Biota: Jurnal Ilmiah Ilmu-Ilmu Hayati, Vol. 5 (1): 42-47, Februari 2020
p-ISSN 2527-3221, e-ISSN 2527-323X, https://ojs.uajy.ac.id/index.php/biota
DOI: 10.24002/biota.v5i1.2938

URL terbitan

Coliform BacteriaQuantity as Bioindicator for Water Pollution(Case Study of Several Tributaries in Purwokerto City, Banyumas Regency, Central Java)

Nur Laila Rahayu[1*], Eko Hendarto[2], Indah Sulistiyawati[1], Rina Dwi Agustiani[3]

*[1, 3] **Biology Study Program, Faculty of Science and Technology, University of Nahdlatul Ulama Purwokerto**, Jl. Sultan Agung No.42, Karangklesem, Kec. Purwokerto Sel., Kabupaten Banyumas, Jawa Tengah, Indonesia*
*[2] **Animal Husbandry Study ProgramFaculty of Animal Husbandry, University of Jenderal Soedirman,** Jl. DR. Soeparno No.60, Karangwangkal, Kec. Purwokerto Utara, Kabupaten Banyumas, Jawa Tengah, Indonesia*
*[3]**Biologi Study Program, Internasional Women University**, Jl. Pasir Kaliki No. 179 A, Bandung, Jawa barat, Indonesia*
Email : nurlailarahayu@gmail.com **Penulis Korespondensi*

Abstrak

This research examines several tributaries of a large river. Some tributaries that pass through the city of Purwokerto are Raden River, Caban River, t Jurig River and Luhur River. Tributaries have the potential to affect water quality. This study aimed to analyze the quantity of Coliform bacteria as an indicator of water pollution in several tributaries in Purwokerto City, Banyumas Regency. Microbiological tests were carried out by calculating the total Coliform quantity and Fecal Coliform using the Most Probable Number (MPN) test. Coliform and Fecal Coliform total can be used as a indicator reference of water quality in the presence of water pollution. The laboratory test results for Coliform bacteria quantity showed that in several tributaries in Purwokerto City, Banyumas Regency, there was a massiveof Coliform or Fecal Coliform, exceeding the water quality standard.

Keywords: coliform bacteria, water quality, water pollution

Received: 14 November 2019, approved: 20 January 2020

Introduction

Purwokerto city is one of the developing cities in Central Java Province, precisely on the slopes of Mount Slamet. This city is passed by several tributaries, namely the Raden River, Caban River, Jurig River and Luhur River (PSDA, 2010). Tributaries are very potential in influencing water quality and very beneficial for the lives of Purwokerto people. The benefits are mainly for irrigation, agriculture and household needs. The existence of tributaries is often used unwisely, for example being used to dispose of household waste, garbage and other wastes. Changes in the designation of small rivers are closely related to the progress of the economy of a region. Increasingpopulation every year also increases settlements that will dispose of waste directly or indirectly into the river.The waste discharged directly into the river will affect the quality of river water (Indarsih et al., 2011; Shoolikhah et al., 2014).

The river is often used to dispose of feces such as human, animal or garbage disposal, thus the river water often contains infectious diseases such as dysentery, cholera, typhus and other digestive tract diseases. The aquatic environment is easily polluted by pathogenic microorganisms that enter from various sources such as settlements, agriculture and animal husbandry. The high use of riparian zone along river flow will affect the entrance of waste into river water body.The change in land utilization is from rice fields to settlements. The use of riparian zone will affect the concentration of bacteria in the river, particularly fecal coliform bacteria (Kalaivani, et.al, 2014; Eleria and Vogel, 2005).

