Jurnal Biologi Tropis

Original Research Paper

Restoration of Tofu Wastewater Quality Using Water Hyacinth (*Eichhornia crassipes*)

Heppy Tasya Pibiputri[1], Suripto[2]*, Isrowati[2], Rachmawati Noviana Rahayu[2]

[1]Department of Environmental Science, Faculty of Mathematics and Natural Sciences, University of Mataram, Mataram, Indonesia;

[2] Faculty of Mathematics and Natural Sciences, University of Mataram, Mataram, Indonesia;

Article History

Received : October 13th, 2026

Revised : October 25th, 2026

Accepted : November 02th, 2026

*Corresponding Author: **Suripto**, Faculty of Mathematics and Natural Sciences Universitas Mataram Mataram Indonesia;

Email: suriptobio@unram.ac.id

Abstract: Tofu industry wastewater contains high levels of organic matter that can degrade environmental quality. This study examined the effectiveness of *ex situ* remediation using water hyacinth (*Eichhornia crassipes*) on wastewater BOD and pH. The experiment employed a 3x3 factorial Completely Randomized Design, testing the number of plants per tank (0, 3, and 6 plants) and the duration in days (0, 7, and 14), with three replicates. Plants aged 14 days with a height of ±10 cm were collected from their natural habitat, cleaned, and acclimatized in pond water before being grown in 3 L of wastewater for 14 days. BOD and pH were measured on days 0, 7, and 14. Data were analyzed using two-way ANOVA and the DMRT post-hoc test. The results showed that the number of plants and the duration of remediation significantly influenced the reduction of BOD and the increase in pH. The combinations (3-7), (6-7), (3-14), and (6-14) reduced BOD by 18.64%, 25.36%, 39.29%, and 44.19%, respectively, and increased pH by 29.68%, 27.32%, 36.08%, and 41.87%, respectively. These combinations successfully reduced BOD below the quality standard (150 ppm) and raised the pH to ≥6.0.

Keywords: BOD; *Eichhornia crassipes;* pH; Phytoremediation; Tofu wastewater.

Introduction

Phytoremediation is an implementation of applied ecological principles that utilizes plant-microorganism interactions to restore environmental quality. This technology is based on the ability of hyperaccumulator plants to absorb, degrade, and transform pollutants through rhizofiltration and phytodegradation mechanisms. Compared to physical-chemical methods, phytoremediation is considered more sustainable because it is low-cost, does not produce secondary chemical sludge, and utilizes natural biological processes (Dewi & Akbari, 2020; Listyaningrum, 2022).

The concept of phytoremediation effectiveness is largely determined by two biological factors: the biomass of the remediation agent and contact time. Physiologically, *Eichhornia crassipes* (water hyacinth) has adaptive advantages in the form of broad leaves for transpiration, hollow stems (aerenchyma) as a pathway for oxygen transfer to the rhizosphere, and a dense root system as a habitat for biofilms of decomposing bacteria. Growth phase, root density, and root length determine the rate of organic matter degradation. The selection of water hyacinth aligns with the principles of phytoremediation, which ideally does not use food crops, thus not disrupting food security (Novita & Pradana, 2022; Adi *et al*., 2024).

In the context of organic pollution, two key interrelated parameters are Biochemical Oxygen Demand (BOD) and Dissolved Oxygen (DO). BOD represents the amount of oxygen required by microorganisms to biologically decompose organic matter, while DO is the availability of dissolved oxygen for aquatic life.

This article is licensed under a Creative Commons Attribution 4.0 International License.

© 2026 The Author(s). This article is open access

An increase in BOD will suppress DO. Another crucial parameter is pH, as acidic pH inhibits the activity of aerobic decomposing bacteria and disrupts the balance of aquatic ecosystems (Safitri, 2025; Dzamiri *et al*., 2022).

