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The determination of ground water quality based on the presence of *Escherichia coli* on populated area (a case study: Pasar Minggu, South Jakarta)

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Abstract. This study aims to determine the quality of groundwater in densely populated areas in the Pasar Minggu district, which focuses on examination of *Escherichia coli* bacteria as biological parameters. *E.coli* analysis was conducted in 3 sub-districtin the Pasar Minggu district, South Jakarta (106° 45'0"E - 6° 15'40"S), which included Pejaten Barat, Jati Padang and Kebagusan sub-district based on topography. The method used is Most Probable Number (MPN), referring to SNI 01-2332.1-2006. The results showed that the presence of *E. coli* in the highest groundwater ranged from 1100 MPN/100 ml to > 1100 MPN/100 ml, present in Pejaten Barat sub-district (06° 16'39 "S-106° 49'48" E) whereas the lowest number ranged from 11.5 MPN/100 ml to 23 MPN/100 ml occurred in Jati Padang sub-district (06° 17'6 "S - 106° 49'48" E).The correlation test results show that the amount of *E.coli* in ground water is affected by the distance of the septic tank to the groundwater well. The amount of *E.coli* contained in groundwater is also increasing, 1100 MPN/100 ml in groundwater samples at <10 m and < 20 MPN/100 ml in groundwater samples at> 15 m depth. This study provides information that topography and water flow affect the amount of *E. coli*.
Keywords: *Escherichia coli*, most probable number, pasar minggu district, septic tank, surfer

1. Introduction

Water is an abundant chemical in the human body and plays a central role in the regulation of nutrient transport, toxic waste disposal, regulation of body temperature and digestion, organ function and metabolic activity. However, if drinking water is contaminated with feces, it will spread the disease to large numbers of consumers [1].

A Pipeline distribution network that has not been maximized in Jakarta, causing many residents to use ground water as a source of drinking water. The election of Pasar Minggu district as the object of the research is based on data from Agency of Environmental Management Jakarta 2015, indicating the ground water in Pasar Minggu Disrict (Located in South Jakarta) has been populated by *E. coli* bacteria [2].

Various bacteria, parasites, and viruses, known to be pathogenic, have the potential to cause health problems if they enter the human body. The Environmental Protection Agency (EPA) considers Total Coliform useful as an indicator of other pathogens in drinking water. Total coliform is used to determine adequate water treatment (eligibility) and integrity in the distribution system [3]. Therefore, the maximum limit of contaminant of pathogenic bacteria such as Total coliform and Escherichia coli is 0 for drinking water.

Coliform is naturally present in the environment, but Fecal coliform and E. coli are derived from human and animal waste [4]. Thus, the presence of Fecal coliform and E. coli on a material or water indicates that the water is contaminated by human or animal waste. E. coli causes disease (pathogens) in this waste can cause diarrhea, cramps, nausea, headaches. This pathogen may pose a special health risk for infants, young children, and people with impaired immune systems [5].

Referring to the description, this research is conducted to know the quality of ground water of densely populated area in the Pasar Minggu district, emphasized on examination of Escherichia coli bacteria as biological parameter. The relationship between the number of E. coli bacteria in groundwater with well distances to septic tanks was studied to determine whether ground water is suitable for use as a source of drinking water or not.

2. Research Method

Sampling was conducted in 3 sub-district in Pasar Minggu district, Pejaten Barat, Jati Padang and Kebagusan sub-district (Table 1) and detail location figure out at map (Figure 1). This location has a decreasing contour from north to south where Kebagusan sub-district is with the lowest contour. Sampling is done from April - June, which represents the data of rainy and dry months. In addition to biological parameters such as the presence of E. coli bacteria, physic and chemical parameters including pH, temperature and DO are also measured during sampling.

Bacterial contamination does not alter the physical appearance, odor or taste of the water. Testing by the laboratory is the only way to know if water contains *Coliform bacteria*. [6] The method used in analyzing the number of *Escherichia coli* bacteria in the sample water using the Most Probable Number (MPN) matrix refers to SNI 01-2332.1-2006 on the determination of *coliform* and *Escherichia coli* in fishery products. The groundwater sampling method refers to SNI 6989.58: 2008 on Water and wastewater - Section 58: Groundwater Sampling Method. Analysis of physical, chemical and biological parameters was performed in the Microbiology Laboratory of the Faculty of Landscape Architecture and Environmental Technology.

