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Study Of Coliform And Escherichia Coli Bacteria Contamination In Part Of Gajahwong River Near Universitas Islam Negeri (Uin) Sunan Kalijaga Yogyakarta

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Abstrac

The development of an area is indicated by an increase in the number of settlements. The activities of the UIN Yogyakarta campus have had an impact on the number of newcomers living temporarily and permanently around the campus. The negative impact is caused by the pollution of the Gajahwong River water from the disposal of domestic waste from the surrounding population. This study aims to examine the pollution of coli and Escherichia coli bacteria in the Gajahwong River fragment around the UIN campus in Yogyakarta. The research method was used in the form of field surveys and secondary data analysis of environmental monitoring results from the Yogyakarta Provincial Environment Office during the period of 2015 - 2019. The results showed that the number of stools and a total of coli bacteria were far above the quality standard. Both coli bacteria reach maximum conditions in 2019 and occur during the dry season.

Keyword: pollution, escherichia coli, total coli bacteria

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I. INTRODUCTION

Water is one of the most essential substances for human life which its availability is relatively stable. However, it could be spatially and temporally different due to several conditions such as climate, soil condition, hydrogeology, geomorphology, and land use. Humans occupy different environmental conditions in this world. The water supply for the human need can come from the surface such as from river and lake and can be from the groundwater. Anisafitri et al (2020) defined that river was a channel/vessel that could occur naturally or artificially as a draining water system, from upstream to downstream, with border alongside. The river has a function as a water container or vessel and drains it from rainfall and tunnel. The river also has a function for humans such as cooking, taking shower, washing, watering plant, and irrigation.

Population growth affects the water quality that might decrease its quality. River water pollution could come from garbage, wastewater, fertilizer, pesticide, detergent, wrapping material, etc. (Anisafitri et al., 2020). River pollution could be from domestic wastewater which flows through the water body. One of the crucial issues is contamination by pathogen microorganisms from feces that can cause some serious diseases in the human body (Fathoni, et al., 2016). The microorganism could

be escherichia coli bacteria or total Coli bacteria that come from organic domestic waste, human feces, or cattle dung.

Most of the contaminant source is from the domestic. The denser population has more potential risk in generating organic waste which contains high Coli bacteria. This research is observing a river named Gajahwong in Yogyakarta, Indonesia. This river is surrounded by dense residence area and Universitas Islam Negeri (UIN) Sunan Kalijaga where the sewage is wasted in the river. The presence of university affects directly and indirectly to the population in Depok District, Sleman Regency, Yogyakarta. Gajahwong river flows through in the middle of Depok district from the north to the south and flows pass aside UIN. Gajahwong river receives water from rainfall and the sewages from the domestic. This condition affects the quality of the water river especially in the part of the Gajahwong river near UIN. This research is highlighting the contamination of the total coli and Escherichia coli contamination in the part of the Gajahwong river near UIN.

II. LITERATURE REVIEW

A coliform bacterium is one of the pathogen bacteria contamination indicators in water (river or lake) (Putri, et al., 2018). Total coliforms are divided into two groups, namely fecal coliforms, such as Escherichia coli from human feces, warm-blooded animals, and nonfecal coliforms, such as Aerobacter and Klebsiella which do not come from human feces but come from dead animals or plants (Sutiknowati, 2016).

Escherichia coli usually exists in the soil. If contamination occurs (generally organic pollutants characterized by a high concentration of Biochemical Oxygen Demand (BOD)), the soil becomes a good growth medium for these bacteria and causes an increase in the concentration of Escherichia coli in the soil. When it rains or the snow melts, more and more of these bacteria are carried by groundwater into rivers. Thus the concentration of Escherichia Coli will be detected in high groundwater and rivers, thus indicating soil contamination (Sutiknowati, 2016).