The tofu industry is a strategic food sector in Indonesia, but it produces liquid waste with a high organic load from the soaking, grinding, and especially the coagulation (whey) stages. Physically and chemically, this waste is cloudy, has a pungent odor, and tends to be acidic (pH 4-5). Recent studies show that the BOD content of small-scale tofu waste can reach 3,000-5,000 mg/L (Dewi & Akbari, 2020; Alifah *et al*., 2024; Kamsul *et al*., 2025). If disposed of directly without treatment, this organic material triggers a bloom of decomposing microbes that deplete DO, causing biota death and degradation of water quality. This problem is massive in small-scale industries that do not have Wastewater Treatment Plants (WWTP).

Phytoremediation research with *E. crassipes* has been extensively conducted, but generally uses a single variable (only the number of plants or only the duration) and focuses on COD or heavy metals. Factorial studies that simultaneously examine the interaction of plant number and remediation duration on the BOD and pH of diluted tofu waste are still limited, particularly those aimed at determining the minimum plant dosage capable of achieving quality standards.

Therefore, this research is urgently needed as an alternative waste treatment that is applicable, affordable, and environmentally friendly for small-scale industries. This study aims to determine the most effective combination of E. crassipes plant numbers and remediation duration in reducing BOD and increasing pH of tofu industrial wastewater, as well as projecting the remediation's reach for varying initial BOD and pH.

Materials and Methods

The study on the *ex situ* phytoremediation of tofu industry wastewater using *E. crassipes* was conducted in three main stages: preparation comprising the design of the remediation experiment and the acclimatization of *E. crassipes* experiment execution, and data analysis (Figure 1).

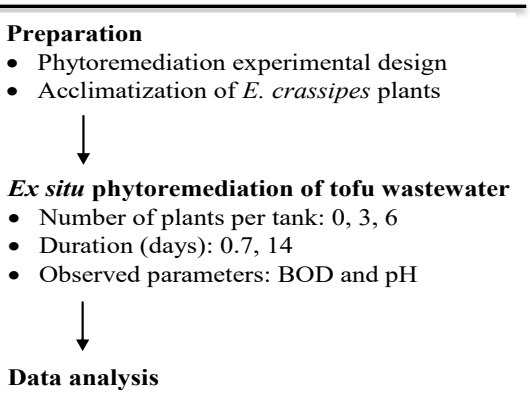


Figure 1. Flowchart of *ex situ* phytoremediation research on tofu waste using *E. crassipes* plants.

Experimental design

Ex situ phytoremediation using *E. crassipes* to treat tofu wastewater was conducted using a 3x3 factorial completely randomized design (CRD)—involving plant quantity and duration—with three replicates (r) (Figure 2).

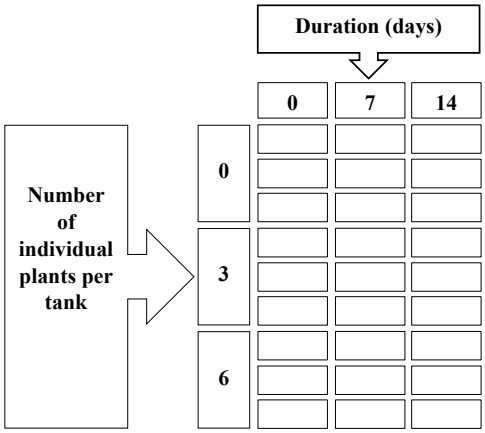


Figure 2. 3 x 3 factorial randomized block design with 3 replications

Preparation and acclimatization of *E. crassipes* plants

E. crassipes plants were collected from the waters of the Jangkok River in Ampenan, Mataram City. The river in this area is frequently covered by masses of these plants, which thrive and float freely on the water's surface. Specimens were selected based on uniform criteria: an age of 5–6 weeks (or approximately 14 days after the separation of new offshoots), a height of 10–15 cm, a wet weight of 25–50 grams per clump, a dense root system 10–15 cm in length, and 4–6 fresh green leaves. All parts of the plant, especially the roots, were cleaned using running

water to remove mud, debris, insect eggs, pathogens, and organic matter, so as not to interfere with the parameters under study, such as pH and BOD (Herman *et al.*, 2017; Hafidhin *et al.* 2023). Each clump of water hyacinth was separated into individual plantlets, which were then acclimatized and grown in clean water within acclimatization tanks under adequate sunlight for seven days. Following acclimatization, healthy plants—characterized by dense root systems approximately 10 cm long and fresh green leaves—that were uniform in size (approximately 20 cm in height and 20 g in weight) were selected for use in the experiment (Borrong *et al.*, 2023; Novita & Pradana, 2022).