One indicator of microbial pollution is the presence of coliform bacteria. Coliform bacteria belong to the family Enterobacteriaceae which has 14 genera (Waluyo, 2007). Common bacterium used as an indicator of contamination of a water body is *Escherichia coli*, which is one of bacteria that is classified as coliform and lives normally

in human and animal feces, thus it is also called faecal coliform. Faecal coliform is a member of coliform which is able to ferment lactose at 44.5ºC and is the major part (97%) in human and animal feces (Effendi, 2003). Alaerts and Santika (1994) stated that Faecal coliform is the most efficient indicator of faecal pollution, because Faecal coliform is only and always found in human feces. If the bacterium is present in the waters, it can be said that the waters have been polluted and cannot be used as a source of drinking water. Other coliform bacteria derived from animals and dead plants are called non-fecal coliforms.(Alaerts and Santika, 1994). Divya and Solomon (2016) assessed Chalakudy River surface water to evaluate the pollution burden in the river due to the presence of Coliform bacteria in the Chalakudy River. The study found that the microbial contamination was detected very high in the form of Total Coliform bacteria. The result of high Total Coliform bacterial content followed by water quality content when compared to other rivers.

The objective of the study was to analyze the quantity of coliform bacteria as an indicator of water pollution in several tributaries in Purwokerto City, Banyumas Regency. Microbiological test that will be carried out are the total number calculation of coliforms and fecal coliforms using the Most Probable Number (MPN) test. Through the quantity of coliform bacteria, the water quality in several tributaries in Purwokerto City, Banyumas Regency can be known.

Research Method

This study was conducted in several tributaries in the Purwokerto City Banyumas Regency namely Raden River (Upstream 7º 22’ 56,172” S 109º 14’ 22,618” E - Downstream 7º 26’ 35,254” S 109º 15’ 47,588” E), Caban River (Upstream 7º 23’ 48,570” S 109º 13’ 52,644” E - Downstream 7º 27’ 17,611” S 109º 13’ 57,353” E), Jurig River (Upstream 7º 23’ 47,116” S 109º 13’ 17,800” E - Downstream 7º 26’ 31,348” S 109º 13’ 22,436” E) and Luhur River (Upstream 7º 24’ 41,044” S 109º 12’ 49,064” E - Downstream 7º 26’ 9,287” S 109º 12’ 56,790” E) in Desember 2018.

The method used in this study was a survey method applied from the upstream to downstream of Raden River, Caban River, Jurig River, Luhur River. The sampling technique was done by purposive sampling at eight observation stations with two repetitions in two-week intervals. One upstream regional station represents the area before Purwokerto and one downstream regional station represents the area after Purwokerto. A total of 100 ml of sample was put into a sterile bottle and placed in a cool box to be taken to the laboratory.

The quantity of coliform bacteria determined in this study was total coliform and fecal coliform which followed the MPN method according to Waluyo (2009) procedure. Lactose Broth (LB) tubes which showed positive results were incubated in tubes containing media and Durham tubes. Coliform bacteria determined by incubation were kept at 37ºC for 2x24 hours.

Data analysis was performed using qualitative analysis technique. The analysis results were compared with environmental quality standards according to Government Regulation No. 82 of 2001 concerning Management of Water Quality and Water Pollution Control. The class IV quality standards was used as a comparison, that is water which designation can be used to irrigate crops and or other uses that require the same water quality as the purpose. The reason of the use of designation class IV is due to the river being studied is a small river and not intended as raw water. The river to be studied is a river that is mostly used for domestic waste disposal, hence makes it appropriate to be compared to class IV quality standards in Government Regulation No. 82 of 2001.

Results And Discussion

The quantity of coliform bacteria for fecal coliforms and total coliforms both upstream and downstream of the Raden River exceeds the threshold of quality standard. Fecal coliform and total coliform contained in the downstream was higher than the upstream. Fecal coliform at the upstream was 23,000 sum/100 ml while at the downstream was 170,000 sum/100 ml. Total coliform at the upstream was 49,000 sum/100 ml while at the

downstream was 350,000 jml/100ml. The high content of fecal coliform and total coliform greatly exceeds the quality standard where the quality standard for fecal coliform is 2000 sum/100 ml while at the upstream part of the Raden river waters was 23,000 sum/100 ml and at the downstream was 170,000 sum/100 ml. The total content of coliform exceeds the threshold of quality standard grade IV where the upstream part is 49,000 sum/100 ml and the downstream part is 350,000 sum/100 ml (Figure 1).

High bacterial content in the Raden River is thought to be caused by dense settlements on the riparian zoneThe majority of the settlements on the riparian zone allegedly disposed of domestic waste directly into the river which is indicated by the large number of pipes or sewer into the river.

