

# Urban river water quality improvement in Bandung City, Indonesia

*by* Yonik Meilawati

---

**Submission date:** 31-Aug-2023 12:49PM (UTC+0700)

**Submission ID:** 2154821755

**File name:** n\_river\_water\_quality\_improvement\_in\_Bandung\_City,\_Indonesia.pdf (952.17K)

**Word count:** 3421

**Character count:** 18620

PAPER · OPEN ACCESS

## Urban river water quality improvement in Bandung City, Indonesia

To cite this article: Y M Yustiani and T Alfiah 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **896** 012053

View the [article online](#) for updates and enhancements.

### You may also like

- [Water Quality Improvement Effective Analysis for Artificial Groundwater Recharge in Urban River Network System](#)  
Wang Xiao, Wei Jun, Cheng Kaiyu et al.
- [A Study on Application of Ecological Engineering Methods to a River Pollution Remediation – Case study of Liuchuan River](#)  
Che-Yu Hsu and Sheng-Jung Ou
- [Study on Impact of Industrial Structure Upgrading on Energy Efficiency in the Yellow River Basin—Based on the data of 2001–2019](#)  
Liu Juan



### 244<sup>th</sup> Electrochemical Society Meeting

October 8 – 12, 2023 • Gothenburg, Sweden

50 symposia in electrochemistry & solid state science

▶ Deadline Extended!  
**Last chance to submit!**

New deadline:  
April 21  
**submit your abstract!**

## Urban river water quality improvement in Bandung City, Indonesia

Y M Yustiani<sup>1\*</sup>, T Alfiah<sup>2</sup>

<sup>1</sup>The Department of Environmental Engineering, Universitas Pasundan, Jl. Dr. Setiabudhi 193, Bandung 40153, Indonesia

<sup>2</sup>The Department of Environmental Engineering, Institut Teknologi Adhi Tama Surabaya, Indonesia

yonik@unpas.ac.id

**Abstract.** Bandung City is one of the big cities in Indonesia with a relatively poor river water quality. Several improvement efforts have been made, especially by the government. This study aims to review these improvement efforts and the results obtained. The rivers that are the leading review are the Cikapundung River, Citepus River, Cicadas River, and Cipamokolan River. The data was obtained from the monitoring results conducted by the government environmental service bureau of Bandung and the Province of West Java. Based on the study results, it was found that there was an improvement in the water quality of the Citepus River, but this river had a non-biodegradation capacity in 2020. The high TSS, COD, BOD, and MBAS detergents indicate the dominating domestic activity in urban watersheds. The most significant control effort to improve the quality of river water in the city of Bandung is the availability of waste treatment at the source, both household and regional scale. Onsite efforts to improve river water quality also have a positive impact, i.e., applying an eco-enzyme solution and developing structures in the river for the aeration process.

### 1. Introduction

Intensive activity in urban areas can cause pollution of river water in the city [1]. Bandung is one of the big cities that has a high level of economic activity in Indonesia. In the last ten years, the river water quality in Bandung is categorized into polluted, lightly polluted, and heavily polluted criteria based on the river water quality index.

The functions of rivers in the city of Bandung include as a source of raw water for drinking water, recreation areas, fisheries businesses, and water for agriculture, especially in upstream and downstream areas. With these various functions, the quality of river water should be maintained to function properly. The leading causes of pollution in urban rivers include domestic waste from households that enter the river without prior treatment [2,3]. In addition, the activities of small industries or home industries also contribute to pollutant conditions in the river in the city of Bandung. The river that passes through Bandung City mostly empties into the Citarum River, which is in the southern part and is a river whose rehabilitation efforts are a priority for the Indonesian government.

In the last three years, the Bandung City Government has made efforts to rehabilitate the river water quality with various efforts. However, the level of success of these efforts has not been analyzed. This study aims to identify the condition of river water quality in Bandung City, which focuses on 4 (four)



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Published under licence by IOP Publishing Ltd

major rivers, namely the Cikapundung River, Citepus River, Cicadas River, and Cipamokolan River. The influence of the river's efforts for river water quality improvement that the Bandung City Government has carried out will also be investigated. Evaluation of river rehabilitation efforts has generally been carried out for the Citarum River, a major river that is a priority for the Indonesian government. However, this evaluation has not been carried out for rivers that empty into the Citarum River, including rivers that pass through Bandung [4,5].