Escherichia coli bacteria was discovered in 1885 by Theodor Escherich and named after its discoverer. Escherichia coli is a rod-shaped bacteria with a length of about 2 micrometers and a diameter of 0.5 micrometers. The volume of Escherichia coli cells ranges from 0.6 - 0.7 m^3. These bacteria can live in a temperature range of 20-40 ^{0}C with the optimum temperature at 370 ^{0}C and are classified as gram-negative bacteria (Sutiknowati, 2016). Escherichia coli is a pathogenic bacterium that is a part of coliform. This bacterium exists in human feces and could cause several serious diseases such as colitis, diarrhea, urinary tract, and bile duct infection (Arisanty et al., 2017).

Escherichia coli cannot be killed by cooling or freezing. These bacteria can only be killed by antibiotics, Ultraviolet (UV) rays, or high temperatures > 1000 ^{0}C. High temperatures will damage the proteins in cells and make them unable to live again (Sutiknowati, 2016).

III. RESEARCH METHODOLOGY

This research is conducted in a part of the Gajahwong river which is located near to Universitas Islam Negeri Yogyakarta, Depok district, Sleman Regency, Special Province of Yogyakarta. The observed

points are the outlet of sewages and the impacted river during 2015 – 2019. The sampling for analysis was conducted three times in a year in the rainy season, transition period, and dry season. The data were obtained from the provincial environmental service. The 5-year analysis is conducted using a trend line graphic. The change in water quality is also associated with the population growth rate in Sleman Regency.

IV. FINDING AND DISCUSSION

IV.1. Climate Condition in the part of Gajahwong river Depok district

The climate is associated with the duration of the rainy and dry season which also affected the flowrate and contamination concentration. When the debt is low, the contamination concentration will increase.

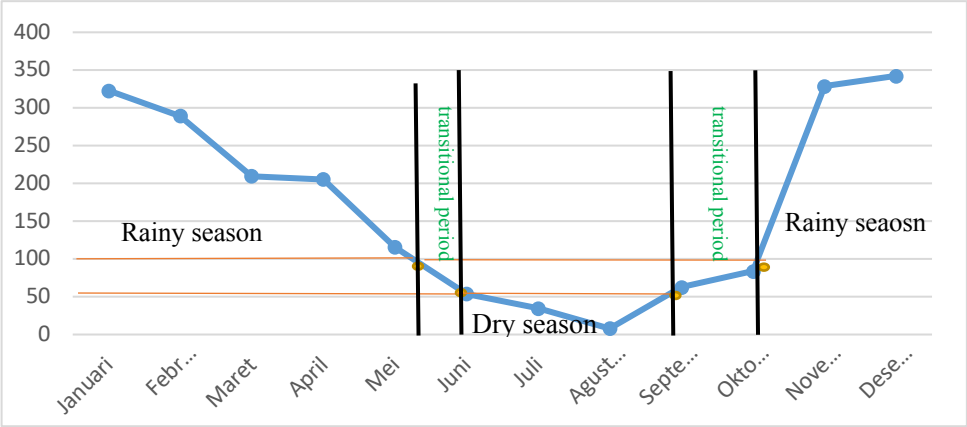


Figure 1. Rain precipitation Gajahwong river in Depok district, Sleman Regency, Special Province of Yogyakarta

In the rainy season, the rain precipitation shows 100 mm/month from October until May. In the dry season, from June to September, the rain precipitation shows below 60 mm/month. The transitional period occurred in May – June, and September – October.

IV.2. Coli Bacteria in the part of Gajahwong River

According to the regulation of Governor of Special Region of Yogyakarta number 22 2007, regarding the classification of river water, the Gajahwong river is categorized as class 2. The quality standard of total coliform for water river of class2 is 5000 MPN/100 ml and the escherichia coli is 1000 MPN/100 ml. The quality standard of the number of e coli is not mentioned in the regulation. However, e coli is equal to the amount of Escherichia coli bacteria. The higher amount of e coli the higher of escherichia coli.

