Caspian Journal of Environmental Sciences
Online ISSN: 1735-3866
Print ISSN: 1735-3033

Ground water quality in Ciracas sub-district, East Jakarta, Indonesia

Alwin*, Tri Cahyono, Ali Sya'ban, Siti Dahlia

Geography Education Study Program, Prof. Dr. Hamka Muhammadiyah University, Jakarta, Indonesia

** Corresponding author's E-mail: alwin@uhamka.ac.id*

ABSTRACT

The study aimed to know, and get a picture of the condition of groundwater quality in the area of Ciracas Urban Sub-District, Ciracas District, East Jakarta, Indonesia. Besides, to know the groundwater in the residential area of Ciracas Sub-district, East Jakarta has been contaminated or not based on Permenkes RI's clean water quality standard. No.416 / Menkes / per / IX / 1990. This is a descriptive study based on laboratory analyses. To determine groundwater samples in the study area, we used a sampling technique based on settlement density. The results of the study exhibited that the condition of ground water quality in the study area, according to the physical quality parameters, was odorless. Total dissolved solids (TDS) ranged from 489.1 mg L^{-1} to 298.2 mg L^{-1}; turbidity ranged from 0.30 to 45.08 NTU. Unwelcome, temperature was 30 °C, color ranged between 4 and 13 TCU. Chemical quality of iron (Fe) ranged from 1600 MPN / 100 mL, while total bacterial coliform content was allowed at 50 MPN / 100 mL. This means that groundwater in Ciracas Urban Sub-District, Ciracas District, East Jakarta can not be used as a source of clean water.

Keywords: Water quality, Groundwater, Ciracas Sub-District.
Article type: Research Article.

INTRODUCTION

Water is a very essential resource for living things to meet daily needs, agricultural needs, fishing and other needs. Water, which is universal or comprehensive in every aspect of life, is an increasingly valuable resource, both in terms of quality and quantity (Sudarmaji *et al.* 2016). Water is the most important compound in human life. Almost 85% of our body contains water, the higher our activity level, the more levels of water needs. Starting from small things, such as drinking water to quench thirst to a water wheel that is used as a producer of electrical energy. In terms of its existence, there are various types of water (Permean Sebayang *et al.* 2015). Water quality is defined using the physical, chemical, and biological conditions that can affect the availability of water for human life, industrial, agriculture, recreation and other water uses (Chay Asdak 2014; Omidi & Shariati 2021; Fatih Ali *et al.* 2021; Heidari *et al.* 2022; Abdulkareem Hussein *et al.* 2022). Furthermore, Hefni Effendi (2003) explained the same theory that water quality is the nature of water in the content of living substances, energy, or other components in water. Water quality is expressed in several parameters, namely physical parameters (turbidity temperature, dissolved solids and some of them), and chemical parameters (pH, oxygen dissolved, directors, metal content, and some). The standard for clean water or water to meet daily needs is determined based on the Regulation of the Minister of Health of the Republic of Indonesia No.416/Menkes/Per/IX/1990 concerning requirements and monitoring of water quality. According to Giriet *et al.* (2018), understanding the effect of land use on water quality is essential for sustainable water management. Regions with high population density and dominated by arable land can reduce the quality of river water, however, if an area has sufficient forest area it will reduce pollution in river. Air quality is an important aspect of integrated environmental management and

Caspian Journal of Environmental Sciences, Vol. 21 No. 2 pp. 349-354 Received: Oct. 12, 2022 Revised: Dec. 25, 2022 Accepted: March 02, 2023
DOI: 10.22124/CJES.2023.6501

Publisher: University of Guilan,

sustainable development, namely by ensuring the demand for water is met with the availability of water. Demand for water needs should ensure that water quality is suitable for human and ecological needs (Srebotnjak *et al.* 2012). The quality of surface water and groundwater can be identified from its physical, chemical and biological parameters (Loukas 2010).

Table 1. Clean water quality standards according to the Regulation of the Minister of Health of the Republic of Indonesia Number: 416/MENKES/PER/IX/1990 Date: 3 September 1990.

