Groundwater quality : comparing alluvial plain and tertiary volcanic in tropical region

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Abstract. Sustainable water resources are the most important issue related to the effects of land use change. However, aspects of geomorphology and lithology have not been studied by researchers before. This study aims to analyze the characteristics of groundwater systems associated with lithology and geomorphology. The method used in this study was a survey. Data retrieval is done during the long dry season (tropical region), and the normal dry season in regions with different land forms and lithology. Analyze the data by comparing groundwater samples with physical water quality. The results showed that in tertiary volcanic areas there is a decrease in the quality of groundwater physically during the long dry season, while in alluvial plains there is no physical decrease in water quality. The decrease in water quality occurs during the long dry season. The decrease in groundwater quality is influenced by the dry season, the litology of quartzland volcanic rocks, and the shape of tertiary volcanic landform.

Keywords: Groundwater, alluvial plain, tertiary volcanic, tropical region

1. Introduction
Groundwater in Jember Regency, Indonesia is characterized by a large quantity due to tropical climates. In addition, other features include aquifer ranges from unbranded sand and pebble deposits to retaknys of sedimentary rocks, basalt rocks and porous sediments. Groundwater usually has good natural qualities, except for a few geologically different areas, most of which meet the requirements set for households [1]. Groundwater in the formation of geology that can store and pass water in large quantities, known as aquifer [2]. Classifies a few formations that can not save and perfect groundwater flow [3]. It is aquiclude, aquifug, and aquitard. Groundwater of Jember has major contribution for Jember poeples. Several function of groundwater in East Jawa is used for settlement, industries, and agriculture.

Groundwater usage in major city is different with in district, bathing and washing in big cities in Jember such as Surabaya, Malang, Jember, Kediri and Madiun. Rapid growth of settlements, and development hospitality that is in dire need of a lot of raw water, so a good source of water surface or groundwater should be sufficient to meet the needs daily. In addition to improving the management of water sources in the field, another appropriate way to improve the management of ground water is one of them with provide information about water resources is groundwater based digital form Geographic Information System (GIS) or Geographic Information System (GIS) in the region [4]. In addition, many wells in cracked rocks are used for a single home supply in urban areas. In Jember, porous basaltic porous aquifers become an important source of drinking water, in addition to fluvial deposits, as well as porous aquifers with consolidation of vital importance in urban areas.

Jember regency has different topography characteristics with other regencys. Most of the rock formations consist of tertiary and quartz sediments and quintessential igneous rocks. This results in differences in landscapes and aquifer systems in each region. The average temperature of Jember is around 22 degrees as August and 28 derjat in January. This makes the rainfall so high that it will cause a very abundant ground water potential. The potential of this ground water in big cities in Jember has a lower quality compared to in small towns. This will potentially reduce the quality of the environment and public health.
Average rainfall is high (2100 mm / year) in volcano area and aluvial area, otherwise 1500 mm / year only in areas in the shadow of an orographic rain like the mountains of southern eastern of Java. Therefore, the difference is quite large in the pattern of groundwater filling in these two areas. The highly varied and seasonal vegetation is also characteristic for Jember, some areas produce little or no groundwater updates in the dry season. Jember geology and groundwater filling characteristics The bedrock ranges from late Tertiary and a small fraction of the initial tertiary. Some karst systems are also found, especially in the southern region of Jember. Such karst forms also have a major impact on land formation; the form of fluvial land covers a large area and forms an important aquifer in most areas [1]. In addition, the area of land that is being pressured by the burden by urban development becomes a prone to ground water conditions. This allows the deposition of the material into an aquifer to be inhibited.

Sea sediments affect the ground water system in different ways, the characteristics of marine sediments are strongly influenced by the high porosity of rocks, thus potentially reducing the quality of groundwater. Variations of the main rock in Jember and the development of large cities are the basis for the importance of continuous groundwater quality study. Previous research focused more on water quality physically, biologically, and chemically, so a study of the relationship between water and lithology and geomorphology was needed to analyze the causes of the decrease in groundwater quality. This study aims to analyze the causes of decreased groundwater quality in two different forms of land and lithology.

2. Methods

All research sites will be observed using landsat 8 interpretation techniques, land use maps, and geological map. As for strengthening the interpretation results, it requires a field check technique that aims to strengthen the results of image interpretation. Field observations were conducted in Central Java Alluvial Plain and Jember as a tertiary volcanic region. These locations are big cities that have the potential to have groundwater quality problems.

