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Hydrochemical Study of Groundwater Quality in Jepara Coastal Plain and Lowland

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Abstract – Jepara coastal plain and lowland are located along Java Sea in the Java Island which is selected a appropriate field to study about hydrochemical of groundwater quality in the unconfined aquifer. The primary purpose of the study is to assess the groundwater quality of unconfined aquifer. Physical characteristic of groundwater such as pH, Electrical Conductivity/EC, Salinity, and Dissolved Oxygen/DO value will explain to the actual condition of groundwater quality. It will then combine with the assessment of major cations and anions content. Moreover Piper diagram provides more detail explanation about groundwater facies in the study area. There were around thirty-five (35) groundwater depth measurement and analyze physical properties while around twenty-eight (28) of them were analyzed the major cations and anions content to define groundwater facies. Water table flows from the mountain in the southeast to coastal plan and lowland in the northwest. Some physical characteristics of groundwater in the unconfined aquifer show pH around 5.0-7.3, the maximum EC up to 1,614 $\mu\text{S}/\text{cm}$ in Bandengan (close to the coast), salinity in the range 0-5.2 mg/L as well as DO from 0.1 to 2.1 mg/L. The water type is alkaline water with predominantly hydrogen bicarbonate and chloride. Meanwhile Sodium is the most cation content while Chloride indicates the highest anion contents.

1. INTRODUCTION

Java Island as the highest percentage of urban growth in Indonesia occurs in the coastal cities [1]. The increasing population in the coastal cities affects an enormous stress on groundwater as the most precious natural resources. Some environmental problems related to the groundwater exploitation in the recent years are seawater intrusion, degradation of groundwater quality, lowering groundwater level, flooding, and subsidence. Jepara coastal plain and lowland are located along Java Sea in the Java Island which is selected a appropriate field to study about hydrochemical study of the groundwater quality in unconfined aquifer. Population are increased from 1.1 million in 2010 to 1.2 million in 2015 or around 1.5% of annual population growth rate [2]. To fulfill daily need of fresh water, groundwater is withdrawn via dug wells in the unconfined aquifer. The primary purpose of the study is to assess the groundwater quality of unconfined aquifer. Physical characteristic of groundwater such as pH, Electrical Conductivity/EC, Salinity, and Dissolved Oxygen/DO value will explain to the actual condition of groundwater quality. It will then combine with the assessment of major cations and anions content. Moreover the Piper diagram provides more detail explanation about groundwater facies in the study area.

Regionally, stratigraphy of Jepara coastal plain and lowland from young to old consist of Alluvium (Qa) and Muria tuff (Qvtm). Alluvium is spread along coastal plain that consists of unconsolidated material from gravel to clay. Meanwhile, Muria tuff is found from the slope of Muria Mountain in the southeast to the lowland area in northwest of Jepara [3].

2. METHODS

Hydrogeological mapping was the basis to conduct some hydrogeological characteristics by measuring groundwater depth and collecting groundwater samples via dug wells as shown in Figure 1. There were around thirty-five (35) groundwater depth measurement and analyses physical properties of groundwater quality such pH, EC, Salinity, and DO by using the water level meters and the WTW Handheld of pH (3210) meters, Conductivity and salinity (3110) meters, and Oxygen (3310) meters. Indeed, around twenty-eight (28) groundwater samples were analyzed the major cations (Ca^{+2} , Mg^{+2} , Na^{+1} , and K^{+1}) and anions (Cl^{-1} , HCO_3^{-1} , and SO_4^{-2}) content to define groundwater facies.

