Artikel

A Study on Bacteriological Measurement of Clean Water in Raja Ampat

Linda Yanti Juliana Noya[1,] *Yura* Witsqa Firmansyah[2]

[1]Balai Teknik Kesehatan Lingkungan dan Pengendalian Penyakit (BTKLPP), Ambon City, Indonesia
[2]Doctoral Program in Environmental Sciences, Graduate School, Universitas Sebelas Maret, Surakarta City 57126, Indonesia
Corresponding author: firmansyahyura@gmail.com

Abstrak: Ketersediaan air bersih merupakan hak yang wajib didapatkan oleh seluruh manusia. Namun sayangnya, beberapa sumber air di Indonesia tercemar oleh total *coliform* dan *Escherichia coli* yang mengancam kesehatan. Penelitian ini bertujuan untuk melakukan pengukuran total *coliform* and *Escherichia coli* di Kecamatan Weisai, Kabupaten Raja Ampat, Provinsi Papua Barat sebagai usaha pemantauan kualitas lingkungan. Penelitian ini merupakan studi observasional dengan pendekatan kuantitatif. Data primer dalam penelitian ini adalah pengukuran Total *coliform* dan *Escherichia coli*. Sampel yang digunakan adalah air bersih di sumur bor kelurahan Bambang Sutejo (T1); sumur gali kelurahan Nyonya Fransina (T2); dan sumur gali kelurahan Om Miter (T3). Pengujian sampel dilakukan oleh Balai Teknik Kesehatan Lingkungan dan Pengendalian Penyakit (BTKLPP), Kota Ambon dan diambil pada 28 November 2022. Hasil pengujian didapatkan, parameter total *coliform* sebesar 1.600 MPN/100 mL dan *Escherichia coli* 2.2 di lokasi T1. Sementara itu T3 konsentrasi total *coliform* and *Escherichia coli* melebihi 1.600 MPN/100 mL. Lokasi T1 dan T3 memiliki nilai yang melebihi baku mutu. Hal tersebut disebabkan karena limbah peternakan yang tidak memiliki saluran pembuangan air limbah dan tidak adanya saluran pembuangan air limbah domestik secara komunal.
Kata Kunci: Air bersih, Total *coliform*, *Escherichia coli*

Abstract: The availability of clean water is a right that all humans must obtain. Unfortunately, some water sources in Indonesia are polluted by total *coliform* and *Escherichia coli*, which threaten health. This study aims to measure total *coliform* and *Escherichia coli* in the Weisai sub-district, Raja Ampat Regency, West Papua province, to monitor environmental quality. This research is an observational study with a quantitative approach. Primary data in this study is the measurement of total *coliform* and *Escherichia coli*. The samples used were clean water in the borehole well of Bambang Sutejo village (T1); the dug well of Nyonya Fransina village (T2); and the dug well of Om Miter village (T3). Sample testing was conducted by the Environmental Health and Disease Control Technical Center (BTKLPP), Ambon City, and taken on November 28, 2022. The test results obtained, total *coliform* parameters of 1,600 MPN/100 mL and *Escherichia coli* 2.2 at location T1. Meanwhile, the T3 concentration of total *coliform* and *Escherichia coli* exceeded 1,600 MPN/100 mL. Locations T1 and T3 have values that exceed quality standards. This is due to livestock waste that does not have a wastewater disposal channel and the absence of communal domestic wastewater disposal channels.
Keywords: *Clean water,* Total *coliform, Escherichia coli*

1 INTRODUCTION

The availability of clean water is a right that all humans must obtain. Water is an important component of an ecosystem (Aznar-Sánchez *et al.* 2019). In line with good clean water sources, globally, 2.2 billion people use groundwater for daily activities (Murphy *et al.* 2019). The use of groundwater is of serious concern, with the World Health Organization (WHO) declaring that pathogen contamination from human feces and waterborne microbes is possible. Directly using

untreated groundwater is a significant cause of enteric diseases globally (Prudden *et al.* 2020). In addition, in a review study conducted by Firmansyah et al., the use of water contaminated with total pathogenic *coliform* and *Escherichia coli* for daily activities caused diarrhea in toddlers (Firmansyah *et al.* 2021). Poor water, sanitation, and hygiene (WASH) causes 842,000 deaths each year from diarrhea and hampers the prevention of malnutrition, numerous neglected tropical diseases (NTDs), and cholera (WHO 2022).