Through this research, recommendations are also formulated for rehabilitation efforts that have the most impact so that river quality management in Bandung can be carried out properly on the target.

## 2. Methodology

### 2.1. River water quality data

The rivers selected as representatives of urban rivers in Bandung are the Cikapundung River, Citepus River, Cicadas River, and Cipamokolan River. The Cikapundung River passes through Bandung City right in the middle of the city [6], while the Citepus River is in the west [7] and the Cicadas and Cipamokolan rivers are in the east [8,9]. These four rivers represent rivers in the city of Bandung, which have various activities.

Identification of river water quality is carried out from annual monitoring data carried out by the Bandung City Environment Service. The time duration considered in data processing is the last three years, namely 2018 to 2020. The data used is the result of monitoring in September, representing the dry season where river discharge reaches its lowest point. In this condition, the quality of river water is usually the worst, so it can be used to make recommendations for improving river quality.

### 2.2. Main parameters

The parameters of primary concern are total suspended solids (TSS), biochemical oxygen demand (BOD), and chemical oxygen demand (COD). This parameter was chosen as an indicator of the level of pollution usually caused by urban activities. In addition to these parameters, the detergent parameter (MBAS) is also considered, showing the condition of waste from household or domestic waste.

### 2.3. Data analysis

All the main parameters were analyzed based on the quality standards set by the Indonesian government, namely a maximum of 50 mg/L for TSS, 3 mg/L for BOD, 25 mg/L for COD, and 0.2 mg/L for detergent MBAS. The quality standard is the maximum limit for each river water quality parameter in Class 2 based on Government Regulation of the Republic of Indonesia No. 22 the year 2021.

There are 4 types of classes for this river waters. The government carries out the determination of water classes for each river with their respective functions. Rivers in Bandung City were categorized as Class 2, rivers with functions as water recreation infrastructure/facilities, freshwater cultivation, animal husbandry, water for irrigating crops, and/or for similar functions.

Data analysis was also carried out by calculating the ratio of BOD to COD to determine the level of biodegradation capacity of the river. Biodegradation capacity is biodegradable if the ratio is more than 0.6, slow biodegradable if it ranges from 0.3 to 0.6, and non-biodegradable if it is less than 0.3 [10].

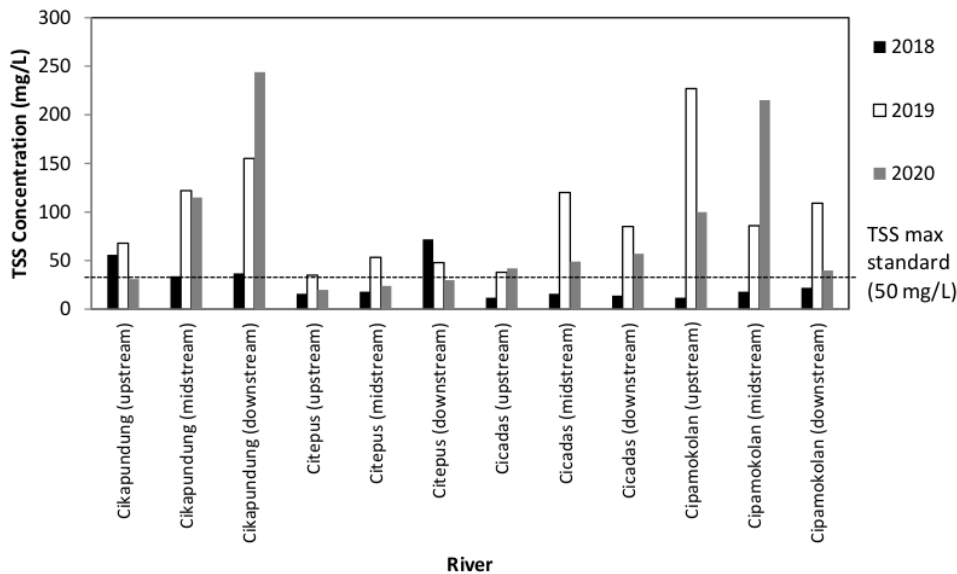
### 2.4. Information about improvement efforts

Data on the efforts made by the government and the private sector, and communities in improving river water quality were obtained through literature studies and other sources. This data includes the time and methods of improvement that have been implemented.

