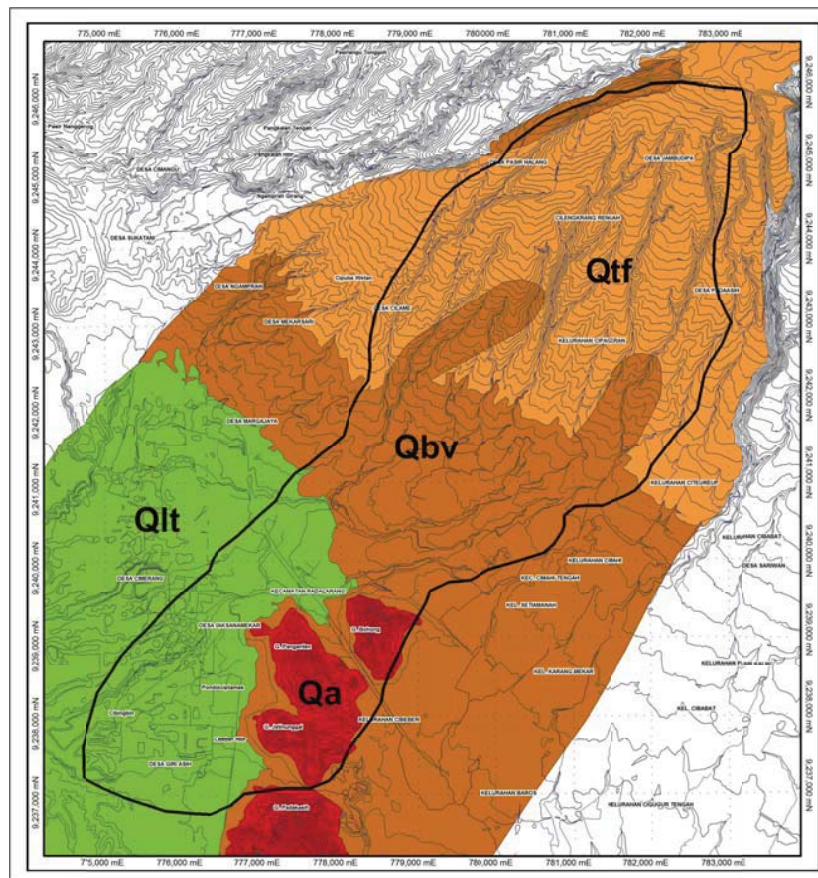


Figure 1. Geological Map of Study Area

3.1 Geomorphological and Geological Condition

The study area has a height of between 630 - 1250 m above sea level. Based on the classification slope [3] study area has a slope between 0-140%. From the data obtained, the study area is largely a volcanic morphology, consisting of mountain slopes and there are estimated lacustrine plain. Geomorphology unit division based on differences in morphography aspect, morphometry aspect, lithology properties (including facies), and geological structure in the form of activity of endogenous and exogenous, so that the unit geomorphology study area is divided into; Unit Geomorphology of Strato Volcano Body, Strato Volcano Foot, Intrusion, and Plain.

In general, the rocks in the study area consists of volcanic rocks that make up the body of volcanoes. Based on field data conducted by the Laboratory of Hydrogeology and Environmental Geology, University of Padjadjaran and compared with Regional Geological Maps of Bandung sheet by [4], in order to formed the unofficial naming of these lithologies, outside of lithostratigraphy and litodemik rocks units can be interpreted that existing lithologies research areas with the sequence of the oldest rocks to rock the youngest, namely: Unit Volcanic Breccia (Qbv), Porphyry Andesite (Qa), Unit Tuff (Qtf), and The Deposition of Lake (Qlt).

