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Phytoremediation of water quality in the Ciujung River with local potentials of Panicum sp. Bioagent

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ABSTRACT

The Ciujung River has been polluted, and its load-carrying capacity has decreased. Several parameters that exceed water quality standards are BOD, COD, DO, TDS, temperature, and pH. One of the methods that can be used to reduce pollution in Ciujung River water is phytoremediation. Phytoremediation, namely cleaning, eliminating, and reducing toxicity in polluted land or water with photosynthetic plant mediators. This study aims to improve the water quality of the Ciujung River using the phytoremediation method using plants from the Poaceae family, namely *Panicum sp.*. This study used static phytoremediation techniques with plant variations of 300 gr (P1), 500 gr (P2), and 700 gr (P3) in 5 liters of Ciujung River water samples for 30 days. The results showed that for the mass variation of 300 grams (P1), there was an increase in pH from 6-8, an increase in TDS from 97-322.5 ppm, and a decrease in temperature from 29-25.3°C. In the 500 gr mass variation (P2), there was an increase in pH from 6-8, an increase in TDS from 97-460 ppm, and a temperature from 29-25.4°C. In the 700 gr mass variation (P3), there was an increase in pH from 6-8, an increase in TDS from 97-461 ppm, and a decrease in temperature from 29-25.6°C. And there was a decrease in BOD from 15.6 mg/l – 1.2 mg/l, COD from 33.2 mg/l – 10.3 mg/l, and an increase in DO from 3.7 mg/l – 15.7 mg /l.

Conflict of interest: The authors declare that they have no conflicts of interest.

Introduction

The Ciujung River is one of the largest rivers in Banten Province which has an area of ±4,170.85 km² and a length of 147.2 km[1]. The Ciujung River is a very important source of water utilization for the local community. Not only that but also in industrial, domestic, agricultural, and fishery activities.

As with other rivers in Indonesia, the Ciujung River is one of the rivers that has problems such as a decrease in water quality or pollution in the river water and a decrease in water

discharge during the dry season. At present, the status of the Ciujung River is moderate to severe and there has been a decrease in the carrying capacity of organic pollution loads from upstream to downstream. This causes the river to be unable to reduce industrial waste disposal so that the water becomes black and the smell is quite pungent. Pollution of the Ciujung River water caused by industrial waste will have an impact on decreasing water quality and affecting the economic, social, and environmental sectors which can harm the local community. Many industrial activities and human activities result in the release of heavy metal waste into the environment. This condition can cause disruption, and damage, and is also very dangerous for living things that depend on water. Not only industrial waste can cause a decrease in water quality but also caused household waste, both liquid waste and solid waste[2].

Parameters that are often used to see pollution in rivers can be determined by looking at the size of the BOD (Biological Oxygen Demand) value. If the BOD value is higher, the river water will be more polluted and vice versa. The other parameters are COD (Chemical Oxygen Demand), temperature, DO (Dissolved Oxygen), pH, and heavy metal content. The results of parameter studies that have been carried out on the water quality of the Ciujung River, namely the downstream area, show an average BOD of 15.6 mg/l and COD of 33.2 mg/l [1]. Industrial areas have temperatures of 28°-30°C, DO (3.7-7.8 mg/l), and pH (6.6-7.5)[3]. This value is the value above the quality standard set by the government. From the results of the parameter research, waste treatment must be carried out to minimize the potential for pollution of the Ciujung River. One of the methods that can be used to treat waste is phytoremediation.

Phytoremediation is a method of improving the land by binding to compounds and absorbing to reduce the concentration or toxicity of chemical compounds as an effort to restore natural conditions that are environmentally friendly, effective, and require low costs compared to other treatments[4]. Phytoremediation techniques are also interpreted as technologies for removing, cleaning, or reducing pollutant substances in the soil or water using one of the photosynthetic plants[5]. Phytoremediation aims to restore the water conditions of the Ciujung River which are environmentally friendly by using plants selected to grow certain pollutants and reducing their chemical content or compounds. One way to fix this is by using plants from the Poaceae family.

The Poaceae family is the fourth-largest family of flowering plants in the world with 11,000 species and 800 genera[6]. Spread almost all over the world and mostly in the tropics. The Poaceae family is useful as an erosion barrier and can bind the soil and hold water-borne sediment and silt. In addition, it can grow easily and is resistant to drought and waterlogging[7], An example of a plant from this family is *Panicum sp.*.