### 3. Result and discussion

#### 3.1. River water quality parameters

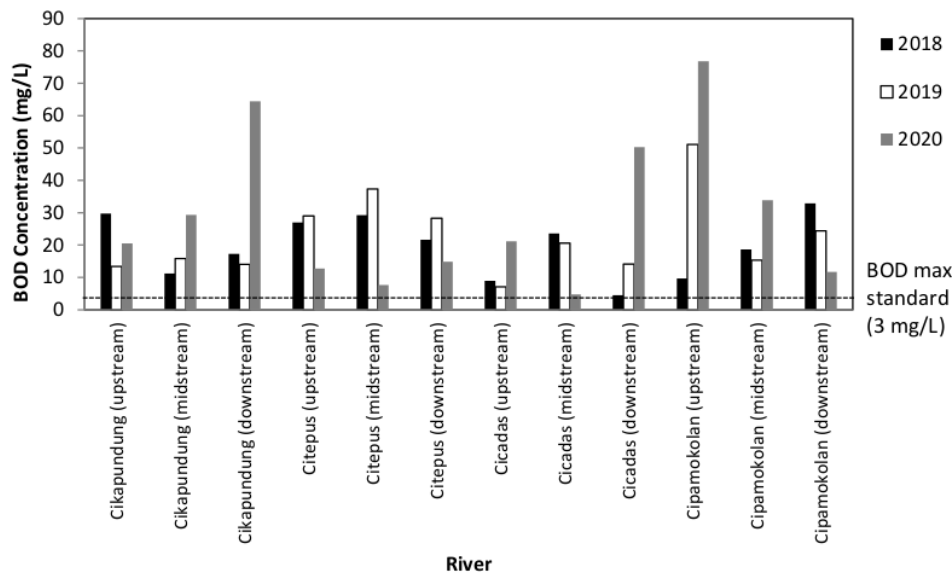
Figures 1 to 4 are recapitulation of the results of water quality monitoring for the main parameters in this study, i.e. TSS, BOD, COD and MBAS detergent.



**Figure 1.** TSS concentrations of the rivers taken on every September of 2018, 2019 and 2020.

The concentration of TSS in 2018 looks low and almost entirely meets the quality standards only seen exceeding the maximum limit of quality standards in upstream Cikapundung and downstream Citepus. The Cikapundung River, which passes through the central part of Bandung City, shows a trend towards downstream the higher pollution level, especially in 2019 and 2020. It can happen if there is waste that enters along with the river flow. The concentration of TSS in the upstream river is low except for the Cipamokolan River in 2019. The high concentration of TSS causes many problems for the health of aquatic ecosystems [11].

Based on the trend of TSS concentration as seen in Figure 1, the Citepus River and Cicadas River experienced an improvement in quality in 2020. However, the TSS concentration increased in the downstream Cikapundung River and the midstream Cipamokolan.



**Figure 2.** BOD concentrations of the rivers taken on every September of 2018, 2019 and 2020.

Figure 2 shows an increase in BOD concentration as an indicator of pollution in 2020, especially in the Cikapundung River. The further downstream, the value of the BOD concentration increases. The Citepus River has improved its quality in terms of the BOD value but is still above the maximum quality standard. The high BOD value indicates the amount of organic matter contained in the waters. The decomposition process of organic matter will consume dissolved oxygen in the water so that its concentration decreases. Low oxygen concentrations result in the death of aquatic organisms [12].

Figure 3 also shows the increasing COD concentration in 2020 in the Cikapundung River. Meanwhile, in the Citepus River, the COD concentration decreased in line with the BOD trend. There was also a sharp increase in the downstream Cicadas River. The high number of BOD and COD in the downstream Cicadas River can occur due to local activity waste directly discharged into the river without processing [13]. The land use of the land around the Cicadas River is dense settlements and home industry.

Land use affects river water quality, especially if the waste generated is not treated before being discharged into the river [14,15]. Usually, home industries that produce foods such as processed soybeans generate waste with high levels of BOD and COD [16].