Table 1. Sampling location coordinate.

Sub-district	No	Location	Coordinate
Pejaten Barat	1	Siaga Raya Street RT 12/ RW 4 no 8 Pejaten Barat	06°16’12”S ; 106°50’15”E
	2	WarungJati Barat Street no 98 Pejaten Barat	06°16’39”S ; 106°49’48”E
Jati Padang	3	Jatiwangi Street no 7 Jati Padang	06°17’6”S ; 106°49’48”E
	4	Raya Ragunan Street no 4 Jati Padang	06°17’6”S ; 106°50’15”E
	5	Damai Street no 62 RT 2/RW 1 Ragunan	06°17’33”S ;106°49’21”E
Kebagusan	6	Kebagusan Street 1 No 9 Kebagusan	06°18’0”S ;106°49’48”E
	7	Kebagusan Street 4 Kebagusan	06°18’54”S ;106°49’48”E

The MPN is a procedure to estimate the population density of viable microorganisms in the test sample. This is based on the application of probability theory to the number of positive growth responses observed in a series of standardized sample inoculum dilutions placed on a number of culture media tubes. Positive growth response after incubation can be demonstrated by observations such as gas production in the fermentation tube or turbidity seen on the broth tube, depending on the type of media used [7].

The verification indicating the presence of total coliform bacteria is indicated by the production of gas in Lactose Broth (LTB) media followed by positive LTB inoculation into the Brilliant Green Lactose Broth (BGLB). Furthermore, for total coliform testing, positive and negative bacteria should be retested on LTB / BGLB media. For testing the presence of positive and negative *E.coli* bacteria bacteria were tested again using LTB / EC Broth (EC-MUG) [8].

The results of the analysis will be compared with drinking water quality standard that is the Regulation of the Minister of Health in 2010 where the maximum presence of *E. coli* bacteria in drinking water is 0 (amount per 100 ml sample). From the data will be analyzed the relationship of well distance to septic tank with the number of *E. coli* bacteria in ground water, due to the possibility of leakage septic tank.

