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Majority Science Journal (MSJ) Vol. 3 No. 4, November 2025
P-ISSN: 0000-0000; E-ISSN:3025-1990
Available : https://jurnalhafasy.com/index.php/msj DOI: https://doi.org/10.61942/msj.v3i4.470

ANALYSIS OF THE IMPACT OF WATER QUALITY DECLINE AND TERRESTRIAL BIOTA DISTURBANCE DUE TO GALENA ORE MINING ACTIVITIES: A CASE STUDY OF PT CHRISTINA EXPLO MINING

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Inputed : October 13, 2025 *Revised : November 15, 2025*
Accepted : October 27, 2025 *Published : November 24, 2025*

Abstract

This study aims to evaluate the environmental impacts of galena ore mining activities, particularly related to water quality degradation and disturbances to terrestrial biota. This study was conducted in the operational area of PT Christina Explo Mining in 2024, focusing on the water quality of the Sasak and Rero rivers and disturbances to flora and fauna due to land clearing activities. The methods used included sampling surface water and clean water in the mining area and observing terrestrial biota. The analysis results indicate that water quality in the study area remains within the quality standards based on Government Regulation No. 22 of 2021 and Minister of Health Regulation No. 2 of 2023. However, potential disturbances to terrestrial biota habitats were identified, necessitating sustainable environmental management and regular monitoring.
Keywords: *water quality, terrestrial biota, mining, RKL, RPL, environmental impact*

Citation:
Amran., Sibali., A. 2025. Analysis of the Impact of Water Quality Degradation and Disturbance to Terrestrial Biota due to Galena Ore Mining Activities: A Case Study of PT Christina Explo Mining. *MSJ: Majority Science Journal*, 3(4), 33-37.

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1. Introduction

Mining activities, particularly galena ore (PbS), have become a major regional economic driver, but they have the potential to cause serious ecological impacts. One of the most crucial impacts is the decline in surface water quality due to sedimentation, chemical runoff, and changes in land use. Furthermore, drastic habitat changes also threaten the sustainability of terrestrial biota, both local flora and fauna (Rahman et al., 2020). Several recent studies have also shown that heavy metal mining activities can increase the risk of bioaccumulation of toxic metals in the food chain and simultaneously disrupt the community structure of aquatic and terrestrial organisms (Putra et al., 2023; Nurhasanah et al., 2022).

Poorly managed mining activities can cause significant environmental degradation. Decreased water quality can impact the availability of clean water for surrounding communities and the survival of aquatic organisms. Furthermore, disturbances to terrestrial biota, such as the loss of natural habitats, risk resulting in continued biodiversity decline. Therefore, this study is crucial as a basis for planning more adaptive and responsive mitigation and environmental management strategies.

This study examines the implementation of environmental management and monitoring by PT Christina Explo Mining as part of the implementation of the 2024 RKL and RPL. The main focus is directed at analyzing water quality and evaluating disturbances caused to terrestrial ecosystems, with the aim of providing data-based recommendations for sustainable management.

2. Method

The research was conducted in the mining area of PT Christina Explo Mining during the first quarter of 2024, covering the Sasak River and Rero River as the main sampling locations.

Majority Science Journal (MSJ) Vol. 3 No. 4, November 2025
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Data Collection Techniques

- Water Quality: Water sampling was carried out using the grab sampling method according to SNI 6989.59:2008, including physical parameters (TSS, TDS, turbidity), chemical (pH, nitrate, nitrite, ammonia, heavy metals), and microbiological (E. coli, Total Coliform).
- Terrestrial Biota: Direct observations were made to identify changes in local flora and fauna using key species study approaches and visual documentation.

Data Analysis

Water quality data was analyzed in a laboratory, compared with the water quality standard threshold based on PP No. 22 of 2021 and Permenkes No. 2 of 2023. Biodiversity data was analyzed descriptively.

No	Parameter	Satuan	Baku Mutu	Hasil	
				AP.2	AP.3
A	Physical Properties				
1	Total Dissolved Solid (TDS)	mg/L	2000	52	61
2	Total Suspended Solid (TSS)	mg/L	400	11	16
B	Chemical Properties				
1	pH	-	-	6.8	7.1
2	Nitrate as N (NO_3-N)	mg/L	20	1	1
3	Nitrite as N (NO_2-N)	mg/L	-	<0.008	<0.008
4	Total Ammonia (NH_3-N)	mg/L	-	0.04	0.01
5	Dissolved Iron (Fe)	mg/L	-	<0.005	<0.005
6	Dissolved Cadmium (Cd)	mg/L	0.01	<0.009	<0.009
7	Dissolved Mangan (Mn)	mg/L	0.1	<0.004	<0.004
8	Dissolved Zinc (Zn)	mg/L	2	<0.012	<0.012
9	Dissolved Copper (Cu)	mg/L	0.2	<0.009	<0.009
10	Dissolved Lead (Pb)	mg/L	0.5	<0.008	<0.008
11	Total Chromium (Cr)	mg/L	10	<0.008	<0.008
12	Sulfide as H_2S	mg/L	-	0.002	0.003

Sumber: Hasil Analisis Laboratorium Tahun 2024

Figure 1: Documentation of Sasak River Water Sampling

Majority Science Journal (MSJ) Vol. 3 No. 4, November 2025
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3. Results and Discussion

Water Quality Decline

Physical Parameters

TSS values in the Sasak and Rero Rivers were 11 and 16 mg/L, respectively, well below the 400 mg/L threshold. TDS values were recorded at 52 mg/L and 61 mg/L, respectively, still within the 2,000 mg/L limit.