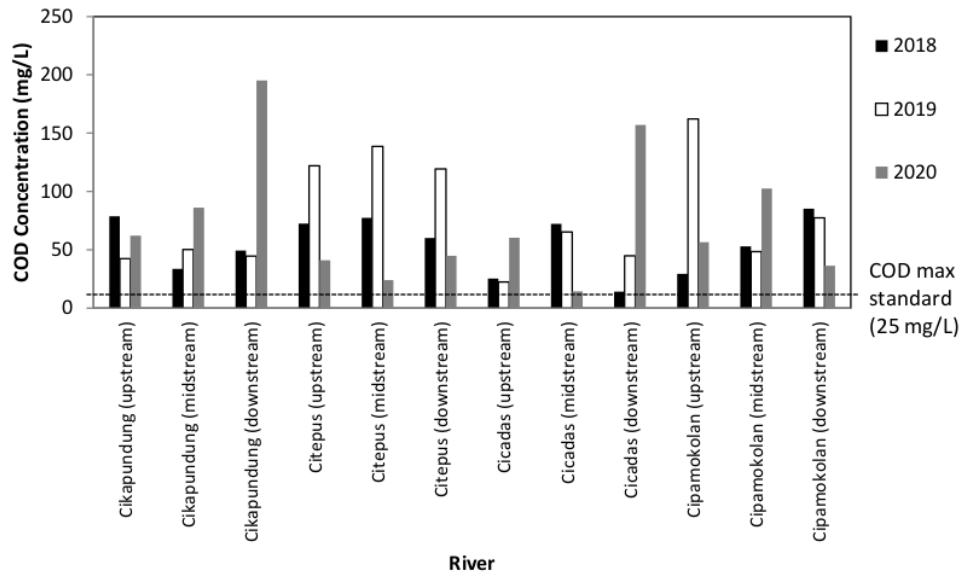


Figure 3. COD concentrations of the rivers taken on every September of 2018, 2019 and 2020.

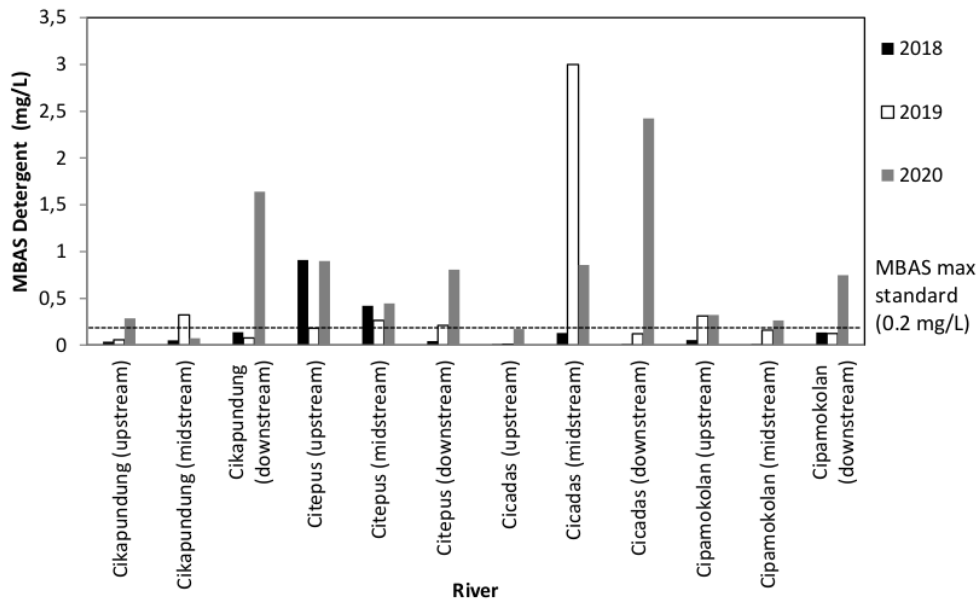


Figure 4. MBAS detergent concentrations of the rivers taken on every September of 2018, 2019 and 2020.



Based on the graph in Figure 4, it can be seen that detergent concentrations increased in 2020 except for the midstream Cicadas. In 2019, detergent concentrations in midstream Cicadas were very high. A high amount of detergent can interfere with the life of aquatic organisms [17]. In addition to being sourced from household activities, detergents can also come from laundry businesses and motor vehicle washing which are widely available in Bandung [18].

Based on the four main parameters that become indicators of domestic waste, it is seen that the efforts made by the government and non-government have not given good results. In 2020 there was a relatively significant increase in pollution, especially in the Cikapundung River. The Citepus River experienced a quality improvement in 2020 for TSS, BOD, and COD parameters but experienced a decrease in quality, as seen from the detergent MBAS parameter.

### 3.2. BOD/COD ratio

The biodegradation capacity calculated from the BOD/COD ratio can show the self-purification ability of river water [17]. Table 1 shows the categories of biodegradation capacity of each river.