Panicum sp.. or Bengal grass is a type of large grass that can be found in Indonesia's moist places and is a plant that can be applied in phytoremediation. Bayombong and Bengal grass are also Banten local plants. *Panicum sp.* can reduce water pollution and can be a wastewater biofilter with high cleaning efficiency[8].

Therefore, this research was raised with the title Phytoremediation of Ciujung River Water Quality with Local Potential Plant Bioagents of the Poaceae Family. To restore the condition of the Ciujung river water so that it is fit for use by the community. Based on the background description above, the problem formulation of this research is: How is the water quality in the Ciujung River compared to the water quality standard parameters set by the government? Can *Panicum sp.*. improve the water quality of the Ciujung River?

Method

The time required for this study was ± three months (July-September) which were located at the Biology Laboratory and Chemistry Laboratory at SMA Negeri 1 Ciruas. Tests for TDS, Temperature, and pH were carried out at the Bioscience Laboratory of Sultan Ageng Tirtayasa University (UNTIRTA) Serang, Banten, and tests for BOD, COD, and DO at the Laboratory

for Examination of Fish Diseases and the Environment (LP2IL). The tools to be used in this study included 3 storage containers, 12 sample bottles of Ciujung River water in the most polluted body (using purposive sampling technique), pH meters, DO meters, TDS meters, thermometers, and scales.

A sampling of Ciujung River water in the most polluted water body area and a sampling of *Panicum sp.*. plants were found in areas around the Ciujung River. Samples will be taken from Ciujung River water where in this study the static phytoremediation method is used (the phytoremediation water is still or not flowing). Before the sample is phytoremediated, its temperature will be measured with a thermometer, pH with a pH meter, DO with a DO meter, TDS with a TDS meter, BOD test, and COD test. After that, a 5 liters sample was put into the basin where the bayombong was acclimated, then the sample was taken to measure again the temperature, pH, DO, BOD, COD, and concentration of Pb metal content after phytoremediation on the 1st, 4th, 7th, 14th, 17th, 21st, and the 30th day of phytoremediation (Fig 1). Replication of 300 gr, 500 gr, and 700 gr of *Panicum sp.*. plants was carried out 2 times with the formula $(n-1)(p-1)\geq 15$. The 300 gram sample is named A1P1 and the repetition sample is A2P1, the 500 gram sample is named A2P1 and the repetition is A2P2, the 700 gram sample is named A1P3 and the repetition is A2P3.