Chemical Parameters

The pH value is neutral (6.8–7.1). Nitrate content of 1 mg/L, nitrite <0.008 mg/L, and ammonia 0.01–0.04 mg/L does not indicate significant pollution. Concentrations of Fe, Cd, Zn, Cu, and Pb are all within safe limits.

Clean Water in the Camp Area

TDS = 146 mg/L, turbidity = 0.05 NTU, and odorless. Although E. coli was not detected, Total Coliform = 51 CFU/100 mL, exceeding the quality standard of 0 CFU/100 mL, indicating the need for attention to drinking water sanitation.

2: Clean Water Conditions at Camp and Analysis Location

No	Parameter	Satuan	Baku	Hasil AB.1
A	Physical Properties	°		
1	Temperature	mg/L	-	26.5
2	Total Dissolved Solid (TDS)	NTU Scale	< 300	14
3	Turbidity	TCU Scale	<	0.05
4	Color	-	1	<
5	Odor **	-	Odorless	Odorless
B	Chemical Properties			
1	pH	-	6.5 - 8.5	6.
2	Nitrate as N (NO_3-N)	mg/L	2	2
3	Nitrite as N (NO_2-N)	mg/L	3	< 0.008
4	Chromium Hexavalent (Cr^{6+}) **	mg/L	0.01	< 0.017
5	Dissolved Iron (Fe)	mg/L	0.2	< 0.005
6	Dissolved Manganese (Mn)	mg/L	0.1	< 0.004
C	Microbiological Properties			
1	E. Coli	CFU/100 mL	0	0
2	Total Coliform	CFU/100 mL	0	51

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Disturbances to Terrestrial Biota

Land clearing and mining development have reduced vegetation cover and disrupted wildlife habitats. Several bird and reptile species are no longer observed in locations that were once their natural habitat.

The loss of green land cover also disrupts local ecological cycles. Endemic flora that previously protected the soil from erosion are now replaced by artificial structures. On the fauna side, species sensitive to habitat changes, such as land reptiles and endemic birds, are experiencing significant population declines. This reinforces the urgency of ecological rehabilitation efforts.

Management and Monitoring Strategy

Implementation of RKL-RPL by the company includes:

- Slope stabilization with terracing
- Controlling rainwater runoff with drainage channels
- Sediment pool cleaning every month

Monitoring is conducted quarterly for water and annually for flora and fauna, referring to standard parameters in Government Regulation No. 22/2021 and Minister of Health Regulation No. 2/2023. However, to be more responsive to environmental dynamics, monitoring frequency can be increased, especially during the rainy season.

4. Conclusions and Suggestions

Water quality in the Sasak and Rero Rivers remains within acceptable safety thresholds in terms of physical, chemical, and microbiological parameters, although coliform contamination is detected in the camp's clean water system and requires attention. Despite these findings indicating that the aquatic environment is still relatively stable, ongoing mining activities continue to exert pressure on surrounding terrestrial ecosystems, particularly through land clearing, soil erosion, reduced biodiversity, and habitat fragmentation. If these pressures are not managed effectively, they may escalate into long-term ecological degradation affecting both environmental quality and community livelihoods.

Given these conditions, a strong institutional and operational commitment to the sustainable and adaptive implementation of the Environmental Management Plan (RKL-RPL) is essential. This commitment should not only meet regulatory compliance but also prioritize ecosystem resilience and long-term environmental stewardship. Environmental rehabilitation strategies must be optimized through the restoration of native vegetation, development of micro-conservation zones to protect sensitive species, and the reestablishment of ecological corridors. In addition, community involvement is crucial; therefore, environmental education and participatory monitoring programs should be encouraged to strengthen awareness, accountability, and collaborative environmental governance.

To support these efforts, the adoption of green technology is highly recommended, particularly for wastewater filtration, sedimentation control, real-time water quality monitoring, and post-mining land recovery. The integration of these measures is expected to minimize environmental risks, strengthen mitigation efforts, and ensure that mining activities remain aligned with sustainable development principles.

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Majority Science Journal (MSJ) Vol. 3 No. 4, November 2025
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Available : https://jurnalhafasy.com/index.php/msj DOI: https://doi.org/10.61942/msj.v3i4.470

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