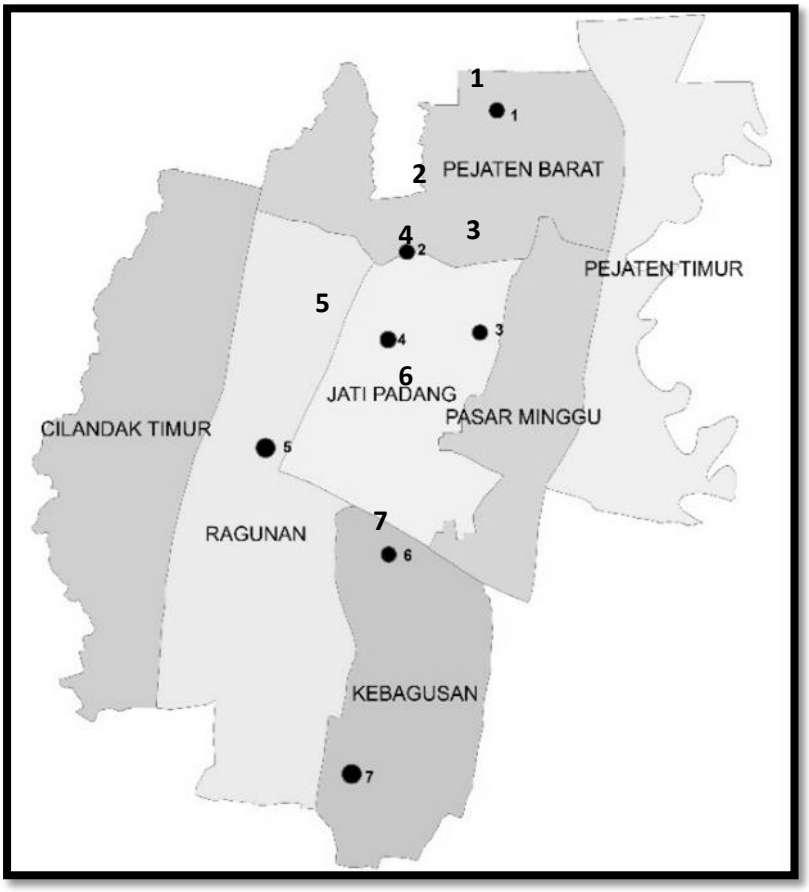

Figure 1. Sampling location map.

3. Results and Discussion

Amount of presence of E.coli in MPN/100 ml, where the results were obtained from sampling in May (sampling 1), June (sampling 2), and July 2017 (sampling 3) see Table 2. Based on the average number *E. coli* was found that the highest value of 738 MPN/100 ml located in Pejaten West village is Warung Jati Barat Street. The lowest value is in Jati Padang village that is Jatiwangi street 13 MPN/100 ml. With the average data of *E. coli* at third sampling times, the standard deviation score is 453. With a large standard deviation value indicates that the data obtained show high diversity (heterogeneous).

Table 2. Amount of *E.coli* bacteria at each sampling location.

Sub-district	No Sampel	Location	Sampling 1	Sampling 2	Sampling 3	Average	Quality Standard
			(MPN/100 ml)				
Pejaten Barat	1	Siaga Raya Street RT 12/ RW 4 no 8 Pejaten Barat	138 ± 1,442	<3 ± 0	1100 ± 0	414	0
	2	Condet Pejaten Street RT 1/RW 7 no 7	>1100 ± 0	1100 ± 0	< 3 ± 0,141	738	0
Jati Padang	3	Jatiwangi Street no 7 Jati Padang	12 ± 0,636	23 ± 0	<3 ± 0,967	13	0
	4	BP 7 Belakang Balai Street	>1100 ± 0	40,5 ± 0,353	< 3± 0,263	385	0
Ragunan	5	Damai Street no 62 RT 2/RW 1 Ragunan	1100 ± 0	780 ± 4,525	122 ± 4,030	664	0
Kebagusan	6	Kebagusan 1 Street no 9 Kebagusan	14 ± 0	195 ± 6,363	225 ± 2,121	159	0
	7	Kebagusan 4 Street Kebagusan	29 ± 1,485	195 ± 0,636	195 ± 0,636	150	0

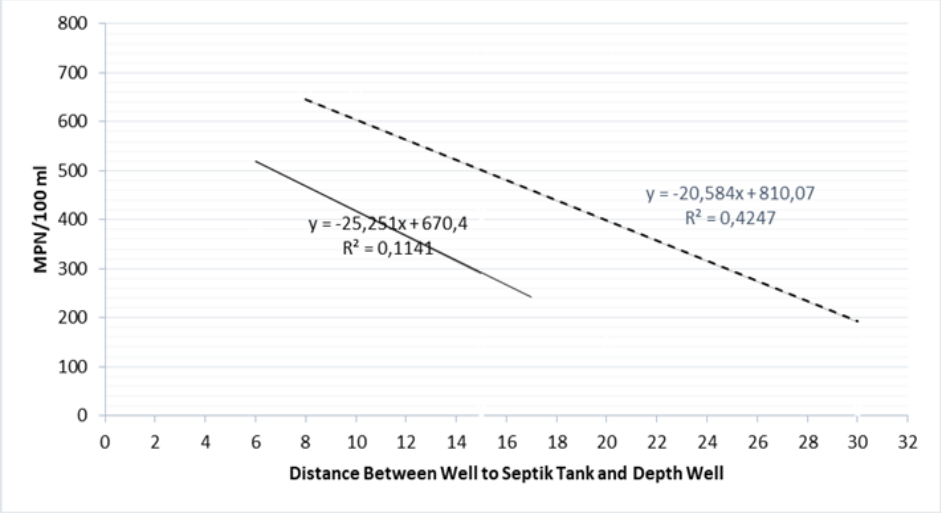

Figure 2. Correlation between amount of *e.coli* on the distance of wells to septic tank and depth well**.**