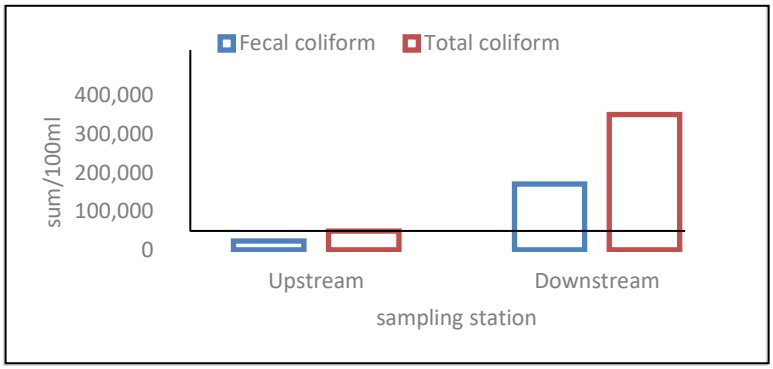

Figure 1. Laboratory test results for total coliform and fecal coliform quantities in the Raden River

Microbiological parameters exceed the threshold of quality standard both for upstream and downstream parts. The content of fecal coliform and total coliform in the downstream was higher than the upstream. Fecal coliform in the upstream part was 130,000 ml/100 ml while at the downstream partwas 540,000 ml/100 ml. Total coliform in the upstream part was 130,000 sum/100 ml while in the downstream part was 540,000 sum/100 ml. On the other hand, the high content of fecal coliform and total coliform was very far exceeding the quality standard for fecal coliform quality standard that was 2,000 sum/100 ml while in the Jurig river was 130,000 sum/100 ml for the upstream part and 540,000 sum/100 ml for the downstream part. Furthermore, the total coliform content exceeds the threshold of quality standard of 130,000 sum/100 ml in the upstream and 540,000 sum/100 ml in the downstream. The high content of fecal coliform and total coliform bacteria in the Jurig River is due to the large number of settlements along the riparian zone. Domestic waste disposed of by residents generally contains a lot of organic material so that there are many microorganisms contained in Jurig River.

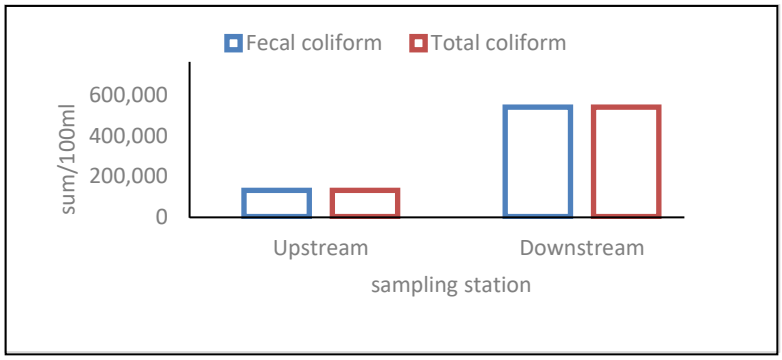

Figure 2. Laboratory test results for total coliform and fecal coliform quantities in the Jurig River

Microbiological parameters exceed the threshold of quality standard for both upstream and downstream parts. The fecal coliform and total coliform contents in the downstream part were the same as the upstream part. Fecal coliform in the upstream part was 350,000 sum/100 ml while in the downstream part was 350,000 sum/100 ml. The total coliform in the upstream was 350,000 ml/100 ml while in the downstream was 350,000 ml/100 ml. The high content of fecal coliform and total coliform greatly exceeds the quality standard where the quality standard for fecal coliform was 2,000 sum/100 ml while in Caban river waters was 350,000 sum/100 ml in the upstream and 350,000 sum/100 ml in the downstream. The total coliform content exceeds the threshold of quality standard where the upstream part was 350,000 sum/100 ml and the downstream part was 350,000 sum/100 ml. The high content of fecal coliform and total coliform bacteria in the Caban River is due to the large number of settlements along the riparian zone. Domestic waste that is disposed of generally contains a lot of organic material so that there are many microorganisms contained in the Caban River.