**Table 1.** Biodegradation capacity.

River	Year			Analysis
	2018	2019	2020	
Cikapundung (upstream)	slow-biodegradable	non-biodegradable	non-biodegradable	worsen
Cikapundung (midstream)	non-biodegradable	non-biodegradable	slow-biodegradable	improve
Cikapundung (downstream)	non-biodegradable	non-biodegradable	biodegradable	improve
Citepus (upstream)	slow-biodegradable	slow-biodegradable	non-biodegradable	worsen
Citepus (midstream)	slow-biodegradable	slow-biodegradable	non-biodegradable	worsen
Citepus (downstream)	non-biodegradable	slow-biodegradable	non-biodegradable	worsen
Cicadas (upstream)	non-biodegradable	non-biodegradable	non-biodegradable	worsen
Cicadas (midstream)	non-biodegradable	non-biodegradable	non-biodegradable	worsen
Cicadas (downstream)	non-biodegradable	non-biodegradable	biodegradable	improve
Cipamokolan (upstream)	non-biodegradable	biodegradable	biodegradable	improve
Cipamokolan (midstream)	non-biodegradable	non-biodegradable	slow-biodegradable	improve
Cipamokolan (downstream)	slow-biodegradable	slow-biodegradable	non-biodegradable	worsen

Based on Table 1, the Cicadas River seems to have decreased its biodegradability, both in the upstream, middle, and downstream areas. The downstream Cikapundung River, the downstream Cicadas River, and the upstream Cipamokolan River have biodegradable characteristics. Taking this into account, improvements in river water quality indicated by a decrease in pollutant concentrations are not necessarily followed by river improvements in terms of biodegradability.

### 3.3. Efforts to improve river water quality

Activities to improve river water quality in the city of Bandung have been carried out using various methods [20]. These activities are technical, educational, and management. River cleaning technology, among others, is carried out by installing garbage nets in several rivers in the city of Bandung carried out by the Bandung City Government, one of which is at the location of recreational facilities on the Cikapundung River, i.e., the Cikapundung Terrace, to minimize waste thrown into the river and also reduce the potential for flooding. Installation of garbage nets is very effective in improving the quality of river water. However, if it is not appropriately designed, it will cause problems such as obstruction of flow, resulting in silting the river [21].



The Bandung City Public Works Department often holds activities intending to improve river quality. One of the things done by this department is the application of eco-enzyme, which is made from fermented organic waste to the river. Based on research, it is stated that this eco-enzyme can improve surface water quality [22,23]. This activity has not shown a significant improvement impact because it is still determining the exact dose of eco enzyme for the river. The Department of Public Works also uses water hyacinth plants to improve river water quality following the phytoremediation method.

Physically, the design of the river channel is also made by allowing the river water to be turbulent to provide an opportunity to enter oxygen (reaeration) into the water column. However, this improvement in river channel design is not practical because the river structure is disturbed by polluting garbage. Raising public awareness is also very important. The community habits of throwing waste and discharge wastewater into rivers are often found in big cities in Indonesia due to the low awareness of environmental conservation [24,25]. Several things can be achieved with a high level of public awareness, i.e., the reduction of waste generated, the return of the habit of cooperation activities. Public awareness of river water quality management can be increased through various activities, including counseling about waste, the dangers, and waste management. Education given from an early age is also a factor that indirectly affects the quality of river water. Involvement of the nearby river community in river management may also improve the river's environmental quality [26].

#### 3.4. Recommendation

Improving the quality of river water directly in the river is very difficult if the waste continues to enter the river without prior treatment. The provision of eco-enzymes and the use of phytoremediation methods cannot overcome the waste that continues to enter water bodies. Therefore, the quickest and most reasonable effort to improve the quality of river water in the city of Bandung is the provision of wastewater treatment facilities for all potential pollutants that will enter the river, both from housing and non-domestic sources such as home industries, hospitals, shops.

Garbage that also interferes flow of river water should also be prohibited from being dumped into the river. Garbage collection sites must be available in sufficient quantities and affordable. Even though a community drives awareness of environmental cleanliness, a 'hard structure' approach in the form of providing waste management facilities will be convenient to implement.