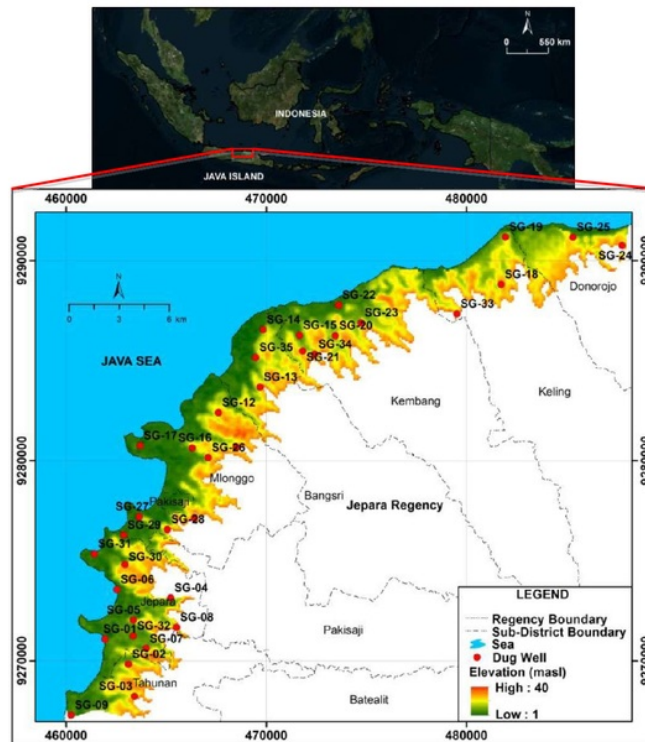


Figure 1 Study area and location of groundwater samples.

3. RESULTS AND DISCUSSION

People in Jepara coastal plain and lowland utilize dug wells to fulfill daily need of fresh water. Groundwater is abstracted via dug wells in the unconfined aquifer. The groundwater depth has a range from 0 to 14 m depth based on the measurement in the hydrogeological mapping. The maximum depth is found in Bondo village (Bangsri sub-district), SG-13 (Figure 1), while the groundwater depth in Telukawur village (Tahunan sub-district), SG-09, is approaching the ground surface. Groundwater flows from the mountain in the southeast to coastal plain and lowland in the northwest. Groundwater levels start from close to the ground surface up to 36 m above sea level (Figure 2a).

Physical analyses of groundwater samples conduct pH around 5.0-7.3 (Figure 2b). The minimum value of pH is located in Kalaman village (Kembang sub-district), SG-34, while sample SG-29 in Mororejo village (Mlonggo sub-district) provide the maximum of pH value. The average of pH is 6.2 indicate the groundwater samples in the range of standard for water drinking based on the regulation of Ministry of Health the Republic of Indonesia [4]. Meanwhile, conductivity value shows that the highest value is found in Bandengan village (SG-31) as shown in Figure 2c. It is up to 1.614 $\mu\text{S}/\text{cm}$. This sample is located close to the coast. The highest value may be caused by the interaction between fresh and seawater. Indeed, the salinity value is in the range 0-5.2 mg/L. The highest salinity is found in sample SG-01 that is located in Bulu village (Jepara Kota sub-district) in the city center. Salinity in the city center to the southwest shows higher value than other region that is indicated by tight contour (Figure 2d). Moreover, DO values are from 0.1 to 2.1 mg/L (Figure 2e). DO are effected by the source, temperature of water, treatment and chemical or biological processes in the distribution system [5].

Based on the major cations and anions content analyses, ion sodium (Na^+) has the highest cations content (Table 1). It is up to 2,454 mg/L while Mg^{+2} shows the minimum cations content. Sodium is highly soluble chemical element and naturally found in groundwater. The location of this sample is close to the coastline. Meanwhile, Chloride ion (Cl^-) is the highest anion contents in groundwater samples up to 3,176 mg/L. Sodium and chloride are the most abundant ions commence in the atmosphere above the oceans, and atmospheric deposition of chloride and sodium from the oceans is the highest along coastal areas [6] as occurs in Jepara coastal plain. It obviously indicates that salt-water intrusion into wells in coastal plain area affect elevated sodium and chloride levels in groundwater. To identify the groundwater facies, the Piper diagram [7] describes the electrical equivalent percentage (meq%) composition of different ions (Figure 2f). The major cations concentration in groundwater are in the decreasing order as $\text{Na}^+ > \text{Mg}^{+2} > \text{Ca}^{+2} > \text{K}^+$ while anions concentration are in the

decreasing order as $\text{HCO}_3^{-1} > \text{Cl}^{-1} > \text{SO}_4^{-2}$. The water type is alkaline water with predominantly hydrogen bicarbonate and chloride.