Tabel 1. Concentration of escherichia coli bacteria in Gajahwong river near UIN Yogyakarta 2015-2019

No	*Climate*	***2015***	***2016***	***2017***	***2018***	***2019***
1	Rainy season	7000	15000	15000	15000	240000
2	Transitional period	460000	11000	23000	11000	39000
3	Dry season	93000	7000	93000	7000	21000000

Table 1 shows the e coli has a high concentration if it is equalized to escherichia coli quality standard. The coli bacteria exceed the quality standard. In rainy and dry season show inclining trend (Figure. 2 and 3). The increment rate gradient occurred in the dry season because the flowrate in the dry season is lower than in the rainy season. The stagnancy and motionless water in the dry season caused the bacteria to reproduce faster.

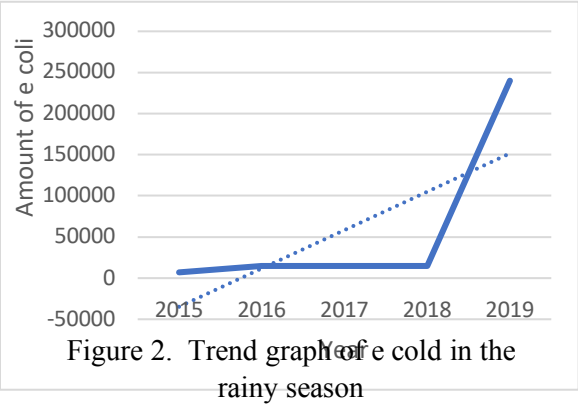


Figure 2. Trend graph of e cold in the rainy season

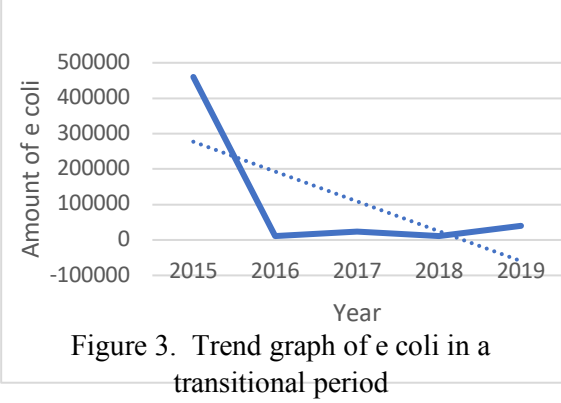


Figure 3. Trend graph of e coli in a transitional period

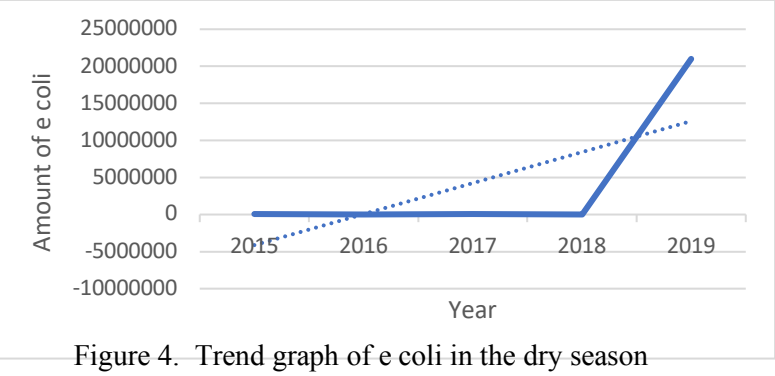


Figure 4. Trend graph of e coli in the dry season

Table 2 shows the total coliform bacteria exceed the quality standard. It shows tens of thousands to millions. Total coliform is the total amount of pathogenic and nonpathogenic Coli bacteria in water. The change rate is fluctuating between the rainy season, transitional period, and dry season. In the rainy season and the transitional period, the change rate shows a declining trend, even though it shows a fluctuating trend in the transitional period (Fig. 5 and 6).

