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Risk Management for Sustainable Mining in Kazakhstan

Sergei Sabanov[1], Ruslana Korshunova[1]
[1]School of Mining and Geosciences, Nazarbayev University
53, Kabanbay batyr Ave., Astana, Kazakhstan
sergei.sabanov@nu.edu.kz; ruslana.korshunova@nu.edu.kz

Extended Abstract

Risk management in sustainable mining practices is crucial for Kazakhstan, a country rich in mineral resources but facing significant environmental and social challenges. The mining sector is a cornerstone of Kazakhstan's economy, contributing substantially to GDP and employment. However, the environmental impacts of mining activities, including pollution and resource depletion, necessitate a robust risk management framework that aligns with sustainable development goals.

Kazakhstan's mining industry is currently undergoing a transformation aimed at enhancing sustainability through digitalization and advanced analytics. Uteshov et al. highlight that effective digitalization is essential for timely and sustainable technological modernization, which is critical for maintaining competitiveness and profitability in the mining sector [1]. This technological shift is necessary to address the environmental challenges posed by mining operations, as emphasized by Sikhimbayev et al., who discuss the need for improved management systems that minimize environmental impacts while ensuring social guarantees for personnel [2].

Environmental impact assessments (EIA) play a pivotal role in risk management for mining projects. Zarubin et al. propose a GIS software module specifically designed for optimizing EIA calculations in open-pit mining, which can significantly reduce negative environmental impacts [3]. This tool is particularly beneficial for small mining operators in Kazakhstan, who may lack access to comprehensive commercial software solutions. Furthermore, Baubekova et al. underscore the urgent need for monitoring environmental contamination by toxic trace elements, which has become a pressing issue in regions with intensive mining activities [4]. Effective EIA, coupled with continuous monitoring, can mitigate risks associated with environmental degradation and public health.

Water resource management is another critical aspect of sustainable mining in Kazakhstan. Atakhanova discusses the risks associated with mine water use, highlighting the need for regulatory frameworks that address the high resource intensity of mining operations [5]. The deterioration of surface and groundwater resources due to inefficient practices poses significant risks to both ecosystems and human health, necessitating a comprehensive approach to water management in the mining sector [6].

Health impacts of mining activities, particularly concerning uranium extraction, are significant. Adotey at al studied influence of heterogeneous (gas-solid) chemistry of atmospheric Cr in Astana city, Kazakhstan [7]. Bersimbaev and Bulgakova detail the health risks associated with radon and uranium exposure, which are prevalent in mining areas [8]. The historical context of uranium mining in Kazakhstan necessitates a focus on remediation and health risk management as part of the broader sustainability agenda.

In conclusion, effective risk management for sustainable mining in Kazakhstan requires an integrated approach that encompasses technological innovation, rigorous environmental assessments, and proactive health and water resource management. By adopting these strategies, Kazakhstan can enhance the sustainability of its mining sector while addressing the environmental and social challenges it faces.

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