Total *coliform* and *Escherichia coli* are parameters of clean water and drinking water that must be measured and not be found in clean water sources cited from the Regulation of the Minister of Health of the Republic of Indonesia number 32 of 2017. Coliform bacteria are divided into two groups: total *coliform* and *fecal coliform* (Indiana State Department of Health 2009). One type of total *coliform* bacteria is *Salmonella*, a pathogen of typhoid disease, while fecal coliform bacteria is Escherichia coli, a pathogen of diarrhea disease. The presence of *coliform* bacteria is generally in the digestive system of animals and humans (New York State Department of Health 2017). *Coliform* bacteria are found in the environment through human and animal waste (Firmansyah *et al.* 2021).

Based on the description of these problems, there is a need for massive monitoring of clean water quality in Indonesia. This research was conducted in the Weisai sub-district, Raja Ampat Regency, West Papua province. Biological parameters (total *coliform* and *Escherichia coli*) were measured in several wells in the Weisai sub-district.

2 METHOD

This study is an observational study with a quantitative approach. Primary data used in this study were measurements of biological parameters (total *coliform* and *Escherichia coli*). The measurement of biological parameters was carried out by the Environmental Health and Disease Control Technical Center (BTKLPP), Ambon City. The test method for total *coliform* parameters was IKM/5.4.12/BTKL-AMQ double tube, while *Escherichia coli* used the IKM/5.4.13/BTKL-AMQ double tube method. The sample used was well water with a random sampling technique obtained from three wells, namely the Bambang Sutejo village borehole well (T1); Nyonya Fransina village dug well (T2); and the Om Miter borehole well village (T3) at Weisai Health complex Raja Ampat. The existing condition of the area is a livestock area with no communal wastewater treatment plant. Secondary data used are articles published in journals with themes following this study. This research was conducted on November 23-27, 2021.

3 RESULT AND DISCUSSION

The samples were submitted on November 28, 2022, to the Environmental Health and Disease Control Technical Center (BTKLPP), Ambon City. Testing was conducted for three days. The results of the December 1, 2022 test are presented in table 1 below,

Table 1. Test Results of Biological Parameters in Well Water of Weisai sub-district 2022

Location	Type of Sample	Unit	Result of Test	Limit Standart
T1	Water borehole well	MPN/100 mL	Total *coliform* (1.600) *Escherichia coli* (2.2)	Total *coliform* 50 *Escherichia coli* 0
T2	Water dug well		Total *coliform* (<1.8) *Escherichia coli* (<1.8)	
T3	Water dug well		Total *coliform* (>1.600) *Escherichia coli* (>1.600)	

Table 1 shows the results of total coliform and Escherichia coli measurements in the Weisai subdistrict, Raja Ampat Regency, West Papua province. Based on the test results, location T1 had total coliform and Escherichia coli concentrations that exceeded the quality standards

11

with values of 1,600 and 2.2 MPN/100 mL, respectively. Meanwhile, location T3 also had concentrations that exceeded the quality standards for total coliform and Escherichia coli >1,600 MPN/100 mL.

The observation results of locations T1 and T3 have farms in the vicinity. There are also pigs roaming around locations T1 and T3. Unquestionably, *environmental coliform bacteria* come from animal and human waste or feces. In line with the study conducted by Frena et al. 2019, the seasonal distribution of *fecal coliform* can be found in tropical estuaries sourced from domestic waste; animal and human feces (Frena *et al.* 2019). Farms that do not have sewerage automatically discharge their waste into the environment. Over a long time, livestock waste in the environment will experience infiltration in the soil layer to contaminate groundwater. Furthermore, in Maharashtra, India, anthropogenic activities are a source of *coliform* bacteria contamination (Mukate *et al.* 2018). In line with the Paraná River, Argentina study, *coliform* bacteria were identified from anthropogenic community sources (Blettler *et al.* 2019).

Another cause is the absence of domestic wastewater sewers. Not all communities have proper latrines and wastewater treatment plants. Undoubtedly, *Escherichia coli* habitat in the human digestive system. When human feces are not disposed of in the sewerage system, it becomes a source of contaminants in the environment (Dinata 2022; Melliawati 2009). On the other hand, in T2, there are no livestock areas, and the community already has latrines. Nonetheless, there is a need for regular inspection of the T2 site, especially regarding the latrine structure and the initiation of communal sewerage.