Phytoremediation experiment

Tofu industry wastewater was collected from the discharge outlet of a tofu factory in Abian Tubuh, Mataram City. Abian Tubuh is known as a hub for small-scale tofu industries in Mataram City. Acclimatized *E. crassipes* plants in specific quantities per experimental unit (0, 3, and 6 plants per tank)—were grown in remediation tanks containing 6 L of tofu industry wastewater under adequate sunlight for 14 days. Throughout the experiment, the wastewater level in the tanks was maintained at a minimum of 14 cm. The BOD and pH of the experimental wastewater were measured on days 0, 7, and 14. BOD measurements were conducted in the laboratory, whereas pH was measured directly at the experimental site.

Data analysis

The BOD and pH data were analyzed using two-way ANOVA followed by DMRT to determine which treatment combination was most effective in reducing BOD or increasing pH to meet quality standards (<150 ppm for BOD and >6 for pH). The reduction in BOD or increase in pH (in %) was calculated using the following formula (Equation 1).

$$Ch = \left[\frac{c0-ci}{c0}\right] x\ 100\% \quad \ldots\ldots\ldots (1)$$

Where,
Ch = percentage change in parameter quantity (in %)
C0 = parameter quantity in the control treatment
Ci = parameter quantity in treatment i

Results and Discussion

Changes in BOD and pH of tofu wastewater

Prior to remediation, tofu industry wastewater exhibited BOD levels of 5.50–5.52 ppm and a pH of 3.86–3.96. The BOD levels met the standard, as they were below the maximum limit (<150 ppm). However, the pH values were unsafe, falling below the minimum quality standard limit (<6). Following a 14-day remediation process using *E. crassipes*, BOD levels decreased and pH increased in correlation with the quantity of plants and the duration of remediation (Table 1).

Table 1. BOD and pH values of tofu wastewater in *ex situ* remediation with *E. crassipes* for 14 Days

Parameter	0 days, with the number of individual plants per tank			7 days, with the number of individual plants per tank			14 days, with the number of individual plants per tank		
	0	3	6	0	3	6	0	3	6
BOD (ppm)	5,52	5,48	5,06	5,3	4,48	4,11	5,13	3,53	3,09
	5,5	5,4	5,1	5,27	4,4	4,03	5,19	3,24	3,02
	5,5	5,56	5,15	5,28	4,56	4,19	5,14	3,26	3,11
pH	3,91	3,82	3,89	3,92	5,56	5,38	4,06	6,02	6,89
	3,86	3,88	3,84	3,86	5,51	5,33	4,12	6,14	6,77
	3,96	3,88	3,94	3,96	5,61	5,43	4,2	6,19	6,52

Wastewater BOD

Following remediation, the BOD of the wastewater (average of three replicates) tended to decrease as the number of *E. crassipes* plants and the duration of remediation increased (Figure 3). In the control without plants, the decrease in BOD over time was very gradual (blue line), whereas in the combinations using plants, the decrease was sharp (red and black lines). The ANOVA and DMRT results showed significant differences in BOD among combinations that did not involve 0 plants and 0 days (Table 2).