Samples are determined purposively taking into account the lithological aspects and shape of tertiary volcanic land. the data is analyzed descriptively by looking at the physical parameters of water and the distribution of landform and lithology. Physical parameter on Water quality will be measured by the numbers 1 to 5 (1 = very low, 2 = low, 3 = moderate, 4= high, 5 = very high).

3. Results and Discussion

In Jember, ground water about 60% of the water supply is used for the needs of the population. The infiltration and recharge of aquifers in the infiltration basin of the Quaternary aquifer mostly occur in Jember. Although ground water use in Jember has increased by 38-42% over the past few decades, water quality has not improved.

In Jember, the groundwater system between one region and another is different. North Jember is a tertiary and quarterly sediment zone. The area has great groundwater potential because there are many open aquifers. The city that goes into this region is Surabaya. The central region of Jember has much more groundwater reserves because it includes a quarterly volcanic zone. This zone can be found in high infiltration due to the ideal freezing of the rocks as water.

In Jember, the selection of good water sources and mixing of raw water between different sources is usually done as a measure to meet drinking water standards to achieve good water quality. Many small utilities depend on one source water and in some cases, the source is also located in areas with potential pollution from agriculture or seawater intrusion. Ground water sources in Jember Cities are generally contaminated by polluters. Though these cities have a very high groundwater needs. quartz sediment characteristics with seawater intrusion make groundwater quality low.

Table 1 shows the decrease in physical quality of water that occurs during the long dry season in November and December. Turbidity and the smell of water decreased due to drought in tertiary mountainous regions. The ability of weak aquifers makes the quantity of groundwater very low.
Aquifers in this region are strongly influenced by the presence of tertiary volcanic rocks that have reached the level of litification.

**Table 1. Physical Groundwater Quality of Tertiary Volcanic in Long dry season**

| Indicator | Jan | Feb | Marc | April | May | June | July | Augu | Sept | Oct | Nov | Dec |
|-----------|-----|-----|------|-------|-----|------|------|------|------|-----|-----|-----|
| Turbidity | 5   | 5   | 5    | 5     | 5   | 5    | 4    | 4    | 3    | 2   | 2   | 2   |
| Smell     | 5   | 5   | 5    | 5     | 5   | 5    | 3    | 2    | 2    | 1   | 1   | 1   |

Table 2 shows that the physical quality of groundwater in alluvial plain areas is very good. The stability of groundwater quality is due to the presence of aquifer systems compiled by alluvium and shallower groundwater. In addition, in this region there are also no tertiary volcanic rocks that can affect the intensity of percolation.

**Table 2. Physical Groundwater Quality of Alluvial Plain in Long dry season**

| Indicator | Jan | Feb | Marc | April | May | June | July | Augu | Sept | Oct | Nov | Dec |
|-----------|-----|-----|------|-------|-----|------|------|------|------|-----|-----|-----|
| Turbidity | 5   | 5   | 5    | 5     | 5   | 5    | 4    | 4    | 4    | 4   | 4   | 4   |
| Smell     | 5   | 5   | 5    | 5     | 5   | 5    | 5    | 5    | 5    | 5   | 5   | 5   |

Figure 1 shows a decreased water quality with indications of a decrease in the value of turbidity and odor. The water quality of the smell aspect drops lower because it is affected by the density of the population. In very dense settlements, settlement waste will be susceptible to contamination with aquifers. This is influenced by the low quantity of water. Figure 2 shows that plain alluvium has a better ability to be an aquifer both in quality and quantity.

![Figure 1. water quality trends of Tertiary Volcanic in Long dry season](image-url)
Groundwater quality is not only influenced by geological, physical, biological, and chemical aspects. The geomorphological aspect determines water quality. The type and shape of the land is a factor that is strongly related to lithology and aquifer ability. In tropical areas with very high rainfall does not guarantee high water availability if it is in the region of tertiary volcanoes. Lithology in this region will be strongly related to the character of old volcanoes that are no longer able to increase the capacity of perkolasi. These findings are supported by [5,6] findings that geomorphology greatly affects groundwater quality.

4. Conclusion
Groundwater quality in tertiary volcanic areas cannot be equated with alluvial plain areas. The two regions are litologically very different in character. The development of the settlement should consider the character so that the need for clean water can be fulfilled. In the volcanic region of the quarter it is necessary to design the construction of settlements that pay attention to the distance between houses and also the long dry season.

Acknowledgments
This research was supported by the Institute of Research and Community Service, University of Jember.

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