No	Parameter	unit	Maximum level allowed	information
A.	PHYSICS			
1.	Smell	-	-	No smell
2.	Amount of dissolved solids (TDS)	mg L^{-1} Scale	1500	
3.	Turbidity	NTU	25	No smell
4.	flavor	-	-	
	temperature	°C		
5.	color	Scale	Air temperature ± 3°C	
6.		NTU	50	
B.	Chemistry			
1.	Mercury	mg L^{-1}	0.001	
2.	Arsenic	mg L^{-1}	0.05	
3.	Iron	mg L^{-1}	1.0	
4.	Fluoride	mg L^{-1}	1.5	
5.	Cadmium	mg L^{-1}	0.005	
6.	Hardness ($CaCO_3$)	mg L^{-1}	500	
7.	Chloride	mg L^{-1}	600	
8.	Chromium, val.6	mg L^{-1}	0.05	
9.	Manganese	mg L^{-1}	0.5	
10.	Nitrate, as N	mg L^{-1}	10	
11.	Nitrite, as N	mg L^{-1}	1.0	
12.	pH	-	6.5-9.0	This is the minimum and maximum limits, especially for rainwater with a minimum pH 5.5
	Selenium			
13.	Zinc	mg L^{-1}	0.01	
	Cyanide			
14.	Sulfate	mg L^{-1}	15	
15.	Lead	mg L^{-1}	0.1	
16.		mg L^{-1}	400	
17.		mg L^{-1}	0.05	
C.	Organic Chemistry			
1.	Aidrin dan Diedrin	mg L^{-1}	0.0007	
2.	Benzene	mg L^{-1}	0.01	
3.	Benzo (a) pyrene	mg L^{-1}	0.00001	
4.	Chlordane (total isomer)	mg L^{-1}	0.007	
	Chloroform			
5.	2,4 D	mg L^{-1}	0.03	
6.	DDT	mg L^{-1}	0.10	
7.	Detergent	mg L^{-1}	0.03	
8.	1,2 Disclorocthane	mg L^{-1}	0.5	
9.	1,1 Disclorocthene	mg L^{-1}	0.01	
10.	Heptachlor and Heptachlor	mg L^{-1}	0.0003	
11.	epoxide	mg L^{-1}	0.003	
12.	Hexachlorobenzene	mg L^{-1}	0.00001	
13.	Gamma-HCH (Lindane)	mg L^{-1}	0.04	
14.	Methoxychlor	mg L^{-1}	0.10	
15.	Pentachlorophenol	mg L^{-1}	0.01	
16.	Pesticide Total	mg L^{-1}	0.10	
17.	2,4,6 urichlorophenol	mg L^{-1}	0.01	

18.	Organic Substances ($KMnO_4$)	mg L^{-1}	10	
D.	Micro Biology			
	Total coliforms (MPN)	amount /100 mL	50	Not piped water
				Piped water
		amount /100 mL	10	
	Radioactivity			
1.	Alpha Activity (Gross Alpha Activity)	Bq L^{-1}	0.1	
2.	Beta Activity (Gross Beta Activity)	Bq L^{-1}	0.1	

Source: http://www.pppl.depkes.go.id/_asset/_regulation/53_permenkes% 2042.

Ciracas sub-district is one of five sub-districts in the Ciracas district, East Jakarta (Administrative City). It has very dense settlements. Therefore, the distance between one house and another is very close, or not far apart. In addition, the environmental conditions of the residential areas look dirty. Very dense settlements have caused residents to build household waste disposal sites and septic tanks close to clean water sources. Some of the sources of clean water used by residents in the Ciracas Sub-District are obtained from the Drinking Water Company (PAM) and some use ground water. The residents whose source of clean water comes from groundwater, collect the water using dug wells and use water pumps (drilled wells). The distance between adjacent houses means that the distance between the water pump from a drilled well to a septic tank or household wastewater disposal is quite close (± 3-5 meters). This condition can allow the ground water in Ciracas Sub-district to be polluted by water from septic tanks or household wastewater. Based on the observations and narratives of the residents, the groundwater used by the residents smells like iron and has a yellowish colour. In addition, there is an oil-like layer on the surface of the water, especially during the dry season. Even with such water conditions, most of the population still uses it as a source of clean water. However, before use, residents filter groundwater into containers or reservoirs that have been designed by themselves. Residents aim that the groundwater can be used for daily needs so as to reduce the cost of decomposition. Residents do not use ground water for cooking, since they are worried about harming their health. Based on the background above, the following problems can be put forward: (i). How is the condition of groundwater quality in Ciracas Sub-District, Ciracas District, East Jakarta? (ii). Is the ground water quality in the service area in the Ciracas Sub-District already polluted according to the clean air quality standards of the RI Minister of Health No.416/Menkes/Per/IX/1990?