Table 1. Physico-chemical data of study area

Code	pH	TDS (mg/l)	EC (Imhos/cm)	Elevation (mdpl)	Water Temp (°)	Air Temp (°)	Type
MA-1	6.2	30	80	1195	20.8	28	Spring
MA-2	6.3	110	240	1187	23.6	26	Spring
MA-3	5.6	70	160	1174	24.7	25.5	Spring
MA-4	5.4	80	170	952	24	27.5	Spring
MA-5	6	160	220	867	25.4	28.3	Spring
SM-1	-	-	-	1175	-	-	Dug Well
SM-2	6	170	370	1074	26.2	27.1	Dug Well
SM-3	5.6	90	210	1072	23.3	27.1	Dug Well
SM-4	5	50	140	794	31.7	32.7	Dug Well
SM-5	5.4	200	420	780	25.5	25	Dug Well
SM-6	5.7	240	510	778	24.3	25	Dug Well
SM-7	6	160	340	773	24	25	Dug Well
SM-8	5.5	70	160	793	24.4	25.9	Dug Well
SM-9	4.5	180	370	843	24.8	26.6	Dug Well
SM-10	6.4	220	460	739	24.3	26	Dug Well
SM-11	6.4	230	470	747	25	31	Dug Well
SM-12	6.2	250	440	738	24	28	Dug Well
SM-13	5.8	130	270	747	25.1	27.9	Dug Well
SM-14	6.3	270	560	703	24.4	27.7	Dug Well
SM-15	5.7	440	890	699	24.4	26.7	Dug Well
SM-16	5.7	270	570	750	25.2	28	Dug Well
SM-17	5.3	60	340	853	24.7	30	Dug Well
SM-18	5.9	180	390	822	24.9	27.5	Dug Well
SM-19	5.9	220	450	817	28.5	29	Dug Well
SM-20	5.9	-	-	722	-	-	Dug Well
SM-21	5.7	650	1320	827	24.8	26.2	Dug Well
SM-22	5.8	80	190	831	24.9	26	Dug Well
SM-23	6.3	200	420	735	24.7	24.8	Dug Well

These are primary data which obtained from direct measurement from the 27 locations of the research area used a Hanna Multiparameter Probe instrument.

3.2 Groundwater Characterization

In this study, the parameters are classified is a major chemical element that is (Ca, Mg, Na, K, HCO₃, SO₄, Cl) and physico-chemical parameters such as pH, electrical conductivity (EC), total dissolve solids (TDS). From these data can be analyzed descriptively about groundwater characterization. On springs and wells, based on the classification [5] classified the water quality fresh water category (for TDS value 0 - 1000g / m³) and also classified as fresh water (for grades DHL 30-2000μS).

Table 2. Major chemical elements of study area

Code	Converted Laboratory Result (meq/liter)						
	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄
SM-02	1.9755	0.9082	0.1352	0.2337	1.6782	1.2890	0.0922
SM-05	2.1572	0.9263	0.0833	0.5420	2.2268	0.9331	0.4095
SM-09	1.6367	1.2307	0.0615	0.3122	1.9241	1.1931	0.3419
SM-11	2.6008	0.7213	0.3770	0.2466	2.6884	0.8781	0.8780
SM-12	2.2984	0.6747	0.5463	0.1186	3.6041	0.4048	0.7726
SM-15	3.6692	2.2602	0.7946	0.3144	3.2571	3.7523	0.7947
SM-16	2.1367	1.6774	0.0891	0.8711	2.3272	2.0785	0.5143
SM-19	1.8144	1.0678	0.0720	0.8011	2.0183	1.4337	0.6263
SM-21	4.6158	4.2530	0.2514	2.2185	3.0877	4.9530	2.3402
SM-22	0.8263	0.6433	0.0581	0.2197	1.4509	0.3156	0.0421
MA-3	0.6048	0.6655	0.0691	0.1594	1.2857	0.3086	0.0581
MA-5	0.8668	0.4854	0.0534	0.1959	1.4004	0.2950	0.0473

These are primary data which obtained from the 12 locations of the research area and used bottles as samples, then analyzed in chemical laboratory.

