Impact Of Lead And Zinc Mining On Aquatic Biota

Proposal

October 7th, 2022

Background

Lead and zinc mining has a long history, with thousands of years of records in many parts of the world. In recent years, however, the industry has seen sharp decline due to environmental concerns, health risks and technological advancement. Ten years ago, the worldwide production of zinc amounted to 13.7 million metric tons, while the production of lead was 4.9 million metric tons. Whereas It is estimated that up to 1 million metric tons of zinc and 0.5 million metric tons of lead is produced worldwide this year . The socio-economic impact of lead and zinc mining have been severe, with significant health and environmental consequences for both humans and ecosystems in the immediate vicinity (Worlanyo, A. S., & Jiangfeng, L., 2021).

Lead and zinc mining operations, which generally generate large amounts of toxic waste, can cause contamination of soil, water, and air in the surrounding area by particulate matter and heavy metals. Lead is particularly dangerous, as it can cause cognitive delay, anemia, damage to the reproductive system and a host of other health problems. It is also highly toxic to aquatic life, as lead has a tendency to accumulate in organisms, magnifying its damaging effects (Tolvanen, A., wt al, 2019). Zinc, while less toxic than lead, can still cause harm when present in highly concentrated amounts, as it can be toxic to the nervous system and cause skin irritation, vomiting and diarrhea. Zinc can harm aquatic biota by accumulating in organism tissues and interfering with physiological functioning, ultimately leading to diminished aquatic life survival, growth, and reproduction.

Furthermore, lead and zinc mining has had a significant financial impact on the communities that surround the mine. This can either be positive; with the creation of jobs and revenue, or negative, due to the various externalized costs that the mining operations impose on adjacent communities. Additionally, the financial impacts of lead and zinc mining on aquatic life can be significant, as mining operations that cause extensive and for a long time environmental impacts can result in substantial expenditures for remediation and compensation measures. (Luckeneder, S., et al, 2021).

Problem statement

This project intends to show the results of mining on fish and macroinvertebrates in aquatic region. Mining disturbance affects the whole ecosystem structure, which causes a great decline in quality and biodiversity within the local aquatic biota. Remediation will help to increase biological diversity and healthy fluvial and aquatic habitats (Kumari & Paul, 2020).

Damages sustained in aquatic biota

Lead and zinc mining is a dangerous activity that can cause severe damage to aquatic biota when it is done without following environmental regulations. Lead is especially dangerous because it is a toxic metal that can lead to long-term health effects in humans and wildlife when it enters the food chain. Zinc is also toxic and can interfere with natural processes if present in large concentrations in water. Many times, mining operations leave behind acid drainage which can contaminate water bodies with lead and/or zinc (Kivinen, S., et al, 2020).

The effects of lead and zinc mining on aquatic biota can be explored both on the macro and micro level (Ali, M. M., et al, 2021). Macro effects include changes to the water's physical characteristics like color, odors, and temperature; the destruction of aquatic habitats; and the contamination of aquatic food sources. The micro effects can be more difficult to detect and investigate because they involve the direct toxicity of the lead and zinc that is entering the water. These toxic metals can affect the behavior, growth, reproduction, and survival of aquatic organisms. Lead and zinc poisoning can cause neurological damage, anemia, and damage to internal organs like the liver and kidneys (Okereafor, U., et al, 2020).

Aquatic biota that live in or near contaminated water sources like rivers, lakes, and streams can accumulate these toxic metals in their bodies, leading to bioaccumulation and biomagnification. This implies that the concentration of lead and zinc can increase through the food chain, and even small concentrations of these metals can have significant impacts on populations of top predators like fish-eating birds and mammals. In addition to direct toxicity, lead and zinc contamination can also affect the structure and function of aquatic ecosystems. Microbial communities can be disrupted, and the loss of key species like algae and macroinvertebrates can have ripple effects throughout the ecosystem.

Overall, the effects of lead and zinc mining on aquatic biota are complex and can vary depending on factors like the type and number of pollutants released, the characteristics of the water body, and the species and populations of organisms present. Understanding these impacts is crucial for developing strategies to minimize harm and protect aquatic ecosystems and the wildlife that depend on them. Lead & zinc mining results in decreased populations of organisms, changes in behavior and physiology of aquatic species, and damage to the genetic structure of species that live in affected waters (Farjana, S. H.,et al, 2019).

The effects of lead and zinc mining on aquatic biota is of great environmental concern. It is crucial that all mining operations conducted in a planned & guided manner that minimizes environmental harm. Otherwise, the long-term impacts of lead and zinc mining on aquatic life can be very serious. Additionally, remediation of the contaminated habitat is essential for the health and protection of aquatic biota.

Methodology

Soil sample collection and stream asset inventory are crucial in showing the effects of mining disturbances on local aquatic biota. The Stream Asset Inventory (SAI) Field Sampling Procedure guide will be used. Another possible guide to use is Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). The SAI and QHEI guides, as well as soil sample collection, are useful for assessing the health and diversity of stream habitats. Previously, similar approaches were used to assess the impact of mining disturbances on aquatic biota. The SAI or QHEI in our project may be modified to better suit the specific conditions and characteristics of the streams and soils in our study area.

Conclusion

The findings of this study can be used to guide future research into measures for mitigating or preventing the harmful effects of mining on aquatic biota, such as the development of more sustainable and responsible mining practises. We can assist maintain the long-term health and resilience of our planet's valuable aquatic biota by better understanding the linkages between mining activities and aquatic ecosystems." Finally, because of the potential negative effects that lead and zinc mining can have on the health and survival of aquatic life, this project on the impact of lead and zinc mining on aquatic biota is critical.

