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ANALYSIS OF THE ENVIRONMENTAL IMPACT ASSESSMENT OF POLYMETALLIC ORE MINING

Dragomir Vassilev

Technical University of Gabrovo, Bulgaria
**Corresponding author: dvasilev@tugab.bg*

Abstract
This report analyses the environmental impact assessment (EIA) of polymetallic ore mining, looking specifically at a case study of a given site. The report focuses on key aspects of the EIA process, identifying strengths and weaknesses, and offering recommendations for improving the effectiveness and comprehensiveness of impact assessments in the mining industry.
Keywords: Environmental Impact Assessment (EIA), extraction of polymetallic ores, mining industry, sustainable development, mitigation measures, monitoring, air pollution, water pollution, biodiversity, reclamation.

INTRODUCTION

Decision-making processes for mineral extraction are complex and multi-layered, involving careful consideration of technical, economic, social and environmental factors. Within this multi-dimensional framework, **environmental impact assessment (EIA)** emerges as a critical process that aims to balance the economic benefits arising from mining projects with the ethical responsibility to protect the environment and ecosystems.

Mining activities have the potential to stimulate economic growth, generate revenue for countries and create employment opportunities for local communities. On the other hand, these activities can lead to significant environmental impacts, including:

- **Air and water pollution**: Emissions of dust, gases, and chemicals used in mining processes can degrade air quality and contaminate water resources, affecting human health and ecosystems.
- **Land degradation and biodiversity loss**: Disturbance of land for mining infrastructure and activities can lead to habitat loss, fragmentation and extinction of plant and animal species.
- **Socio-economic impacts** : Mining projects can lead to population displacement, disrupt traditional livelihoods, and alter the cultural landscape of local communities.

EIA plays a fundamental role in managing these challenges by providing a systematic approach to:

- **Identification and assessment of potential environmental impacts**: Incorporating scientific data, expert judgment, and stakeholder engagement to assess impacts.
- **Developing mitigation measures**: Proposing practical solutions to reduce, avoid or compensate for negative impacts.
- **Promoting transparency and accountability**: Ensuring that decision-making processes are informed, inclusive and take into account the interests of all stakeholders. [1, 2]

EXPOSITION

Evolution of EIA practices in the mining industry:

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Turning to historical perspectives, it is essential to acknowledge how EIA practices have evolved significantly in the mining sector over the years.

- **Early stages**: In the past, mining projects were often carried out with limited attention to environmental impacts, leading to widespread environmental destruction and social disruption.
- **Increased Regulatory Framework**: Growing environmental concerns have led to the development of environmental laws requiring impact assessments and permits for mining projects.
- **Modern practices**: Modern EIAs are characterized by a more holistic and integrated approach that encompasses a wide range of environmental components and sustainability considerations.

The internal influence on this evolution:

- **Regulatory Requirements**: Governments around the world have enacted stricter environmental protection laws, forcing mining companies to conduct in-depth EIAs and implement mitigation measures.
- **Assessment standards**: Standardized methodologies and guidelines for conducting EIAs have been developed, ensuring consistency and comparability in assessment processes.
- **Stakeholder expectations**: Growing awareness of environmental issues has led mining companies to engage with stakeholders, take their concerns into account, and incorporate their views into decision-making processes.

Recognizing the transition from one-off compliance to mandatory measures, it is essential to highlight that contemporary best practices emphasize active stakeholder engagement, adaptive management strategies, and the promotion of transparency and accountability throughout the project lifecycle. This evolution reflects the growing understanding that mining activities must be undertaken in a sustainable manner, taking into account environmental, social, and economic aspects. [3-5]

OVERVIEW OF THE EIA PROCESS

A detailed description of the different stages of the EIA process, starting from screening and scoping to the preparation of the EIA report, public consultation, decision-making and post-approval monitoring.

Highlighting the key objectives and requirements at each stage, as well as the roles and responsibilities of relevant stakeholders (project proponent, regulators, consultants and the public).

Review of the regulatory framework that guides EIA for mineral extraction projects, including applicable laws, regulations, licenses, and permits.

Analysis of guidance provided by regulators, agencies and industry associations on conducting EIAs, impact mitigation and best management practices.

Exploring different methods for identifying and predicting potential environmental impacts, such as checklists, matrices, networks, computer models, and spatial analysis.

Discussion of the strengths and weaknesses of each method, including their suitability for different environmental components and project stages.

Assessment of available approaches to assess the significance of impacts, including qualitative assessments, quantitative assessments and threshold criteria.

Review of the role of scientific judgment, professional expertise, and public opinion in determining levels of significance and prioritizing impacts for mitigation.

Description of considerations for including various environmental components in the EIA process, including air quality, water quality, soil characteristics, biodiversity, noise, vibration, socio-economic aspects, cultural heritage and human health. [6-9]

In-depth consideration of the specifics of the impact assessment on each component,

ensuring that the report is comprehensive and relevant.