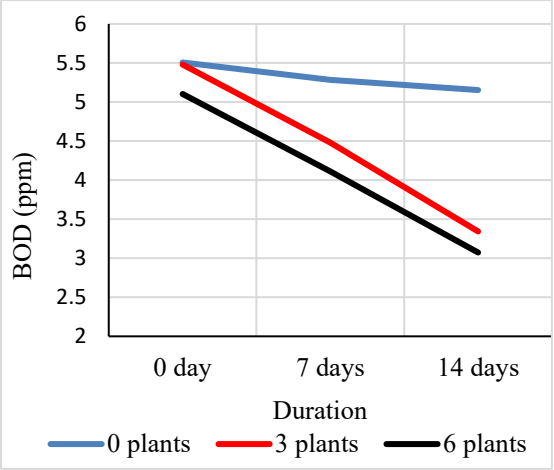


Figure 3. BOD value of tofu waste resulting from remediation with *E. crassipes* for 14 days.

Table 2. DMRT for BOD based on treatment combinations of *E. crassipes* quantity per tank and retention time

Duration (days)	Number of plants per tank					
	0		3		6	
0	5,51	g	5,48	g	5,1	e
7	5,28	f	4,48	d	4,11	c
14	5,15	e	3,34	b	3,07	a

Based on Table 2 above, the reduction in BOD (in %) increases significantly with the number of plants and the duration of remediation (Table 3).

Table 3. BOD reduction (%) in tofu wastewater by plant quantity and remediation duration

Duration (days)	Number of plants per tank		
	0	3	6
0	0,00%	0,48%	7,32%
7	4,06%	18,64%	25,36%
14	6,42%	39,29%	44,19%

Table 3 shows that remediation using three plants reduced BOD by 18.64% over 7 days, with the reduction percentage increasing to 39.29% at 14 days. A similar pattern was observed with six plants, showing a BOD reduction of 25.36% at 7 days and 44.19% at 14 days. The tofu waste studied had an initial BOD concentration of 5.15–5.51 mg/L, well below the established quality standard threshold of 150 mg/L. Consequently, the effectiveness of remediation in reducing organic content could not be directly assessed. This low value constitutes a limitation (gap) in the study, as the normal BOD characteristic of unprocessed tofu wastewater typically ranges from 5,000 to 10,000 mg/L due to the high protein, carbohydrate, and fat content of soybean processing residues (Alifah *et al*., 2024). The BOD value of around 5 mg/L at the outlet is considered very low for raw wastewater, even equivalent to the quality of clean river water. This phenomenon is thought to occur due to extreme dilution in the production area. Tofu factories generally combine the process wastewater (whey/acid) with water from washing, soaking, or a continuous flow of clean water, so that the massive volume of dilution water drastically reduces the BOD concentration when samples are taken at the outlet. Therefore, wastewater samples should be taken from the pressing stage because it produces the highest BOD, with values reaching 8,000 to 10,000 ppm (Al-Qohar & Rahmayanti, 2024).

However, the results of the reduction in BOD percentage in this study can be implied for similar waste with BOD above the quality standard (>150 ppm). The combinations of plant quantity and remediation duration—(3–7), (6–7), (3–14), and (6–14)—reduced BOD by 18.64%, 25.36%, 39.29%, and 44.19%, respectively. Based on these percentages, these combinations are projected to be capable of reducing BOD to below the standard for wastewater with maximum initial BOD levels of 184.38, 200.97, 247.76, and 268.76 ppm, respectively (Table 4).

Table 4. Projection of maximum waste BOD level reduction to achieve quality standards (<150 ppm)

Duration (days)	Number of plants per tank	
	3	6
7	184,38	200,97
14	247,06	268,76

The initial BOD in this study ranged from 5.15 to 5.51 ppm, which is lower than the 1,000–4,000 ppm reported in the literature. This discrepancy is likely due to the samples being collected from a final holding tank where dilution by wash water and rainwater had occurred, and where natural organic degradation had taken place prior to treatment. Differences in the scale of the home industry and the type of soybean used also played a role. Despite the low absolute values, the percentage reduction in BOD achieved by *E. crassipes* remains a valid

indicator of remediation effectiveness, allowing the results to be projected for wastewater with higher BOD loads.