MATERIALS AND METHODS

This research is a descriptive study that is more directed at disclosing a problem or situation as it is by disclosing existing facts or data obtained from analysis in the laboratory. The results of this research are devoted to provide an overview of the actual state of the object under study (Pabundu Tika 2005).

Geographical conditions of the study area

The research area is Ciracas Sub-District, Ciracas District, East Jakarta, Indonesia. Description of physical conditions including location, boundary and area, climate, geology and geomorphology, soil and land use and water sources are detailed as follows; Ciracas Sub-District is located in the Ciracas District, East Jakarta. Astronomically, it is located at coordinates 06º 18' 40 – 06º 20’ 30 LS” and 106º 52'00” – 106º 53'00” East Longitude with an average altitude of around ± 42 masl. Ciracas Sub-District is one of 5 sub-districts located in the southern part of Ciracas District, East Jakarta with the following administrative boundaries: (a). To the north extends Jl. Pule Susukan Sub-District, Jl. Ali's Bride, Jl. Mahakam, bordering the Sub-District of Rambutan 6; (b). To the south extends Jl. Raya Ciracas Kelapa Dua Wetan Sub-District and Jl. Raya Kiwi, bordered by Pekayon Sub-District; (c). To the east extends Jl. Jagorawi Toll Road, it is bordered by Cipayung Sub-District; (d). To the west, it extends to Jl. Kali Baru, bounded by Cijantung Sub-District. According to the 2019 monograph data for Ciracas Sub-District, Ciracas District, its total area is ± 393.36 ha (3,936 km^2) which is divided into 10 community units (RW) and 141 neighbourhood units (RT) with a population of 73,229 consisting of 37,151 men and 36,078 women. The distance between Ciracas Sub-District and District Government Centre is ± 4 km to the north, and the distance from the DKI Jakarta Provincial government centre is ± 22 km to the north.

RESULTS AND DISCUSSION

Water is a very essential resource for living things, to meet daily needs, agricultural needs, fisheries and other needs. Water, which is universal or comprehensive in every aspect of life, makes this resource increasingly valuable, both in terms of quality and quantity. Currently, the main water resources problems include the quantity of water that is no longer able to meet the increasing demand and the decreasing quality of air for industrial and domestic activities. Industrial and domestic activities and others have a negative impact on water resources, among others causing a decrease in water quality. This condition can cause disruption, damage and danger to fellow living things that depend on water resources. Most of Indonesia is located in a tropical area with high rainfall. Therefore absolutely most areas do not lack water. Indonesia has two seasons, i.e., the dry and the rainy seasons. In general, there is more water in the rainy and less in the dry seasons. The most common reason for occurrence of pollution is the distance between household wastewater disposal and septic tanks, which are close to clean water sources. Water pollution is the entry or inclusion of living things, substances, energy and/or other components into the air by human activities, so that the air quality decreases to a certain level causing it to no longer function according to its designation. Analysis of groundwater pollution caused due to the construction of settlements in the Ciracas sub-district is very dense. Therefore, the distance between one house and another is very close, or not far apart. In addition, the environmental conditions of the residential areas look dirty. Very dense settlements have caused residents to build household wastewater disposal and septic tanks close to clean water sources with a distance of ± 3-5 meters. This research is an analysis of groundwater quality based on clean water quality standards. Groundwater samples taken in this study are water samples based on the density of the population. The study area was divided into 3 settlement densities, namely very dense, dense and medium settlements. In each area, one water sample was taken. Groundwater sampling was carried out in three different places based on location and density residents in district Cirasas. One sample was taken from in a very dense settlement area located at 106° 52' 30" East Longitude and 06° 19' 00" South Latitude with a water temperature of 30°C. The second sample was taken from a densely packed residential area located at 106° 52' 40" E and 06° 20' 00" S with a water temperature of 29°C. The third sample was taken at 106° 52' 50" E and 06° 19' 00" LS with a water temperature of 30 °C. Eight Groundwater samples were taken and then analyzed for water quality at the Pam Jaya Laboratory, Central Jakarta, Indonesia.

a. Results of physical ground water quality testing at Ciracas.