#### 4. Conclusion

Based on the data for the last three years, the quality of rivers in Bandung, represented by the Cikapundung River, Citepus River, Cicadas River, and Cipamokolan River, has shown a decline. The concentrations of TSS, BOD, COD and MBAS detergent for the majority increased in 2020. The Citepus River seems to have improved in quality but has a deteriorating biodegradation capacity which reduces the self-purification ability in the river waters. In general, river water quality is getting worse downstream. It shows that the river receives effluent from diffused sources along the stream. Efforts that both government and non-government have made have not had a significant positive impact. The approach to providing sewage treatment plants is a recommendation to accelerate the improvement of urban river water quality in Bandung.

#### References

- [1] Sidabutar N V, Namara I, Hartono D M and Soesilo T E B 2017 *IOP Conf Ser: Earth Environ Sci* **67** 012034
- [2] Wang Y, Liu Y, Huang J, Wu T and Huang J 2020 *J Phys: Conf Ser* **1549** 022056
- [3] Zhao Z, Wang H, Zhang Y, Deng C, Xie Q and Wang C 2020 *Water* **12** 2260
- [4] Erianti S and Djelantik S 2019 *Jurnal Ilmu Administrasi* **XVI(1)** 81-96
- [5] Juniarti N 2020 *Jurnal Pengabdian kepada Masyarakat* **3(2)** 256-271
- [6] Yustiani YM 2016 *Pollut Res* **35** 475
- [7] Yustiani YM, Mulyatna L and Pranata F 2013 *AIP Conference Proceeding* **1554** 281-284
- [8] Juandi A 2016 *Civicus* **20(2)** 57-68

- [9] Nuryono B, Adinda N R, Mulyadi Y 2019 *Jurnal Isu Teknologi* **14(2)** 9-18
- [10] Tamyiz M 2015 *Journal of Research and Technology* **1(1)** 9 – 15
- [11] Wisna U J, Ondara K 2017 *Journal of Marine and Aquatic Sciences* **3(2)** 154
- [12] Daroini T A, Arisandi A 2020 *Juvenil* **1(4)** 558-566
- [13] Yustiani Y M, Wahyuni S and Kadir A 2019 *Journal of Community Based Environmental Engineering and Management* **3(1)** 9-14
- [14] Hastutiningrum S, Muchlis and Astari N A 2020 *Jurnal Teknologi Technoscintia* **12(2)** 189-194
- [15] Wirosedarmo R, Haji A T S and Zulfikar F 2016 *Jurnal Sumberdaya Alam dan Lingkungan* **3(1)** 33-39
- [16] Sayow F, Polii B V J, Tilaar W A K D *Agri-SosioEkonomi Unsrat* **16(2)** 245-252
- [17] Larasati N N, Wulandari S Y, Maslukah L, Zainuri M and Kunarso 2021 *Indonesian Journal of Oceanography* **3(1)** 13p
- [18] Pradiko H, Mulyatna L, Afiatun E, Heraudi, A F 2021 *IOP Conf Ser: Mater Sci Eng* **1098** 5 052029
- [19] Yustiani Y M and Komariah I 2017 *Int J Geomate* **12(34)** 45-50
- [20] Yustiani Y M, Hasbiah A W, Matsumoto T and Rachman I 2019 *IOP Conf Ser: Earth Environ Sci* **245** 1 012033
- [21] Karmiaty B T and Rafiq R N 2020 *Jurnal Terapan Teknik Mesin* **1(1)** 1-11
- [22] Muliarta I N and Darmawan I K 2021 *Agriwar Journal* **1(1)** 7-12
- [23] Janarthanan M, Mani K and Raja S R S 2020 *IOP Conf Ser: Mater Sci Eng* **955** 012098
- [24] Wijaya Y F and Muchtar H 2019 *Journal of Civic Education* **2(5)** 405-411
- [25] Komariah I and Matsumoto T 2016 *Sampurasun* **2(1)** 115-121
- [26] Leng S T K, Weng C N and Samat N 2020 *EpSBS* **10(02)** 14

# Urban river water quality improvement in Bandung City, Indonesia

---

ORIGINALITY REPORT

---

**21** %  
SIMILARITY INDEX

**18** %  
INTERNET SOURCES

**15** %  
PUBLICATIONS

**12** %  
STUDENT PAPERS

---

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

---

7%  
★ Submitted to Universitas Diponegoro  
Student Paper

---

Exclude quotes      Off  
Exclude bibliography      On

Exclude matches      Off