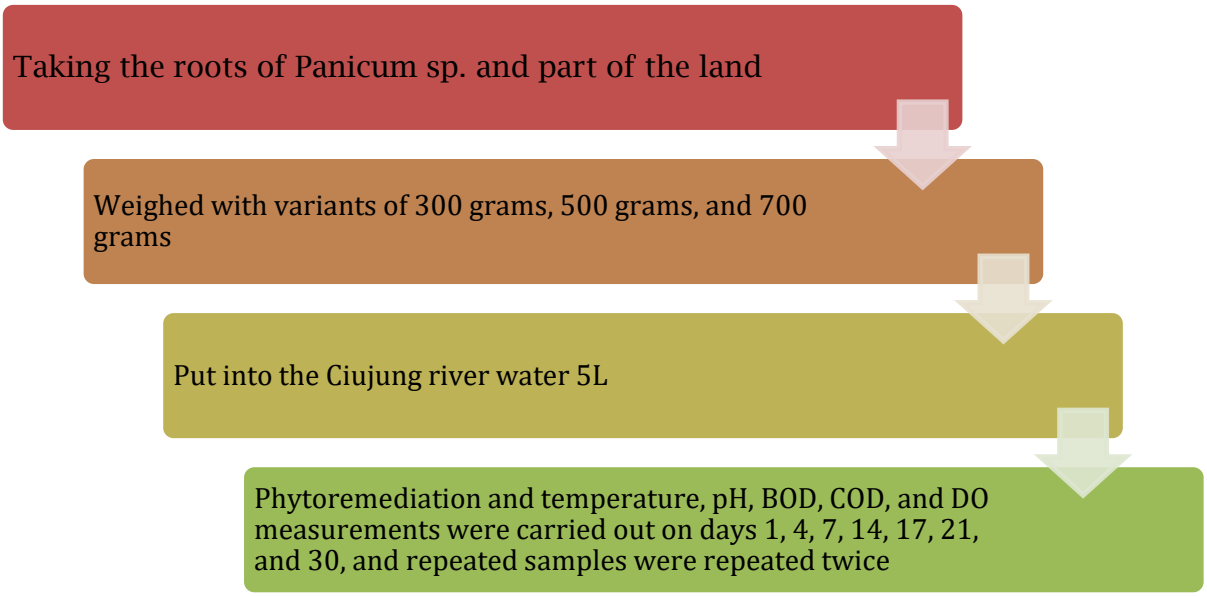

Fig 1. Research flow

Data Processing and Analysis Methods

A. Test the temperature using a thermometer
B. Test the pH using a pH meter
C. DO (Dissolved Oxygen) test using a DO meter
D. TDS (Total Dissolved Solids) test with a TDS meter
E. COD (Chemical Oxygen Demand) Test
F. BOD (Biological Oxygen Demand) Test

The values obtained were seen before and after treatment, whether temperature, pH, DO, BOD, COD, and TDS showed normal values.

Results and Discussion

The water sample used for phytoremediation is using a sample of Ciujung River water in the most polluted part of the polluted body with the initial parameter conditions before getting treatment showing an average. The results of parameter studies that have been carried out on

the water quality of the Ciujung River, namely the most polluted body parts show an average temperature (24.5°-29°C), pH (6-8), and TDS (47-592 ppm). Decreased BOD concentration from 15.6 mg/l to 1.2 mg/l, decreased COD concentration from 33.2 mg/l to 10.3 mg/l and increased DO from 3.7 mg/l to 15.7 mg/l.

Biological Oxygen Demand (BOD)

Biological Oxygen Demand (BOD) is a parameter that shows the amount of dissolved oxygen needed by microorganisms to decompose or break down the organic matter it contains[9]. BOD shows the fraction that is ready to decompose from organic matter in water, besides that the BOD level in a river can be identified as a parameter of water pollution, where the higher the BOD, the more polluted the river water[10-13].

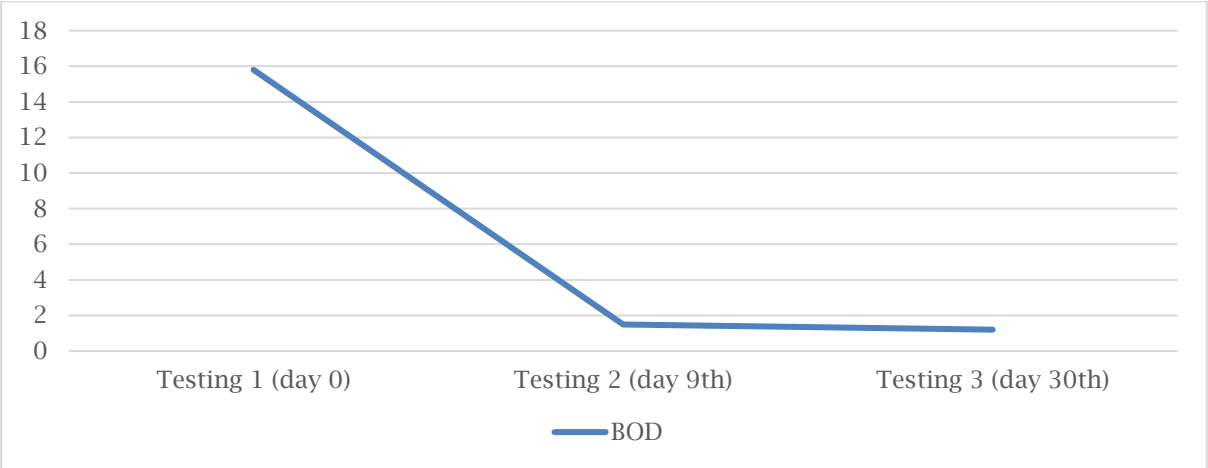

Fig 2. BOD concentration levels in Ciujung River water

The BOD parameter was tested 3 times, namely testing on day 0, 9th and 30th day after water sampling. From the Fig 2 it can be seen that the concentration of BOD has decreased significantly. On day 0, the BOD concentration was 15.6 mg/l, then decreased on day 9 to 1.5 mg/l, and decreased again on day 30, which was 1.2 mg/l.