The physical quality analysed in this study included; odor, amount of dissolved solids, turbidity, taste, temperature, and colour. The results of laboratory analyses of the physical quality of groundwater in the Ciracas Sub-District can be seen in Table 2.

Table 2. Quality of groundwater physics in Sub-District Ciracas.

Water quality parameters	Sample point			unit
	1	2	3	
smell		No smell	No smell	-
Amount of Dissolved Solids	298.2	489.1	321.6	Mg.l
Turbidity	45.08	23.10	0.30	NTU
Flavor	tasteless	tasteless	tasteless	-
Temperature	30	30	30	°C
Color	11	13	4	TCU

Source: Analysis of Pam Jaya Jakarta Laboratory.

Description

Sample 1: Ground water sample in a very dense residential area
Sample 2: Ground water sample in a densely populated area
Sample 3: Samples of ground water in a moderate area

Smell

The physical laboratory quality of groundwater based on the results of the analyses showed that all groundwater samples are odorless. This shows that the review of the smell of the water implies the condition of groundwater in the Ciracas Sub-District area is still in normal condition.

Amount of dissolved substances

According to the results of laboratory analyses on groundwater in Ciracas Sub-District, the amount of dissolved solids in the very dense union area was 298.2 mg L^{-1}; in densely populated residential areas 489.1 mg L^{-1}; and in residential areas with moderate density 321.6 mg L^{-1}. Based on the results of the laboratory analyses above, it is known that the amount of dissolved solids in the ground water in the Ciracas Sub-District residential area has not exceeded the maximum allowable level of 1500 mg L^{-1}.

Turbidity

Based on the results of laboratory analyses, it showed that all groundwater samples in the Ciracas Sub-District service area had turbidity ranging from 0.3 to 45.80 on the NTU scale. Laboratory analysis results above shows that the turbidity of the groundwater in the Ciracas Sub-District is still clear and has not exceeded the maximum level allowed, which is 25 NTU scale.

Flavor

Based on laboratory analyses, all groundwaters in the Ciracas Sub-District area are tasteless. This shows that the taste of groundwater in the Ciracas Sub-District area has not changed.

Temperature

Based on the results of the analysis it is known that the temperature of groundwater in the Ciracas Sub-District area for all samples is the same temperature (30°C). This shows that the groundwater temperature in the Ciracas Sub-District area is still normal or there has been no significant change in temperature.

Color

The colour of groundwater in Ciracas Sub-District is based on an analysis of the maximum permissible level value on a scale of 50 TCU. The results of laboratory analyses on colour found that the colour of groundwater in very dense residential areas was 11 TCU, and in densely populated areas 13 TCU, while in medium density residential areas, it was 4 TCU. This illustrates that the groundwater in the area of Ciracas Kelurahan does not contain chemicals that cause water discoloration

CONCLUSION

Based on the results of studies on the quality of groundwater in the residential area of Ciracas Sub-District, Ciracas District, it can be concluded as follows: Groundwater in Ciracas Sub-District has an odorless physical quality with the amount of dissolved solids was between 298.2 mg L^{-1} and 489.1 mg L^{-1}. Turbidity ranged from 0.30 to 45.08 on the NTU scale. It was tasteless. The temperature was 30 °C, and the colour range was 4-13 TCU. The chemical quality of groundwater in Ciracas Sub-District, i.e., the element iron (Fe) as much as 7,720 mg L^{-1} < 2 MPN/100 mL up to greater than 16,000 MPN/100 mL and has exceeded the clean water quality standards according to the Minister of Health of the Republic of Indonesia No. 416/Menkes/Per/1990.

REFERENCES

Abdulkareem Hussein, H, Khudair, SA, Alwan, M, Aljawahiry, TT, Qasim, MV, Pavlova, I 2022, Impact of pollution caused by salmon breeding centers on river water quality. *Caspian Journal of Environmental Sciences,* 20: 1039-1045.