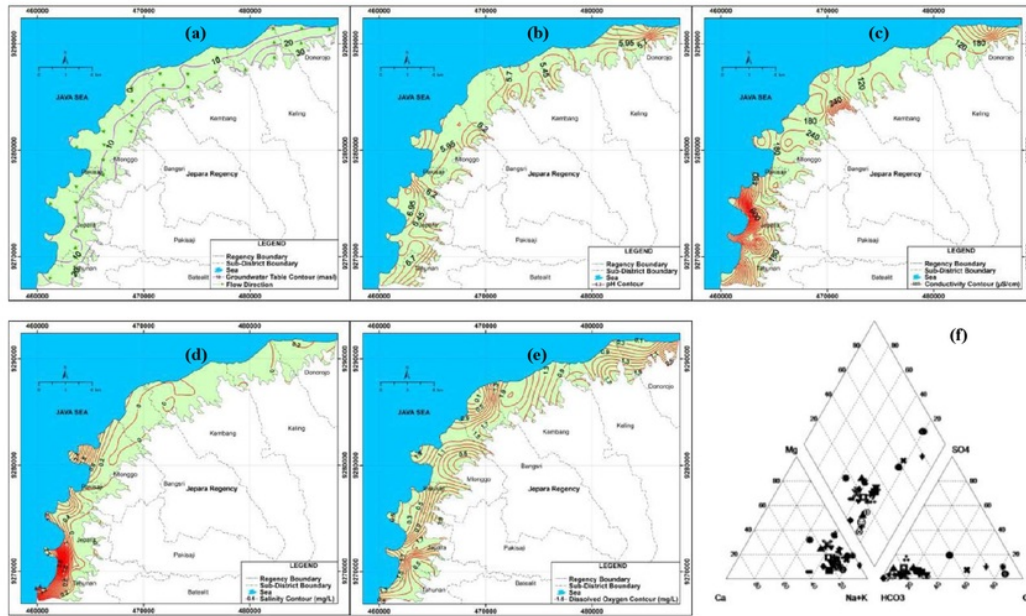


Figure 2 Result of hydrogeological mapping including physical and chemical analyses of groundwater samples. Groundwater flows from southeast to northwest (a), pH around 5.0-7.3 (b), conductivity value is up to 1,614 µS/cm (c), Salinity in the range 0-5.2 mg/L (d), as well as DO around 0.1-2.1 mg/L (e), water type is alkaline water with predominantly hydrogen bicarbonate and chloride (f).

Table 1 Summary statistics of major ions content

Ion	Na ⁺¹ (mg/L)	K ⁺¹ (mg/L)	Ca ⁺² (mg/L)	Mg ⁺² (mg/L)	Cl ⁻¹ (mg/L)	HCO ₃ ⁻¹ (mg/L)	SO ₄ ⁻² (mg/L)
Min	2.25	2.00	5.63	1.95	4.50	54.1	0.10
Ave	320	16.7	40.1	42.4	308	432	8.3
Max	2,454	94	354	313	3,176	985	32.3
SD	615	19.3	64.1	64.7	753	254	8.58

Note: Min: Minimum; Ave: Average; Max: Maximum, SD: Standard Deviation

4. CONCLUSIONS

Groundwater plays role in fundamental aspect for water drinking. Dug wells spread in the most Jepara coastal plain and lowland area which abstract groundwater in the unconfined aquifer. Hydrogeological mapping result that groundwater flows from the mountain in the southeast to the coastal plain and lowland in the northwest. Physical parameters of groundwater conduct that pH has a range of around 5.0-7.3 and the maximum EC is up to 1,614 µS/cm. Salinity is in between from 0 to 5.2 mg/L, while DO levels are 0.1-2.1 mg/L. Chemical analyses of cations and anion content result that the water type is alkaline water with predominantly hydrogen bicarbonate and chloride. Salt-water intrusion into wells in coastal plain area affect elevated sodium and chloride levels in groundwater samples.

5. REFERENCES

- [1] T.T. Putranto, T.R. Rűde, A. Cardona, and F. Wendland, 2014, Research plan for managing groundwater resources of the coastal cities in the central north of Java Island, *1st International Conference Geoscience for Energy Mineral Resources, and Environment Applied*, Bandung.
- [2] BPS-Statistics of Jepara Regency, 2016, Jepara regency in figures 2016, Jepara.
- [3] T. Suwarti and R. Wikarno, 1992, Peta geologi lembar Kudus skala 1:250.000, Pusat Penelitian dan Pengembangan Geologi, Bandung.
- [4] Permenkes Republik Indonesia, 2010, Permenkes No. 492/Menkes/Per/IV/2010 tentang persyaratan kualitas air minum, Jakarta.
- [5] World Health Organization, 2011, Guidelines for drinking-water quality 4th Ed. Geneva, Switzerland.

- [6] Mullaney, J.R., Lorenz, D.L., Amtson, A.D., 2009, Chloride in groundwater and surface water in areas underlain by the glacial aquifer system, northern United States: U.S. Geological Survey Scientific Investigations Report 2009–5086, 41 p.
- [7] Piper, A.M., 1944, A graphic procedure in the geochemical interpretation of water-analyses, Am. Geoph. Union Trans. V. 25, 914-923.

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