The removal of BOD concentrations due to plant activity involves microorganisms that can break down organic contaminants in the phytoremediation process, this phase is called rhizodegradation. Plant roots will produce exudate which then promotes the growth and metabolic activity of microorganisms in the rhizosphere. In addition, the presence of plants can increase the amount of dissolved oxygen through the process of photosynthesis so that microorganisms can decompose organic contaminants. Removal of BOD can also be caused by the process of phytodegradation, in which organic contaminants that pass through the rhizosphere are absorbed through the roots and undergo decomposition through metabolic processes in plants. The decrease in BOD concentrations can also be due to the phytovolatilization process, namely, organic contaminants dissolved or previously broken down through rhizodegradation and phytodegradation processes are translocated to parts of the leaf, and it could be contaminants that are. The translocation is then volatilized and released into the atmosphere through the transpiration process[14,15].

4.2 Chemical Oxygen Demand (COD)

Certain organic materials contained in wastewater are immune to biological degradation and are toxic, materials that cannot be degraded biologically will be chemically degraded through an oxidation process, the amount of oxygen required to oxidize is known as Chemical Oxygen Demand[16]. COD levels indicate the amount of organic matter in the water[13,17].

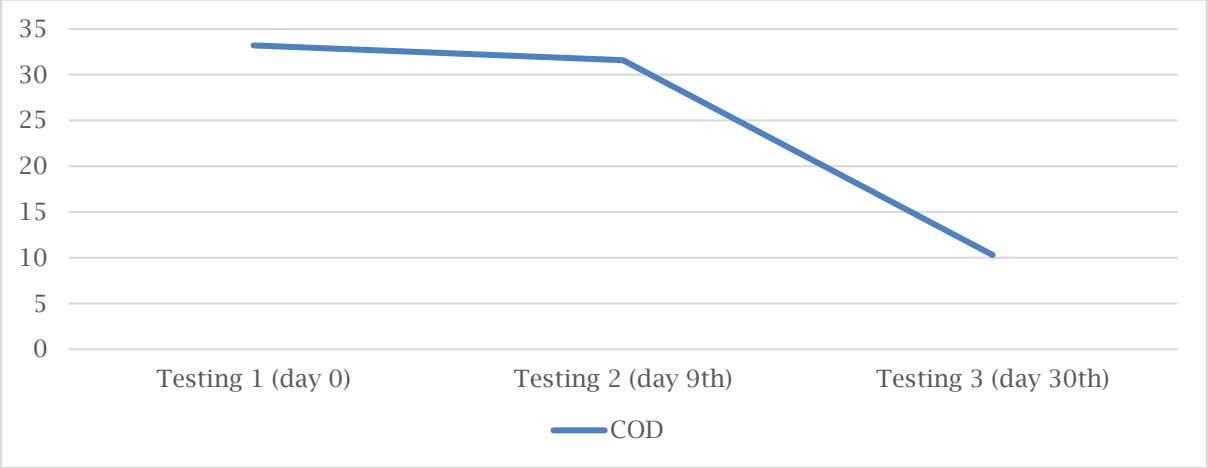

Fig 3. COD concentration levels in Ciujung River water

Based on Fig 3. can be seen that the concentration of COD has decreased significantly. On day 0, the COD concentration was 33.2 mg/l, then decreased on day 9 to 31.6 mg/l, and decreased again on day 30, namely 10.3 mg/l. COD parameter testing was carried out 3 times, namely on the 0th, 9th, and 30th days after sampling. *Panicum sp.* can reduce COD levels due to the absorption of organic matter by the plant. At the roots, organic matter degradation occurs aerobically and anaerobically as long as the liquid waste passes through the rhizosphere of the plant. Organic matter will be decomposed due to microbial activity, nitrogen will be identified if sufficient organic matter is available to be adsorbed by the media and plants[18,19].

4.3 Dissolved Oxygen (DO)

Dissolved Oxygen (DO) is a measure of the need for dissolved oxygen in water, where a higher the value of DO in water, indicates the water has good quality. Dissolved oxygen is a vital requirement for the survival of organisms in the water. In addition, the ability of water to clean up pollution is also determined by the amount of dissolved oxygen in the water[20,21].