Alaerts, G & Sumesti, S 1984, Water research methods, Offset Printing Business Surabaya.

Asdak, CH 1995, Watershed hydrology and management. Yogyakarta: Gajah Mada University Press.

Asdak, CH 2014, Hydrology and watershed management. Yogyakarta: Gajah Mada University Press.

Asmadi, M et al. 2011, Drinking water treatment technology. Yogyakarta: Gosyen Publishing Publisher.

Effendi, H 2003, Study of water quality for the management of aquatic resources and environment. Yogyakarta: Kansus.

Erwin, D & Juanda, D 2015, General hydrology. Yogyakarta: Publisher PT Ombak.

Faith, N 2006, Trends in Water Quality in the Eerste River, Western Cape, 1990- 2005. Amini's thesis was submitted to partially fulfil undergraduate degree requirements. Master of Scientiae, Integrated Water Resources Management in the Faculty Natural Sciences, University of the Western Cape, p. 41.

Fatih Ali, S, Hamud Hays, H & Abdul-Jabar, R 2021, Application of CCME water quality index for drinking purpose in Tigris River within Wasit Province, Iraq. *Caspian Journal of Environmental Sciences,* 19: 781-787.

Giri Subhasis, A, Zeyuan, QB, Zhen, ZC 2018, Assessing the impact of land use on down water quality flow using sensitive hydrology area concept. *Journal Environmental Management*, 213: 309e319. PMID: 29502016, DOI: 10.1016/j.jenvman.2018.02.075.

Heidari, AR, Mortazavi, S & Hasanzadeh, N 2022, Spatiotemporal variation analysis of water quality using multivariate statistical methods, Case study: Koohsar Lake, Western Iran. *Caspian Journal of Environmental Sciences,* 20: 711-720, DOI: 10.22124/CJES.2022.5723.

Jouanneau, S, Recoules, L, Durand, MJ, Boukabache, A, Picot, V, Primault, Y, Lakel, A, Sengelin, M, Barillon, B & Thouand, G 2013, Methods for assessing biochemical oxygen demand (BOD): A review. *Water Research,* 49: 62-82, PMID: 24316182, DOI: 10.1016/j.watres.2013.10.066.

Kusnaedi, 2002. Processing peat water and dirty water for drinking water. Swadaya Bogor.

Loukas, 2010, Study of the quantity and quality of surface water in the Pinios River, Thessaly, Greece. *Desalination*, 250: 266-273. DOI: 10.1016/J.DESAL.2009.09.043, Corpus ID: 97568115.

Muhammad, AKh 2011. Basic Socio-Cultural Science. Bandung: Publisher PT Citra Aditya Bakti.

Muta'ali, L, Nugroho, AR 2016, Development of slum management program in Indonesia from time to time. Yogyakarta: Gajah Mada University Press.

Nazir, M 1988, Research methods. Jakarta: Ghalia Indonesia.

Nugraha, WD 2008, Identification of water class and maintenance of load capacity river bod contamination with qual2e model (Case Study of Serayu River, Central Java). *Journal of Precipitation*, 5: 31-41.

Omidi, A & Shariati, F 2021, Evaluation of Pasikhan River, North of Iran Water Quality Using Water Quality Index (NSFWQI), *Caspian Journal of Environmental Sciences,* 19: 219-230.

Prajapati, UB, 2010, Study of the Water Quality of the Ami River and its Ecomanagement. Pollution and environment research laboratory (PEARL), Department of Botany, DDU Gorakhpur University, Gorakhpur.

Srebotnjak, T, Carr, G, Sherbinin, A & Rickwood, C 2012, Global water quality index and hot-deck imputation of missing data. *Ecological Indicators,* 17: 108-119.

Sumaatmadj, N 1998, Geography studies an approach and spatial analysis. London: Alumni.

Tika, MP 2005, Geographical research methods. Jakarta: PT Bumi Aksara.

Bibliographic information of this paper for citing:

Alwin, Cahyono, T, Sya'ban, A, Dahlia, S 2023, Ground water quality in Ciracas sub-district, East Jakarta, Indonesia. Caspian Journal of Environmental Sciences, 21: 349-354.