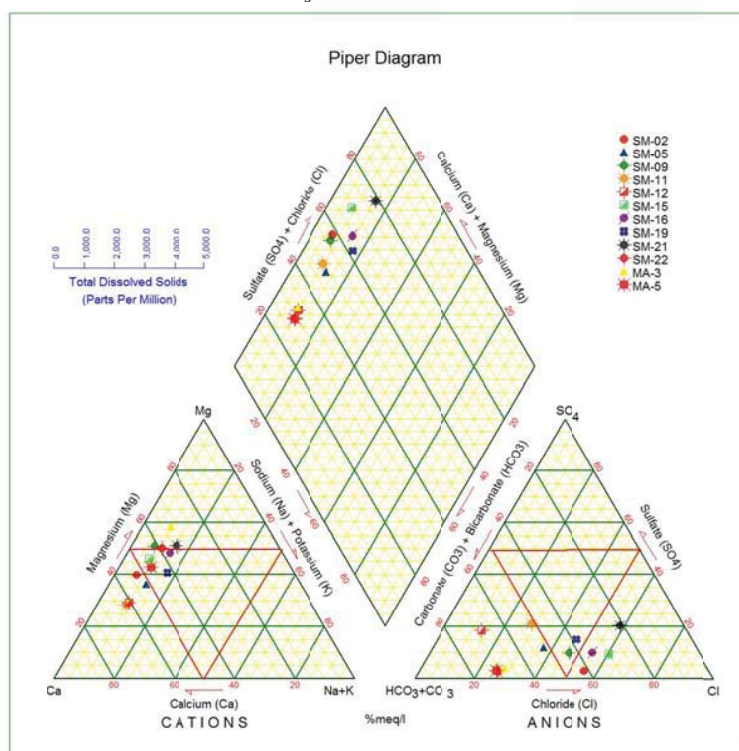


Figure 2. Modified from Piper Diagram [4] show chemical facies of study area used major elements

3.3 Major Elements

Based on the analysis using the piper diagram [4] from chemical major elements plotted, chemical facies in the study area can be grouped into 8 (eight) facies is based determination of anions and cations, namely: Facies of Calcium Chloride, Calcium Bicarbonate, Magnesium and Non dominant, Non Dominant and Chloride, Non Dominant, Magnesium Chloride, Magnesium Bicarbonate, and Non Dominant and Bicarbonate.

3.4 Hydrolics Condition of Groundwater Aquifer

Hydraulic parameters of the aquifer can be known through the pumping test. Pumping test performed on three wells owned by local residents to determine aquifer hydraulic parameters. These wells are shallow aquifer to represent basins in the study area. Hydraulic parameters of the aquifer that develops can be obtained from a pumping test in the study area were analyzed using methods Neuman Wave-Fitling use for unconfined aquifer. Wells pumping test is SM-07 represent the lithology of volcanic breccia, SM-22 represent the lithology of tuff and SM-23 represent the lithology of volcanic breccia.

The Pumping test result of SM-07 are transmitivity values 1,9296 m²/day, conductivity values 0,128 m/day, and velocity values 0,0224 meter/day. The result for SM-22 are transmitivity values 0,95 m²/day, conductivity values 0,063 m/day, and velocity values 0,0135 meter /day. And the result of SM-23 are transmitivity values 4,32 m²/day, conductivity values 0,288 m/day, and velocity values 0,067 meter/day.

4. Conclusion

The characteristics of the groundwater of the study area are in form of the physico-chemical, major elements, and hydrolic parameter of the groundwater aquifers. From 27 locations, the water quality assesment by physico-chemical properties is classified as fresh water category and based on chemical major elements, has been classified 8 facies which are located in the study area. Then, there are two lithologies which act as aquifers ie, tuff and volcanic breccias. Conductivity values in the range of volcanic breccia aquifers respectively 0,128 m/day and 0,288 m/day, transmitivity (T) ranges respectively 1,9296 m²/day and 4,32 m²/day. The value of conductivity in tuff aquifer is 0,063 m/day, transmitivity (T) is 0,95 m²/day. While lithology Qlt (Clay tuffan) is lithology with very low productivity of groundwater or called groundwater rare area (akiclud) and the rock units Qa (Andesite) is a non-aquifer that is the absence of groundwater in these rock units (akifug).

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