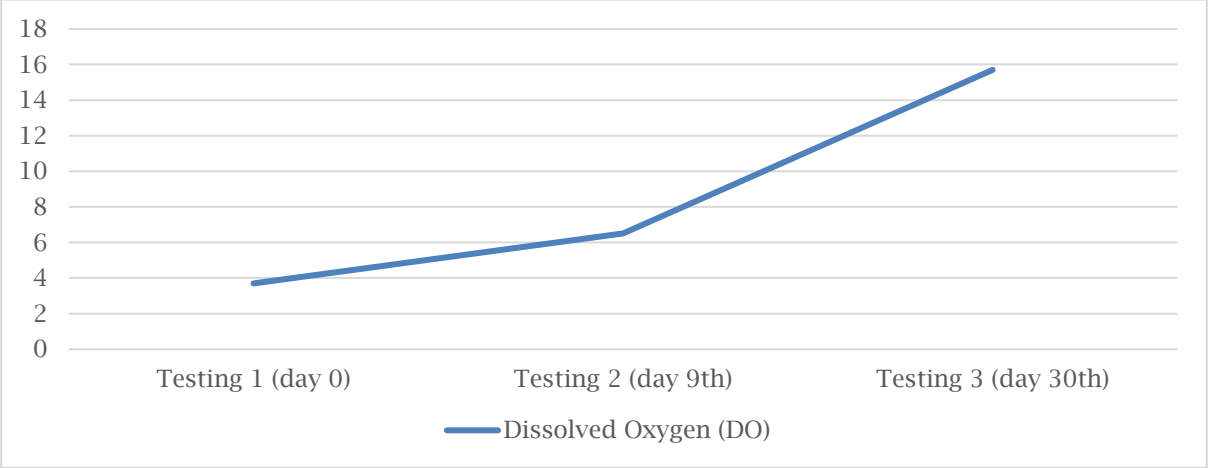

Fig 4. Dissolved Oxygen concentration levels in Ciujung River water

Based on Fig 4. can be seen that the DO concentration decreased significantly. On day 0, the DO concentration was 3.7 mg/l, then decreased on day 9 to 6.5 mg/l, and decreased again on day 30, namely 15.7 mg/l. The increase in DO concentration is because during photosynthesis, carbon dioxide is reduced to carbohydrates, and the air is dehydrogenated into oxygen so oxygen levels can increase. Because the lack of photosynthesis causes a loss of dissolved oxygen which is released into the water by plants[22].

4.4 Total Dissolved Solids (TDS)

Total Dissolved Solids (TDS) is a parameter used to determine solid particles or substances dissolved in water, both organic and inorganic[23]. The high TDS value shows a negative relationship with several parameters of the aquatic environment it can increase the toxicity of the organisms in it[24].

Table 1. Measurement of Total Dissolved Solids (TDS) (ppm)

Sample	Period of phytoremediation								
	Day 0	Day 1	Day 4	Day 7	Day 10	Day 14	Day 17	Day 21	Day 30
A1P1	97	51	134	234	304	324	324	352	311
A1P2	97	51	168	431	580	592	591	612	527
A1P3	97	47	166	276	437	482	458	478	432
A2P1	97	50	118	328	303	316	260	359	334
A2P2	97	51	157	238	323	348	353	384	393
A2P3	97	51	182	309	418	445	447	485	490

Based on Table 1. the result data obtained from day 0 to day 30 the average TDS value in the Ciujung River water sample has increased. At P1 it has an average TDS value of (100-322.5ppm), at P2 it is (100-460ppm), and at P3 it is (100-461ppm). This shows that the solid content contained in the water is increasing. The increase in TDS is because a lot of dissolved substances precipitate, making the TDS rise. The sediment is in the form of impurities that cause pollution. By settling these impurities, it means that the water has been separated from the impurities that cause pollution so that the sediment water is used for other purposes[25].

4.5 Temperature

Temperature is a natural indicator in water that can affect the level of dissolved oxygen concentration and the rate of chemical reaction rates. Temperature is very influential on the balance of ecosystems in water, water with a good temperature is characterized by the number of living things that live in it[26].