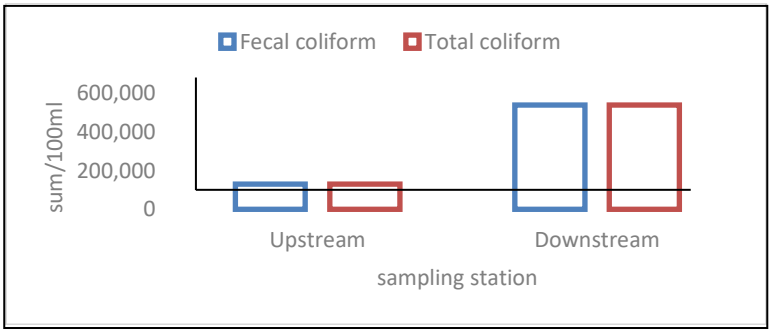

Figure 3. Laboratory test results for total coliform and fecal coliform quantities in the Caban River

Microbiological parameters exceed the threshold of quality standard Grade IV for both the upstream and downstream parts. The high coliform and colifecal in the Luhur River is due to the large amount of domestic waste entering the water body. Furthermore, microbiological parameters exceed the threshold of quality standard for both upstream and downstream parts. The fecal coliform and total coliform contents in the downstream were the same as the upstream. Fecal coliform upstream was 350,000 sum/100 ml while downstream was 110,000 sum/100 ml. Total coliform in the upstream was 350,000 sum/100 ml while in the downstream was 140,000 sum/100 ml. The high content of fecal coliform and total coliform greatly exceeds the threshold of quality standard where the quality standard for fecal coliform was 2,000 sum/100 ml while the upstream and downstream parts of Luhur River were 350,000 sum/100 ml and 110,000 sum/100 ml, respectively. Subsequently, the total coliform content exceeds the threshold of quality standard where the upstream part was 350,000 sum/100 ml and the downstream part was 140,000 sum/100 ml. The high content of fecal coliform and total coliform bacteria in the Luhur River is due to the large number of settlements along the riparian zone. Domestic waste that is disposed of to the waters generally contains a lot of organic material so that there are many microorganisms contained in the Luhur River.

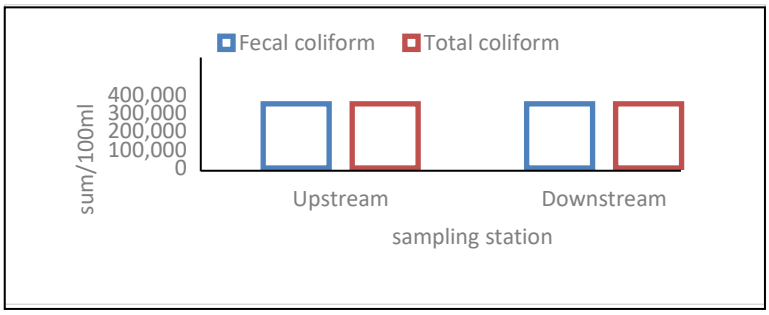

Figure 4. Laboratory test results for total coliform and fecal coliform quantities in the Luhur River

As seen at Figure 5,coliform quantities in all rivers exceed the threshold of quality standard. The highest total coliform was in the Caban River of 350,000 ml/100 ml while the lowest total coliform was in the Raden River which of 199,500 ml/100 ml. The highest fecal coliform was in the Caban River of 350,000 ml/100 ml while the lowest fecal coliform was in the Raden River of 96,500 ml/100 ml. The total coliform and fecal coliform of each river exceeds the threshold of quality standard due to dense settlements along the river flow or theriparian zone. A majority of settlements around the riparian zone disposed of domestic waste directly into the river. The disposal of domestic waste was very influential on river water quality(Figure 6). Domestic waste contains high organic matter. This is in accordance with research conducted by Bahri et al. (2015) that a high total coliform is caused by high organic matter content in the waters. The presence of coliform bacteria may represent the river quality. Fecal coliform content concentration will increase in urban river areas along with the increase in river flow and rainfall (Sanders et.al, 2013).