The reduction in BOD values during remediation indicates a process of organic matter removal from the wastewater. *E. crassipes* plants contribute to reducing the organic content of the wastewater through their root systems, which are in direct contact with the water. The plant roots help absorb certain dissolved substances while simultaneously providing a rhizosphere zone that supports microbial life. Microorganisms inhabiting the root zone particularly heterotrophs can utilize the organic matter in the wastewater as a source of carbon and energy, thereby facilitating its decomposition. Thus, the decrease in BOD is not solely attributable to the plant's uptake of organic matter but is the result of interactions among the plant, its root system, and microbial activity within the rhizosphere (Oktorina & Achmad, 2019; Atma, 2022; Hafidhin *et al*., 2023). During the decomposition process, the organic matter originally present in the waste is broken down into simpler compounds. This process results in a reduction of the amount of biodegradable organic matter, thereby causing the BOD value to decrease (Vigiak *et al.*, 2019; Benedicta *et al.*, 2025; Pratama *et al.*, 2026).

The duration of remediation determines the success rate of the phytoremediation process. The longer the contact time between the plants and the waste, the greater the likelihood of degradation, allowing organic matter to break down more optimally. In addition to duration, plant density also influences the process, as it is closely linked to the extent of the root system. Higher planting density results in a larger total root surface area in contact with the wastewater, thereby expanding the zone of microbial activity around the roots (the rhizosphere) (Vidyawati & Fitrihidajati, 2016; Ningrum *et al.*, 2020).

Wastewater pH level

In contrast to BOD, the opposite pattern was observed for pH. The pH value (mean of three replicates) tended to increase with the increase in the number of plants and the duration of remediation (Figure 4). In the zero-plant control, the increase in pH was gradual (blue line), whereas in treatments with plants, the increase was sharp (red and black lines). ANOVA and DMRT results also indicated significant differences in pH among combinations other than those involving zero plants and zero days (Table 5).

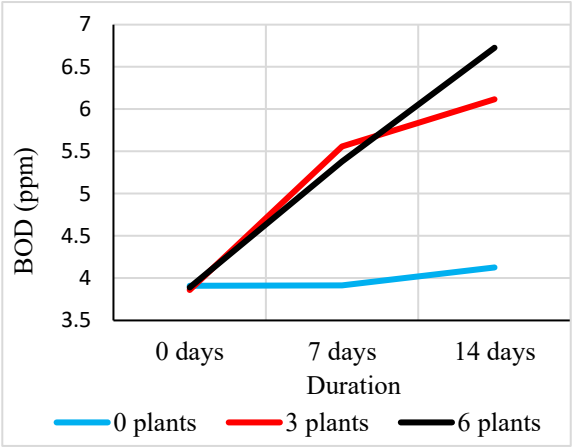


Figure 4. pH values of tofu wastewater during ex situ remediation, based on the number of *E. crassipes* plants per tank and treatment duration.

Table 5. pH of lahu waste after *E. crassipes* remediation

Duration (Days)	Number of plants per tank					
	0		3		.6	
0	3,91	a	3,86	a	3,89	a
7	3,91	a	5,56	d	5,38	c
14	4,13	b	6,12	e	6,73	f

Table 5 shows that remediation treatments using 3 and 6 plants with a duration of 14 days (3-14) and (6-14) were effective in raising the wastewater pH to meet the quality standard (pH > 6). A 7-day remediation period resulting in a pH increase was insufficient to immediately restore the pH of the wastewater samples in this study. However, based on the percentage increase in pH observed over 7 days using either 3 or 6 plants, the method can be projected to effectively raise the pH to meet quality standards for wastewater with higher initial pH levels. For instance, the treatment using 3 plants over 7 days is projected to raise the pH to meet quality standards for wastewater with an initial pH of at least 4.63 (Tables 6 and 7).