Table 2. Temperature measurement

Sample	Period of phytoremediation								
	Day 0	Day 1	Day 4	Day 7	Day 10	Day 14	Day 17	Day 21	Day 30
A1PI	29°C	26°C	26°C	25°C	26°C	26°C	29°C	25°C	25°C
A1P2	29°C	26°C	26°C	25°C	25°C	25°C	29°C	25°C	25.3°C
A1P3	29°C	26°C	25°C	24.7°C	26°C	25°C	28°C	25°C	25.6°C
A2P1	29°C	27°C	26°C	25°C	25°C	25°C	29°C	24.7°C	25.6°C
A2P2	29°C	26°C	26°C	25°C	26°C	25°C	29°C	24.7°C	25.5°C
A2P3	29°C	26°C	26°C	25°C	26°C	25°C	29°C	24.5°C	25.6°C

Based on Table 2, it can be seen that the temperature of the Ciujung River water sample has decreased and increased quite clearly. The initial situation on day 0, namely before the treatment of Ciujung River water samples with a temperature of 29°C, reduced in samples P1, P2, and P3 on the 1st day of phytoremediation to 26°C. Then, the temperature fluctuated from the 4th to the 14th day; that is, it increased and decreased, although not much. On the 17th day, the temperature increased quite drastically, where the temperature in samples P1 and P2 returned to the initial temperature before the treatment was given, while in sample P3, the temperature was 28.5°C. Even though the temperature has decreased and increased, the average temperature of the Ciujung River water sample on the 30th day is in accordance with the water

quality standards set by the government; by including the Ciujung River water sample, it can still support life in the waters.

4.6 pH

pH (pouvoir hydrogen) is a parameter that indicates the concentration of hydrogen ions in water. The degree of alkalinity and acidity can be known from the pH. In addition, pH affects the toxicity of chemical compounds[27-29].

Table 3. pH Measurement

Sample	Period of phytoremediation								
	Day 0	Day 1	Day 4	Day 7	Day 10	Day 14	Day 17	Day 21	Day 30
A1P1	6	6	7	8	7	8	8	8	8
A1P2	6	6	7	7	7	8	8	8	8
A1P3	6	6	7	7	7	8	8	8	8
A2P1	6	6	7	8	8	8	8	8	8
A2P2	6	6	7	8	8	8	8	8	8
A2P3	6	6	7	8	8	8	8	8	8

Based on Table 3, the relationship between pH and length of phytoremediation increased pH on day four and day seven towards normal. The biochemical activity of microorganisms found in water and plant roots causes an increase and decrease in pH[5,30]. Before the treatment was given to the Ciujung River water sample, namely day 0 with a pH of 6. After giving treatment to the three variations of the water sample by adding the *Panicum sp.* plant, the pH on the 1st day was still a pH 6, and on the 4th day until the 30th day the pH increased by 8. Even though on the 10th day the pH decreased, it can be seen that the *Panicum sp.* plant greatly influenced the pH content in the Ciujung River water samples. To prevent the corrosion of water distribution networks and the dissolution of heavy metals, water should be neither acidic nor alkaline. The recommended pH for clean water quality is 6.5-8.5[31].

Conclusion

Phytoremediation of Ciujung River water with *Panicum sp*. for 30 days showed that at 300 gr (P1) mass variation there was an increase in pH from 6-8, an increase in TDS from 97-322.5 ppm, a decrease in BOD, a decrease in COD, an increase in DO, and a decrease in temperature from 29-25.3°C. In the 500 gr mass variation (P2) there was an increase in pH from 6-8, an increase in TDS from 97-460 ppm, a decrease in BOD, a decrease in COD, an increase in DO, and a decrease in temperature from 29-25.4°C. In the mass variation of 700 grams (P3) there was an increase in pH from 6-8, an increase in TDS from 97-461 ppm, a decrease in BOD, a decrease in COD, an increase in DO, and a decrease in temperature from 29-25.6°C.

References

1 Hindriani, H., Sapei, A., Suprihatin & Machfud. Pengendalian pencemaran sungai CiUjung berdasarkan analisis daya tampung beban pencemaran. *Jurnal Sumber Daya Air* **9**, 169-184 (2013).