Annotated Bibliography

1. Farjana, S. H., Huda, N., Mahmud, M. P., & Saidur, R. (2019). A review on the impact of mining and mineral processing industries through life cycle assessment. *Journal of cleaner production*, *231*, 1200-1217.

The article uses a life cycle assessment (LCA) technique to provide a detailed evaluation of the environmental impact of the mining and mineral processing sectors. The writers provide an overview of the mining and mineral processing life cycle stages, which include mining, extraction, beneficiation, and disposal. LCA techniques are used to assess the environmental implications of these stages. The mining and mineral processing sectors have major environmental implications, including land degradation, water and air pollution, and greenhouse gas emissions, according to the article. Several critical elements, such as the type of mining method utilised, the type of ore being processed, and the energy source used during processing, are identified in the review as contributing to these impacts.

2. Kivinen, S., Kotilainen, J., & Kumpula, T. (2020). Mining conflicts in the European Union: environmental and political perspectives. *Fennia*, *198*.

Researchers investigate current mining conflicts in the European Union using data from the Global Atlas of Environmental Justice to gain a better understanding of the potential consequences of the new minerals policy' intensification of mining activity. The reasons of conflict are diverse, ranging from environmental damage to socioeconomic and health concerns of the populations living near mines. While mining conflicts have happened at all stages of a mine's life cycle, new mining ventures have been well presented among the conflicts. Policymakers should pay closer attention to the numerous environmental and social repercussions of mining in order to implement plans for increased mineral extraction.

3. Kumari[1], D., & Paul, D. K. (2020). Assessing the role of bioindicators in freshwater ecosystem. https://www.researchgate.net/profile/Dk-Paul/publication/348098087_Assessing_the_Role_of_Bioindicators_in_Freshwater_Ecosystem/l

inks/5feefcdd92851c13fedb7c0c/Assessing-the-Role-of-Bioindicators-in-Freshwater-Ecosystem.pdf

The work "Assessing the role of bioindicators in freshwater ecosystem" by Kumari and Paul (2020) analyses the use of bioindicators in monitoring the health and quality of freshwater ecosystems. Bioindicators are living things that respond to changes in the ecosystem to provide information about their surroundings. The article discusses how to detect changes in water quality caused by natural and anthropogenic causes using bioindicators such as macroinvertebrates, fish, and phytoplankton. Bioindicators, according to the authors, can be a useful tool for monitoring the ecological health of freshwater ecosystems and providing insights into the overall health of aquatic environments. Overall, the study underlines the importance of monitoring and assessing freshwater ecosystem health in order to support sustainable development.

4. Luckeneder, S., Giljum, S., Schaffartzik, A., Maus, V., & Tost, M. (2021). Surge in global metal mining threatens vulnerable ecosystems. *Global Environmental Change*, *69*, 102303.

   The article "Surge in global metal mining threatens vulnerable ecosystems" investigates the environmental consequences of the large increase in metal mining activities around the world. The authors highlight the increasing demand for metals, which is being driven by reasons such as urbanisation and the transition to renewable energy, as well as the impact on ecosystems. They argue that metal mining contributes significantly to deforestation, land degradation, and pollution, endangering vulnerable ecosystems and the communities that rely on them. The study concludes by underlining the significance of more sustainable mining practises and a greater understanding of the environmental and social consequences of metal mining activities.

5. Okereafor, U., Makhatha, M., Mekuto, L., Uche-Okereafor, N., Sebola, T., & Mavumengwana, V. (2020). Toxic metal implications on agricultural soils, plants, animals, aquatic life and human health. *International journal of environmental research and public health*, *17*(7), 2204.

   The article "Toxic metal implications on agricultural soils, plants, animals, aquatic life, and human health" looks into the detrimental effects of heavy metal contamination on a variety of environmental and human health factors. The authors provide an overview of the sources and pathways of heavy metal pollution in agricultural soils, including fertiliser, sewage sludge, and irrigation water. They also investigate the impacts of heavy metal contamination on soil health,

plant growth, animal health, and aquatic ecosystems, underlining the dangers of hazardous metal bioaccumulation throughout the food chain. The essay underlines the importance of heavy metal contamination monitoring and mitigation to safeguard human health and the environment.

6. Tolvanen, A., Eilu, P., Juutinen, A., Kangas, K., Kivinen, M., Markovaara-Koivisto, M., ... & Similä, J. (2019). Mining in the Arctic environment–A review from ecological, socioeconomic and legal perspectives. *Journal of environmental management*, *233*, 832-844.

The study "Mining in the Arctic Environment: A Review from Ecological, Socioeconomic, and Legal Perspectives" goes into extensive length about mining in the Arctic region. The authors study the ecological, social, and legal elements of Arctic mining, emphasising the problems posed by the Arctic's unique and vulnerable ecosystem. The review looks into the effects of mining on the Arctic environment, including biodiversity, ecosystems, and indigenous cultures' lives. The study also investigates the potential benefits and cons of Arctic mining, taking environmental, social, and economic factors into account. Overall, the article suggests that mining in the Arctic requires a balanced approach that takes into account environmental, social, and legal issues.

7. Worlanyo, A. S., & Jiangfeng, L. (2021). Evaluating the environmental and economic impact of mining for post-mined land restoration and land-use: A review. *Journal of Environmental Management*, *279*, 111623.

"Evaluating the environmental and economic impact of mining for post-mined land restoration and land-use: A review" investigates the environmental and economic consequences of mining operations on post-mined land restoration and land-use. The authors underline the need of sustainable mining practises that prioritise land restoration and reclamation, and they present a variety of strategies for achieving these goals. They also look into the economic aspects of sustainable mining, such as cost savings from higher efficiency and less environmental effect. Overall, the essay underlines the importance of considering both environmental and economic considerations when assessing the impact of mining on post-mined land, and it proposes that sustainable practises can benefit both the mining industry and local residents.