Tofu wastewater is acidic (pH 4–5.5) due to high levels of organic acids primarily acetic and lactic acids resulting from protein fermentation and the breakdown of soybean carbohydrates. This acidic condition inhibits the

activity of aerobic decomposer microorganisms, necessitating neutralization. In this study, remediation using *E. crassipes* significantly raised the pH to above 6.0. The greatest increase (41.87%) was achieved using a combination of six plants over a 14-day period, effectively neutralizing wastewater with an initial pH as low as 4.30. The fact that the pH increase correlated with the number of plants and the duration of the treatment indicates the active role of the plants rather than mere natural evaporation; this is evidenced by the very slight increase observed in the control group with zero plants (Figure 4).

Table 6. Increase in pH of tofu waste (%)

Duration (days)	Number of plants per tank		
	0	3	6
0	0,00%	-1,30%	-0,51%
7	0,09%	29,68%	27,32%
14	5,25%	36,08%	41,87%

Table 7. Proyeksi kenaikan pH minimum limbah pencapaian baku mutu (>6)

Duration (days)	Number of plants per tank	
	3	6
7	4,63	4,71
14	4,41	4,23

The mechanism by which *E. crassipes* raises pH operates through three pathways. First, the roots absorb organic acids as a carbon source. Second, photosynthesis consumes dissolved CO_2, thereby reducing carbonic acid (H_2CO_3) in the water. Third, root exudates and rhizosphere activity promote the growth of acid-degrading bacteria that convert organic acids into CO_2 and H_2O. The more plants there are and the longer the contact, the more optimal the process becomes. These results align with Atma (2022), who reported an increase in tofu wastewater pH from 4.2 to 6.8 after 12 days of phytoremediation using water hyacinth, as well as Dira *et al.* (2025), who noted a pH increase proportional to plant density. Thus, a combination of six plants over a 14-day period can be recommended as the most effective treatment for restoring the pH of tofu wastewater.

Conclusion

The number of *E. crassipes* plants, the duration of tofu wastewater remediation, and the interaction between the two had a significant effect on reducing BOD and increasing pH. In the control (0-0), the BOD was 5.51 ppm and the pH was 3.91. Combinations (3-7), (6-7), (3-14), and (6-14) reduced BOD by 18.64%, 25.36%, 39.29%, and 44.19%, respectively, and increased pH by 29.68%, 27.32%, 36.08%, and 41.87%, respectively. These combinations were capable of reducing BOD to below the quality standard (150 ppm) for initial BOD levels up to 184.38, 200.97, 247.76, and 268.76 ppm, and raising the pH to ≥6.0 for initial pH levels as low as 4.63, 4.71, 4.41, and 4.30. This study utilized dilute wastewater (initial BOD of 5.51 ppm). Further testing on concentrated wastewater (pure whey with BOD >3,000 ppm) and the measurement of COD, TSS, and total nitrogen parameters are required.

Acknowledgments

This research has been approved and supported by the Dean of the Faculty of Mathematics and Natural Sciences at the University of Mataram, under Decree Number 1892/UN18.F7/HK/2026. Acknowledgement is also extended to the Head of the Environmental Science Laboratory at the University of Mataram for facilitating the execution of the *ex situ* phytoremediation experiments in this study.

References

Adi, W. B., Adiansyah, J. S., & Muladi, A. (2024). Evaluasi jejak karbon produk tahu di Kelurahan Abian Tubuh Kota Mataram menggunakan pendekatan penilaian daur hidup (Life cycle assessment). *Jurnal Ilmu Lingkungan*, *22*(2), 439–446. https://doi.org/10.14710/jil.22.2.439-446

Alifah, I., Fitriyani, N., Amburika, N., & Prasetya Adi, N. (2024). Analisis pengaruh limbah pabrik tahu terhadap kualitas air sungai: Studi kasus dan implikasi terhadap lingkungan. *Lambda Journal, Lembaga Bale Literasi*, 4(3), 185–191.https://doi.org/10.58218/lambda.v4i3.974

Al-Qohar, Q. & Rahmayanti, A. (2024). Effectiveness of phytoremediation of cracker factory wastewater using water hyacinth. *Nusantara Technology and*