2 Sasongko, E. B., Widyastuti, E. & Priyono, R. E. Kajian kualitas air dan penggunaan sumur gali oleh masyarakat di sekitar Sungai Kaliyasa Kabupaten Cilacap. *Jurnal Ilmu Lingkungan* **12**, 72-82 (2014). https://doi.org:10.14710/jil.12.2.72-82

3 Laelasari, C. *Kandungan logam berat timbal (Pb) dalam air dan sedimen di sungai Ciujung Kabupaten Serang Provinsi Banten*, Universitas Sultan Ageng Tirtayasa, (2017).

4 Fatmasari, R. D. & Ratnawati, R. Fitoremediasi tanah tercemar logam timbal (Pb) menggunakan tanaman lidah mertua (*Sansevieria trifasciata*) dan jengger ayam (*Celosia*

plumosa). *Al-Ard: Jurnal Teknik Lingkungan* **3**, 62-69 (2018). https://doi.org:10.29080/alard.v3i2.333

5 Ni'mah, L., Anshari, M. A. & Saputra, H. A. Pengaruh variasi massa dan lama kontak fitoremediasi tumbuhan Parupuk (*Phragmites karka*) terhadap derajat keasaman (pH) dan penurunan kadar merkuri pada perairan bekas penambangan intan dan emas Kabupaten Banjar. *Jurnal Konversi* **8**, 55-61 (2019).

6 Arisandi, R., Soendjoto, M. A. & Dharmono, D. Keanekaragaman Familia Poaceae di kawasan Rawa Desa Sungai Lumbah, Kabupaten Barito Kuala. *Enviro Scienteae* **15** (2019). https://doi.org:10.20527/es.v15i3.7433

7 Arisandi, R., Dharmono, D. & Muchyar. in *Seminar Nasional XII Pendidikan Biologi FKIP UNS 2015*. (Universitas Sebelas Maret).

8 Chavan, B. L. & Dhulap, V. P. Sewage treatment with constructed wetland using panicum maximum forage grass. *Journal of Environmental Science and Water Resources* **1**, 223-230 (2012).

9 Atima, W. Bod Dan Cod Sebagai Parameter Pencemaran Air Dan Baku Mutu Air Limbah. *Biosel: Biology Science and Education* **4** (2015). https://doi.org:10.33477/bs.v4i1.532

10 Chalil, D. *et al.* BOD Pressure in the sustainability of the Citarum River. *E3S Web of Conferences* **52** (2018). https://doi.org:10.1051/e3sconf/20185200037

11 Reshetilov, A., Arlyapov, V., Alferov, V. & Reshetilov, T. in *State of the Art in Biosensors - Environmental and Medical Applications* Ch. Chapter 3, (2013).

12 Razif, M. BOD, COD, and TSS Predictions from DO measurement results for the Surabaya River, Indonesia. *Journal of Civil Engineering, Planning and Design* **1**, 1-7 (2022). https://doi.org:10.31284/j.jcepd.2022.v1i1.3047

13 Sara, P. S., Astono, W. & Hendrawan, D. I. in *Prosiding Seminar Nasional Cendekiawan* (2018).

14 Rahmawati, A., Zaman, B. & Purwono, P. Kemampuan tanaman Kiambang (*Salvinia Molesta*) dalam menyisihkan BOD dan Fosfat pada limbah domestik (Grey water) dengan sistem fitoremediasi secara kontinyu. *Jurnal Teknik Lingkungan* **5** (2016).

15 Liggins, P., Jordan, S., Rimmer, P. B. & Shorttle, O. Growth and Evolution of Secondary Volcanic Atmospheres: I. Identifying the Geological Character of Hot Rocky Planets. *Journal of Geophysical Research: Planets* **127** (2022). https://doi.org:10.1029/2021je007123

16 Lee, E., Lee, H., Kim, Y. K., Sohn, K. & Lee, K. Hydrogen peroxide interference in chemical oxygen demand during ozone based advanced oxidation of anaerobically digested livestock wastewater. *International Journal of Environmental Science & Technology* **8**, 381-388 (2011). https://doi.org:10.1007/bf03326225

17 Yuthawong, V., Kasuga, I., Kurisu, F. & Furumai, H. Molecular-Level Changes in Dissolved Organic Matter Compositions in Lake Inba Water during KMnO₄ Oxidation: Assessment by Orbitrap Mass Spectrometry. *Journal of Water and Environment Technology* **17**, 27-39 (2019). https://doi.org:10.2965/jwet.18-043