Table 2. Total coli bacteria concentration in the part of Gajahwong river near UIN Yogyakarta during 2015 - 2019

No	*Climate*	***2015***	***2016***	***2017***	***2018***	***2019***
1	Rainy season	2400000	210000	43000	28000	240000
2	Transitional period	2400000	20000	93000	28000	1600000
3	Dry season	1100000	14000	460000	11000	160000000

In the dry season, the change rate trend of total coliform bacteria tended to incline, and in 2019 the amount reached 160000000 MPN/100 ml (Figure 6). This extreme amount is assumed due to the long dry season (el Nino) in 2019 and caused the flowrate was very low. The stagnancy and motionless water in the dry season caused the bacteria to reproduce faster.

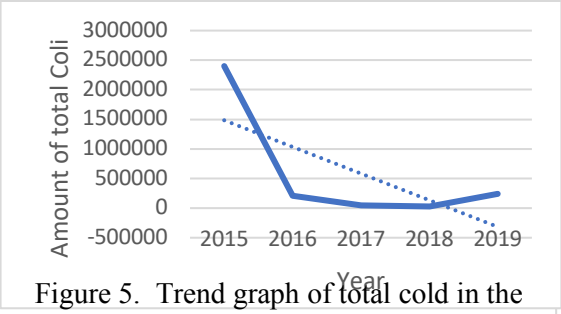


Figure 5. Trend graph of total cold in the rainy season

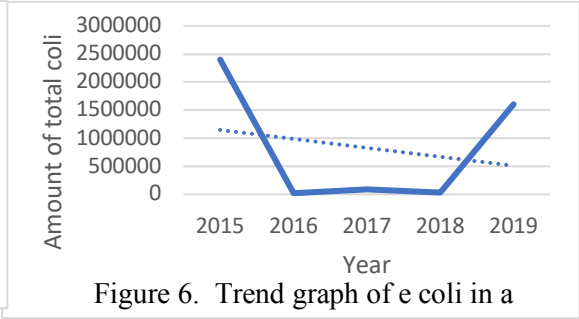


Figure 6. Trend graph of e coli in a transitional period

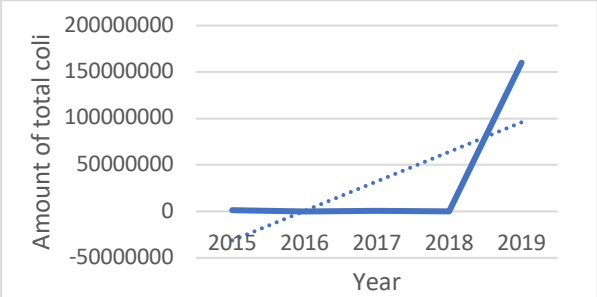


Figure 7. Trend graph of e coli in the dry season

IV.3. The effect of the rate of population change on the number of coli bacteria in the Gajahwong river

The average population growth in Sleman regency is 1.1 / year. This population growth affects the generated domestic waste which would increase the number of coli bacteria in the Gajahwong river as well.

Tabel 3. Population in Depok sub-district and the number of e coli in part of Gajahwong river UIN Yogyakarta during 2015 – 2019

Year	2015	2016	2017	2018	2019
Population	185707	188771	189649	210510	225246
Amount of total coli bacteria	93000	7000	93000	7000	21000000