4   CONCLUSION

The results of measuring water samples at T1, T2, and T3 showed that the total *coliform* and *Escherichia coli* parameters exceeded the quality standards at locations T1 and T3. The test results at T1 had total *coliform* and *Escherichia coli* concentrations that exceeded the quality standards with values of 1,600 and 2.2 MPN/100 mL. Meanwhile, at T3, the total *coliform* and *Escherichia coli* values exceeded 1,600 MPN/100 mL. The source of contamination came from livestock waste and the unavailability of adequate latrines. Livestock waste that does not have a sewer will pollute the environment, including

groundwater sources. The unavailability of restrooms and domestic water treatment plants also contribute to total *coliform* and *Escherichia coli* contamination in the environment. It is necessary to build a livestock wastewater treatment plant, build good latrines, and communal domestic sewerage to reduce total *coliform* and *Escherichia coli* contamination in the environment as pathogenic diarrhea.

ACKNOWLEDGMENT

REFERENCES

Aznar-Sánchez, J, A, Velasco-Muñoz, J, F, Belmonte-Ureña, L, J, & Manzano-Agugliaro, F. 2019. The worldwide research trends on water ecosystem services. *Ecological Indicators*. 310–323. Doi.org/10.1016/j.ecolind.2018.12.05.

Blettler, M, C, M, Oberholster, P, J, Madlala, T, Eberle, E, G, Amsler, M, L,, De Klerk, A, R, Szupiany, R. 2019. Habitat characteristics, hydrology and anthropogenic pollution as important factors for distribution of biota in the middle Paraná River, Argentina. Ecohydrology and Hydrobiology. 19(2),296–306. Doi.org/10.1016/j.ecohyd.2018.08.002

Dinata, A. 2022. Pertumbuhan Dan Kelangsungan Hidup Escherichia Coli. Loka Penelitian dan Pengembangan Kesehatan Pangandaran.

Firmansyah, Y, W, Ramadhansyah, M, F, Fuadi, M, F, and Nurjazuli, N. 2021. Faktor-Faktor Yang Mempengaruhi Kejadian Diare Pada Balita: Sebuah Review. Bul. Keslingmas. 40(1), 1-6.

Firmansyah, Y, Setiani, O, Darundiati, Y, H, Joko, T, & Raharjo, M. 2021. Water Pollution Index and The Distribution of Waterborne Diseases on The East Flood Canal, Semarang City : An Analysis Spatial. Jurnal Aisyah : Jurnal Ilmu Kesehatan. 6(3), 569-578. Doi.org/10.30604/jika.v6i3.701.

Frena, M, Santos, A, P, S, Souza, M, R, R, Carvalho, S, S, Madureira, L, A, S. & Alexandre, M, R. 2019. Sterol biomarkers and fecal coliforms in a tropical estuary: Seasonal distribution and sources. Marine Pollution Bulletin. 139(November 2018), 111–116. Doi.org/10.1016/j.marpolbul.2018.12.007.

Indiana State Department of Health. 2009. Diseases Involving Sewage. https://www.in.gov/health/eph/files/diseases.pdf.

Melliawati, R. 2009. Escherichia Coli dalam kehidupan manusia. BioTrends. Volume 4, nomer 1. https://terbitan.biotek.lipi.go.id/index.php/biotrends/article/download/19/21

Mukate, S, Panaskar, D, Wagh, V, Muley, A, Jangam, C, & Pawar, R. 2018. Impact of anthropogenic inputs on water quality in Chincholi industrial area of Solapur, Maharashtra, India. Groundwater for Sustainable Development. 359–371. Doi.org/10.1016/j.gsd.2017.11.001.

Murphy, H, M, Prioleau, M, D, Borchardt, M, A, and Hynds, P, D. 2017. Review: Epidemiological evidence of groundwater contribution to global enteric disease, 1948-2015. Hydrogeology Journal. Vol. 25, no. 4, pp. 981–1001. Doi:10.1007/s10040-017-1543-y.

New York State Department of Health. 2017. Coliform Bacteria in Drinking Water Supplies. https://www.health.ny.gov/environmental/water/drinking/coliform_bacteria.htm.

Prudden, H, J, Hasso-Agopsowicz, M, Black, R, E, Troeger, C, Reiner, R, C, Breiman, R, F, Jit, M, Kang, G, Lamberti, L, Lanata, C, F, Lopman, B, A, Ndifon, W, Pitzer, V, E, Platts-Mills, J, A, Riddle, M, S, Smith, P, G, Hutubessy, R, Giersing, B. 2020. Meeting Report: WHO Workshop on modelling global mortality and aetiology estimates of enteric pathogens in children under five. Cape Town, 28–29th November 2018. Volume 38, issue 31. Doi.org/10.1016/j.vaccine.2020.01.054.

World Health Organization. 2022. Water, sanitation and hygiene (WASH). https://www.who.int/news-room/fact-sheets/detail/drinking-water