Engineering Review, 2(1), 14–20. https://doi.org/10.55732/nter.v2i1.1235

Ashari, T. M. (2020). Proses pengolahan air limbah tahu dengan menggunakan kombinasi fitoremediasi dan koagulasi-flokulasi. 1(1), 7–18. *LINGKAR; Journal of Environmental Engineering*, https://doi.org/10.22373/ljee.v1i1.846

Atma, D.A. (2022). Efektifitas penurunan kadar COD, BOD, TSS dan pH menggunakan metode kombinasi fitoremediasi menggunakan tanaman eceng gondok dengan filtrasi menggunakan karbon aktif dan silika pada air limbah domestik. *Pelita Teknologi* 17(1), 1-11. https://doi.org/10.37366/pelitatekno.v17i1.1105

Borrong, D. T., Tanjung, R. E., Abdullah, A., & Tuwo, M. (2023). Perubahan fisik eceng gondok *Eichhornia crassipes* dalam fitoremediasi. *Jurnal Ilmu Alam dan Lingkungan*. 14(1), 65–71. https://doi.org/10.70561/jal.v14i1.26251

Dewi, M. O., & Akbari, T. (2020). Pengolahan limbah cair tahu dengan metode fitoremediasi tanaman eceng gondok (Eichhornia crassipes) pada industri Tahu B Kota Serang. *Jurnal Lingkungan dan Sumber Daya Alam,* 3(1), 35-48. Available at https://ejournal.lppm-unbaja.ac.id/index.php/jls/article/view/890/528

Dira, A., Salsabila, A., & Fitrihidajati, H. (2025). Phytoremediation of tofu liquid waste using water hyacinth and water lettuce to improve waste quality. *LenteraBio: Berkala Ilmiah Biologi*, 14(1), 20–26. https://doi.org/10.26740/lenterabio.v14n1.p20-26

Dzamiri, G.Z., Widiarti, I.W. & Gomareuzzaman, M. (2022). Evaluasi Kualitas Air pada Badan Sungai Kali Biru Akibat Limbah Cair Industri Tahu di Desa Taman Agung, Kecamatan Muntilan, Kabupaten Magelang, Jawa Tengah. Prosiding Seminar Nasional Teknik Lingkungan Kebumian. November, 194–202. https://doi.org/10.31315/psb.v4i1.8891

Fahmi, M. R., Rahman, M., & Sofarini, D. (2020). Variations of biomass of hyacinth (*Eichhornia crassipes* Mart. Solms.) towards acidity in Sasirangan Waste Water. *Aquatic*, 3(1), 1–13. https://doi.org/10.20527/aquatic.v3i1.1183

Hafidhin, F. A., Ratnawati, R., Sutrisno, J., & Nurhayati, I. (2023). Penerapan teknologi fitoremediasi menggunakan tanaman eceng gondok untuk mengolah air limbah laundry. *Jurnal Ilmu Alam dan Lingkungan*. 14(2), 42–50. https://doi.org/10.70561/jal.v14i2.28000

Herman, Y., Djo, W., Suastuti, D. A., & Suprihatin, I. E. (2017). Fitoremediasi limbah cair UPT Laboratorium Analitik Universitas Udayana menggunakan tanaman eceng gondok (Eichhornia crassipes) ditinjau dari penurunan nilai COD dan kandungan logam berat Cu dan Cr. *Jurnal Media Sains*, 1(2), 63–70. https://doi.org/10.36002/jms.v1i2.263

Kamsul, Sukarjo, Silvia Azka Shalsabila, Fidya Irsya, Ida Rusdiana, & Winda Fajriani. (2025). Dampak limbah lndustri tahu terhadap kualitas lingkungan. Galen: *Jurnal Riset Ilmu Farmasi dan Kesehatan*, 1(2), 268–275. https://doi.org/10.71417/galen.v1i2.29