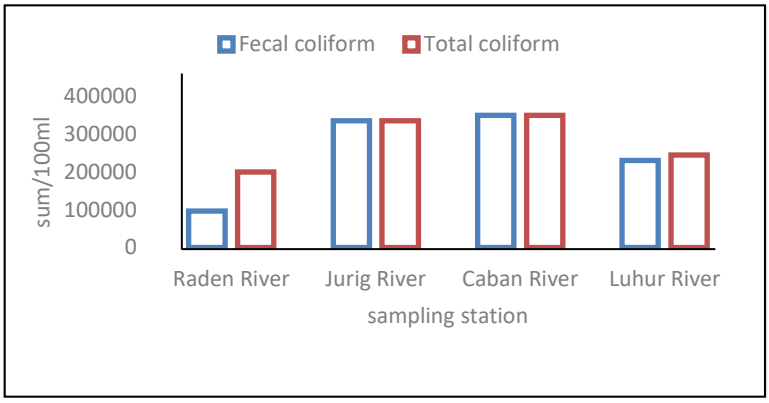

Figure 5. Laboratory test results for coliform quantity in several tributaries in the Raden River of Purwokerto City Banyumas Regency

Figure 5. Small Rivers in the City of Purwokerto, Banyumas Regency

Conclusion

The quantity of coliform bacteria in several tributaries in Purwokerto City, Banyumas Regency is very high both for total coliform and fecal coliform, which exceeds the water quality standard of class IV.

Reference

Andrianto, R. 2018. Pemantauan Jumlah Bakteri *Coliform* Di Perairan Sungai Provinsi Lampung. *Majalah Teknologi Agro Industri (Tegi)*. Vol 10 (1) Juni 2018. 1-6

Bahri, S., Ramadhan, F., & Reihannisa, I. 2015. Kualitas Perairan Situ Gintung, Tanggerang Selatan. Biogenesis Jurnal ilmiah Biologi, ISSN 2302-1616. Vol 3(1), Juni 2015, Hal 16-22.

Divya and Solomon. 2016. Effects of some water quality parameters especially total coliform and fecal coliform in surface water of Chalakudy river. *Procedia Technology* 24; 631 – 638

Eleria, A. & Vogel, W.M. (2005). Predicting Fecal Coliform Bacteria Levels in the Charles River, Massachusetts, USA. *Journal of the American Water Resources Association (JAWRA), 41(5),* 1195-1209.

Feliatra, 2002, Sebaran Bakteri *Escherichia coli* di Perairan Muara Sungai Bantan Tengah Bengkalis Riau, Fakultas Perikanan dan Kelautan, Universitas Riau,Pekanbaru. *Jur. Biogen*. 1. 178-18.

Indarsih, W., Suprayogi, S. & Widyastuti, M. (2011). Kajian KualitaPembuangan Limbah Cair Sentra Industri Batik Desa Wijirejo. *Majalah Geografi Indonesia, 25(1),* 40-54.

Kalaivani, T.R., Dheenadayalan, M.S. & Sivakumar, K.K. (2014). Microbial Status in River Coom Pollution, Chennai, India. *Journal of Science, 4(2),* 113-116.

PSDA. 2010. Kajian Sungai Kabupaten Banyumas. Dinas Pengelolaan Sumber Daya Air (Psda) Wilayah Sungai Serayu-Sungai Citanduy. Kabupaten Banyumas

Sanders, E.C., Yuan, Y. & Pitchford, A. (2013). Fecal Coliform and *E. coli* Concentrations in EffluentDominated Streams of the Upper Santa Cruz Watershed. *Water, 5,* 243-261.

Shoolikhah, I., Purnama, Ig.S. & Suprayogi, S. (2014). Kajian Kualitas Air Sungai Code Propinsi Daerah Istimewa Yogyakarta. *Majalah Geografi Indonesia, 28(1),* 23-32.

Waluyo, L. 2007. Mikrobiologi Umum. Penerbit Universitas Muhammadiyah Malang, Press. Malang

Waluyo, L. 2009. Mikrobiologi Lingkungan. Universitas Muhammadiyah Malang, Press. Malang