ANALYSIS OF THE ENVIRONMENTAL IMPACT OF POLYMETALLIC ORE MINING

Provide a concise overview of the polymetallic ore exploration site, including its location, geological conditions, hydrological characteristics, and environmental sensitivity.

Description of the proposed extraction methods and related activities, taking into account the stages of discovery, drilling, blasting, crushing, processing and waste management.

Presentation of potential environmental impacts identified through the EIA process, with emphasis on significant impacts. Topics include, but are not limited to:

- Air pollution and greenhouse gases from mining equipment and processing processes.
- Surface and underground water pollution from mine runoff, leakage and waste disposal.
- Soil damage and its ability to regenerate from topsoil extraction, storage and treatment.
- Habitat loss, fragmentation and disturbance of wildlife, including endangered or protected species.
- Noise and vibration levels that affect people and wildlife.
- Impact on archaeological or cultural resources.

Provide a clear and concise analysis of the proposed mitigation measures and assess their effectiveness in addressing the identified impacts.

Assessment of public participation in the EIA process, including consultations with local communities, government agencies and environmental organizations.

Analysis of feedback received from stakeholders and how this feedback was incorporated into the EIA process and mitigation plans. [10,11]

Assessment of the EIA report's compliance with applicable legal and regulatory requirements, including national and international standards.

Identifying any gaps or inconsistencies in the EIA process and providing recommendations for improvement.

STRENGTHS AND WEAKNESSES IN THE EIA PROCESS

Strengths:

- **Compliance with the regulatory framework**: The Environmental Impact Assessment (EIA) procedure is carried out in accordance with the current Bulgarian and European legislation. This demonstrates responsibility for environmental protection and compliance with standards.
- **Preliminary nature of the EIA**: The EIA is adopted before the final decision on exploitation, as a new way of exploitation is developed in advance, which allows for more informed decisions to be made and environmental risks to be minimized.
- **Attention to significant factors**: The assessment covers key factors such as ambient air, water, soil, biodiversity, cultural heritage and human health. This provides a comprehensive view of potential impacts.
- **Specific requirements for the contractor**: The contractor had to ensure the safety of people and construction facilities outside the boundary of the danger zone.
- **Socio-economic benefits**: The project is expected to lead to increased foreign investment, improve the economy of the municipality and create new jobs.
- **Public consultation planned**: The public is provided with an opportunity to express their opinions and comments.
- **The project has been revised**: After receiving the Report for the search for archaeological sites with the aim of preserving the cultural and historical heritage and cultural monuments, the mining project has also been revised.

Weaknesses and gaps:

- **Lack of specific quantitative data**: The report may suffer from a lack of specific data to predict water pollution, dispersion of pollutants into the air, noise pollution and other potential environmental effects.

Precise quantitative data would allow for a more accurate assessment of impacts.

- **Unclear data on waste disposal**: The report does not describe clearly enough the plans for the management and disposal of waste generated by the mining activities, which may lead to a lack of a comprehensive assessment of the impact and waste from the activity.
- **Short monitoring scope**: It is necessary to have measures planned for a longer period of time. [12]

RECOMMENDATIONS FOR IMPROVING EIA PRACTICES

Recommendations to improve the effectiveness and objectivity of impact assessments, such as:

- Strengthening data collection and baseline studies for more accurate forecasts.
- Development and implementation of standardized methodologies and models for impact assessment.
- Improve public participation and consultation processes to promote trust and accountability.
- Strengthen monitoring and enforcement mechanisms to ensure the effectiveness of mitigation measures.
- Consideration of alternative mining options, including location, technologies and schedules to minimize environmental impacts.
- Integrating sustainable mining practices, such as water recycling, land reclamation, and energy conservation, to promote responsible environmental management.

CONCLUSION

Basic ecological consequences:

- Air pollution
- Pollution of surface and underground waters with heavy metals.
- Soil degradation: Removal of topsoil layer of soil and the risk of erosion, which violates the natural ones soil characteristics and productivity
- Biodiversity loss: Destruction of wildlife habitats animals and plants.
- Impact and change of terrain: significant landscape changes
- Creating a high noise

Recommendations:

- Strengthening monitoring of key environmental indicators environment, to is follow the effectiveness of mitigation measures and to is discover any unforeseen impacts.
- Applying best practices environmental management practices environment.
- Investing in research and innovation to develop new mining technologies that yes reduce to minimum impact on the environment.
- Promoting cooperation between mining companies, government authorities, local communities and the environmental organizations to is guarantees taking informed decisions and responsibly environmental management environment.

Polymetallic ore mining activities are inherently associated with significant environmental impacts, spanning a wide range of components - from air and water quality to biodiversity, soils, landscapes and socio-economic conditions of local communities. The intensity and nature of these impacts vary significantly depending on the specific mining methods, geological conditions, environmental characteristics and the effectiveness of the mitigation strategies implemented.

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