Nadhifah, I. I., Fajarwati, P., & Sulistiyowati, E. (2019). Fitoremediasi dengan wetland system menggunakan eceng gondok (Eichhornia Crassipes), genjer (Limnocharis flava), dan semanggi (Marsilea Crenata) untuk mengolah air limbah domestik. *Al-Kauniah: Jurnal Biologi*, 12(1), 38–45. https://doi.org/10.15408/kauniyah.v12i1.7792

Ningrum, Y. D., Ghofar, A., & Haeruddin, H. (2020). Effectiveness of eceng gondok (*Eichhornia crassipes*) as phytoremediator for tofu production liquid waste. *Management of Aquatic Resources Journal (MAQUARES)*, *9*(2), 97–106. https://doi.org/10.14710/marj.v9i2.27765

Novita, E., & Pradana, H. A. (2022). Kajian perbaikan kualitas air limbah pengolahan kopi menggunakan metode fitoremediasi dengan tanaman eceng gondok (*Eichhornia crassipes*). *JST (Jurnal Sains dan Teknologi)*, *11*(1), 192–203. https://doi.org/10.23887/jstundiksha.v11i1.45298

Pambudi, T. D., Wahyudi, N., & Nur Faizin, K. (2024). Analisis ketahanan panas komposit serat sabut buah kelapa bermatriks epoxy menggunakan pengujian thermogravimetric analysis. *JEECAE : Journal of Electrical, Electronic, Control and Automotive Engineering*, *9*(1), 6–8. https://doi.org/10.32486/jeecae.v9i1.729

Pangestu, W. P., Sadida, H., Vitasari, D., Kimia, S. T., Teknik, F., & Surakarta, U. M. (2021). Pengaruh kadar BOD, COD, pH dan TSS pada limbah cair industri tahu dengan metode media filter adsorben alam dan elektrokoagulasi. *Media Ilmiah Teknik Lingkungan (MITL)*, 6(2), 74–80. https://doi.org/10.33084/mitl.v6i2.2376

Rahmah, R. R. S. (2024). Efektivitas tanaman eceng gondok (Eichhornia crassipes) dalam menurunkan kadar BOD (Biochemical Oxigen Demand) dan TSS (Total Suspended Solid) pada limbah cair industri tahu Kelurahan Sialang Munggu Kota Pekanbaru. *Jurnal Kesehatan Bertuah Indonesia*, *1*(1), 40–50. Available at https://bertuahjournal.com/index.php/jkbi/article/view/6/5

Rezania, S., Ponraj, M., & Fadhil, M. (2015). The diverse applications of water hyacinth with main focus on sustainable energy and production for new era : An overview. *Renewable and Sustainable Energy Reviews*, *41*, 943–954. https://doi.org/10.1016/j.rser.2014.09.006

Safitri, D. (2025). Analysis Of Biochemical Oxygen Demand (BOD) Levels In River Water Samples. Jurnal Kimia dan Rekayasa, 6(1), 16-22. Available at https://kireka.setiabudi.ac.id/index.php/kireka/article/download/3178/59

Salsabila, A. D. A., & Fitrihidajati, H. (2025). Phytoremediation of tofu liquid waste using water hyacinth and water lettuce to improve waste quality. *LenteraBio: Berkala Ilmiah Biologi*, 14(1),20–26. https://doi.org/10.26740/lenterabio.v14n1.p20-26

Vidyawati, D.S. & Fitrihidajati, H. (2016). The effect of water hyacinth (*Eichornia crassipes*) phytoremediation through dilution to quality of liquid waste industry. *LenteraBio: Berkala Ilmiah Biologi*, 8(2), 113-129. Available at https://ejournal.unesa.ac.id/index.php/lenterabio/issue/view/1762

Vigiak, O., Grizzetti, B., Udias-moinelo, A., Zanni, M., Dorati, C., Bouraoui, F., & Pistocchi, A. (2019). Predicting biochemical oxygen demand in European freshwater bodies. *Science of the Total Environment*, *666*, 1089–1105. https://doi.org/10.1016/j.scitotenv.2019.02.252