18 Marschner, P. Processes in submerged soils – linking redox potential, soil organic matter turnover and plants to nutrient cycling. *Plant and Soil* **464**, 1-12 (2021). https://doi.org:10.1007/s11104-021-05040-6

19 Esser, G., Kattge, J. & Sakalli, A. Feedback of carbon and nitrogen cycles enhances carbon sequestration in the terrestrial biosphere. *Global Change Biology* **17**, 819-842 (2011). https://doi.org:10.1111/j.1365-2486.2010.02261.x

20 Alavaisha, E., Lyon, S. & Lindborg, R. Assessment of Water Quality Across Irrigation Schemes: A Case Study of Wetland Agriculture Impacts in Kilombero Valley, Tanzania. *Water* **11** (2019). https://doi.org:10.3390/w11040671

21 Budiman, H. & Kusniawati, E. A ANALISA SIFAT AIR INJEKSI BERDASARKAN PARAMETER pH, TSS, TDS, DO DAN KESADAHAN. *Jurnal Teknik Patra Akademika* **11**, 9-21 (2021). https://doi.org:10.52506/jtpa.v11i02.109
22 Felani, M. & Hamzah, A. Fitoremediasi limbah cair industri Tapioka dengan tanaman Enceng Gondok. *Jurnal Penelitian Ilmu-Ilmu Kelaman Buana Sains* **7**, 11-20 (2007).
23 Budiman, H. & Kusniawati, E. Analisa sifat air injeksi berdasarkan parameter pH, TSS, TDS, DO dan Kesadahan. *Jurnal Teknik Patra Akademika* **11**, 9-21 (2021). https://doi.org:10.52506/jtpa.v11i02.109
24 Echols, B. S., Currie, R. J., Valenti, T. W. & Cherry, D. S. An Evaluation of a Point Source Brine Discharge into a Riverine System and Implications for TDS Limitations. *Human and Ecological Risk Assessment: An International Journal* **18**, 588-607 (2012). https://doi.org:10.1080/10807039.2012.672892
25 Putro, T. & Prastiwi, A. D. Aplikasi plasma atmosfer pada pH dan TDS air limbah domestik. *Jurnal Aplikasi Pelayaran Dan Kepelabuhanan* **9**, 149-152 (2019). https://doi.org:10.30649/japk.v9i2.33
26 Yeboah Boanu, N., Yaw Dadson, I., Adu-Boahen, K. & Okyere Yeboah, E. Assessment of the physico-chemical properties in the muni-pomadze ramsar site and its catchment in Winneba, Ghana. *Environmental Protection Research*, 95-111 (2022). https://doi.org:10.37256/epr.222022786
27 Kasnir, M. Water quality parameter analysis for the feasibility of shrimp culture in Takalar Regency, Indonesia. *Journal of Aquaculture Research & Development* **05** (2014). https://doi.org:10.4172/2155-9546.1000273
28 Arbildua, J. J. *et al.* Effect of Fe (III) on Pseudokirchneriella subcapitata at circumneutral pH in standard laboratory tests is explained by nutrient sequestration. *Environ Toxicol Chem* **36**, 952-958 (2017). https://doi.org:10.1002/etc.3609
29 Low, K. H. *et al.* Evaluation of water quality variation in lakes, rivers, and ex-mining ponds in Malaysia (review). *Desalination and Water Treatment* **57**, 28215-28239 (2016). https://doi.org:10.1080/19443994.2016.1185382
30 Lamhamedi, M. S., Renaud, M., Auger, I. & Fortin, J. A. Granular calcite stimulates natural mycorrhization and growth of white spruce seedlings in peat-based substrates in Forest Nursery. *Microorganisms* **8** (2020). https://doi.org:10.3390/microorganisms8071088
31 Al-Mudhaf, H. F., Al-Hayan, M. N., Selim, M. I. & Abu-Shady, A.-S. I. Mineral content of bottled and desalinated household drinking water in Kuwait. *CLEAN - Soil, Air, Water* **39**, 1068-1080 (2011). https://doi.org:10.1002/clen.201100257

Author contributions

All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by [**Widayati Norwulan**], [**Mahrawi**], [**Gilang Ramadhan**] and [**Zahra Ismaya**]. The first draft of the manuscript was written by [**Mahrawi**] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.