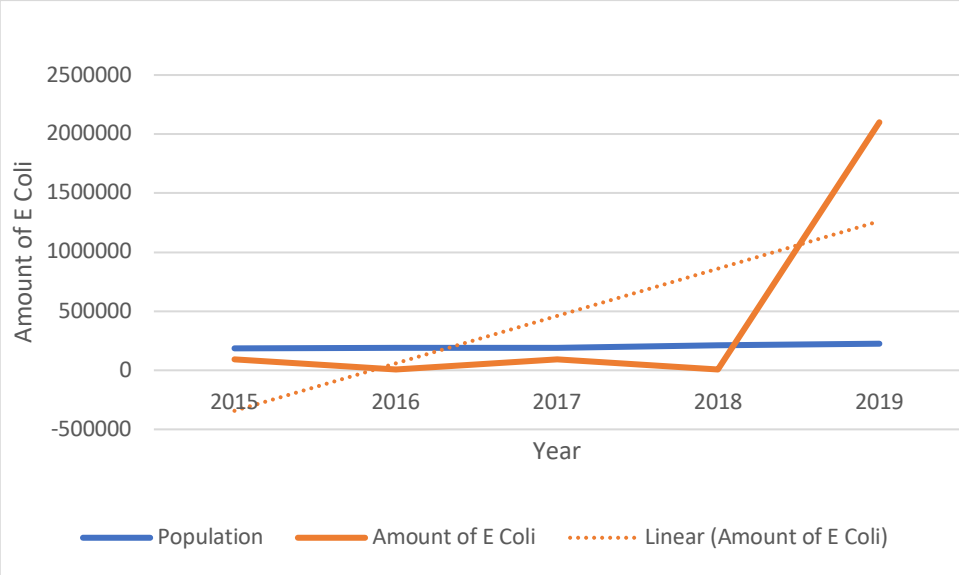
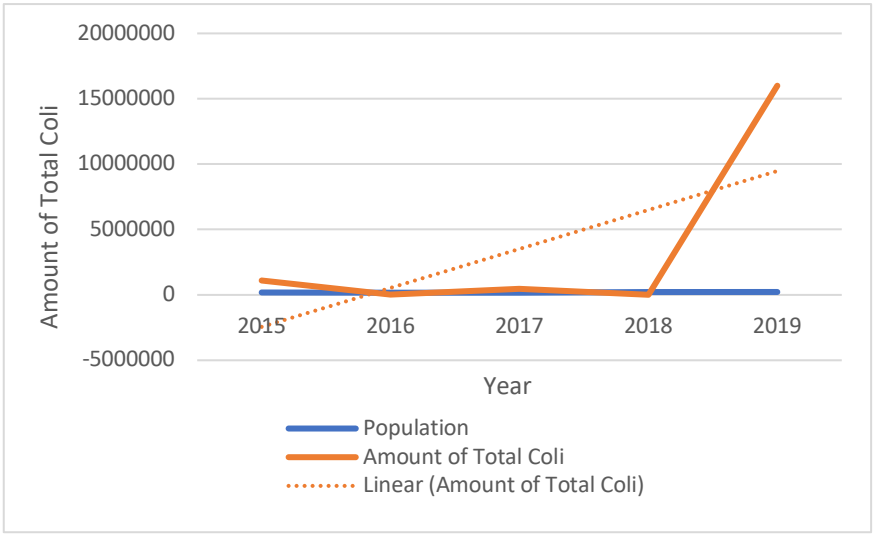


Figure 8. Trend graph the effect of population growth on the number of e coli

Table 3 and figure 8 shows the increase in population growth affects the e coli amount with the incline trend line. This means the population growth is linearly proportionally to the e coli amount.

Table 4. Population in Depok district and the amount of total coli in part of Gajahwong river near UIN Yogyakarta during 2015 -2019

Year	2015	2016	2017	2018	2019
Population	185707	188771	189649	210510	225246
Amount of total coli	1100000	14000	460000	11000	160000000



The trend of total coli bacteria shows linearly proportional to the population growth (Table 4 and Figur 9). This increase is due to the domestic waste that was disposed of directly to the river through the sewage. This contamination can possibly cause health concern to the local society near the river. The contaminated water in the river has the potential to infiltrate the well and cause secondary contamination of total coli and e coli.

V. CONCLUSION AND FURTHER RESEARCH

The increase of total coli and e coli in the Gajahwong river were affected by climate and the population growth. In the dry season, the number of coli bacteria significantly increased than in the rainy season and transitional period. The rise of population growth also affected the increase of e coli and total Coli contamination in part of the Gajahwong river, Depok District, Sleman Regency, Yogyakarta.

VI. RECOMMENDATION

Further research is required to be conducted along the Gajahwong river from the upstream to the downstream and also to link the other possible factors such as land use, another type source contaminant, and waste flowrate that flow through the river body.

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