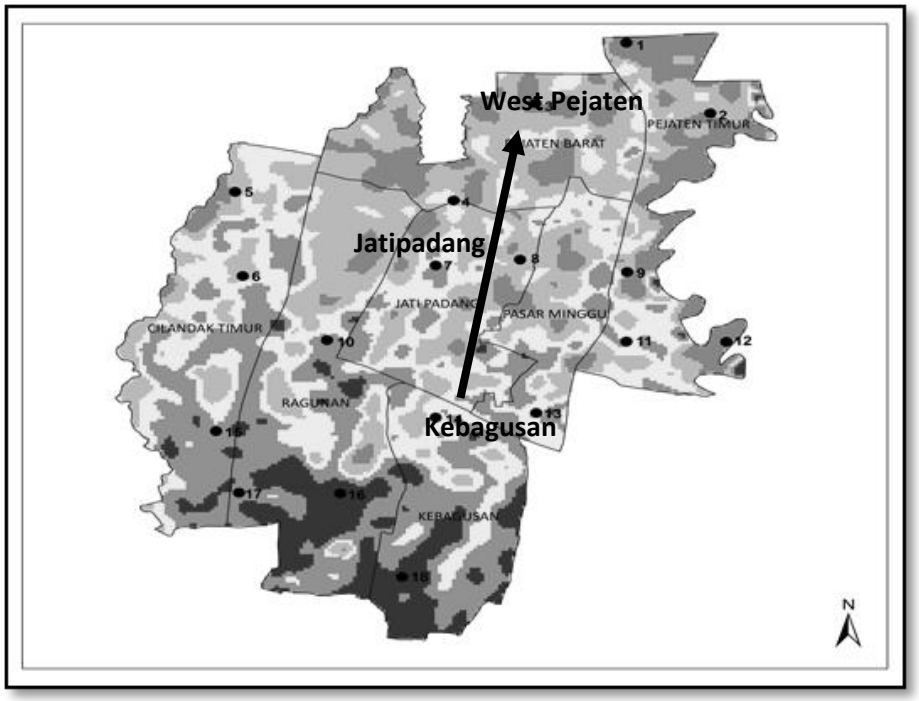

Figure 3. Map contour of Pasar Minggu district.

The relationship between the number of *E.coli* to the well distance to the septic tank (Figure 1) gives the regression coefficient 0.4247, which means there is a weak linear relationship between the number of *E.coli* with the well distances in the septic tank. And for the depth of the well gives a regression coefficient 0,11417 means a weak relationship between the amount of *E. coli* with the depth of well. So it can be concluded that the presence of *E. coli* in groundwater in Pasar Minggu subdistrict is influenced by the distance of the well to septic tank and the depth of the well but the influence is not significant or weak.

Based on the contour of Kebagusan subdistrict area is in the south of Pasar Minggu district and has the highest topography, then West Pejaten Village is in the northern part of Pasar Minggu and has the lowest topography (Figure 3). Based on the value of MPN analysis results in 3 the urban subdistrict, Kebagusan Village has the lowest MPN value, then the village of Jati Padang and West Pejaten village has the highest MPN value. It can be concluded that topography influences the amount of *E. coli*. The topography of the area is related to groundwater flow, ground water flows from high to low. This is supported by previous research that Winata (2013) proves that the pattern of *E. coli* distribution is increasing in the Bajiro village to Gembiraloka Residential following the flow direction of Gajah Wong from north to south, so that the *E. coli* bacteria distribution follows the direction of water flow [9].

4. Conclusion

With regression value obtained shows that there is a weak relationship between the number of bacteria *E.coli* (MPN/100 ml) with the well distance to septic tank. The presence of *E. coli* in ground water is influenced by groundwater flow based on the topography of the region. Based on the data obtained found that the amount of *E. coli* on the groundwater is all above the maximum value of the quality standard. Thus, this research is not recommended for the use of well water as the main source of drinking water in the area.

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