

Prioritizing Sustainable Indicators for Mineral industry of Pakistan

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Abstract

The mineral industry plays a pivotal role in the economic development of nations, and as sustainability becomes increasingly critical, the need to prioritize sustainable practices within this sector becomes paramount. This paper explores the imperative of identifying and prioritizing sustainable indicators tailored to the unique context of the mineral industry in Pakistan. Pakistan have huge mineral potential and is amongst the global mineral rich nations, so far more than 92 minerals have been explored. The main resources includes billion tons of coal, copper, gypsum, granite, gold, and iron, these are estimated to be 186, 6.72, 4.85, 4.414, 1.85, and iron 1.43, respectively(Shah, 2018). The average annual growth rate of the industry and its contribution to the gross domestic product (GDP) is about 3% which is not proportionate to its capacity. Despite these mineral potentials, one cannot disagree with the risks of mineral extractions. Both surface as well as underground mines are present in Pakistan and is functioning with outdated practices and old mining laws (Jiskani et.al, 2020). This study will also address the risk factors pertaining to issues of organization in implementing the sustainability in mining sector. The case study result will open an avenue for practitioners and decision-makers of Pakistan to understand sustainability implication in mining sector. Overall, this study will be a contribution in making a Policy framework for mining industry of Pakistan, which is a major contribution.

Keywords

Sustainable indicators, Eco-friendly practices, Environmental regulations, Sustainable mining practices, Climate resilience.

1. Introduction

Mining is considered as one of the main driving business across the globe. According to the International Council of Mining and Metals (ICMM), nearly 70 countries are primarily dependent on the mining industry; most of those countries are low income developing countries. The mineral industry plays a pivotal role in the economic landscape of Pakistan, contributing significantly to the country's GDP and employment. However, the pursuit of mineral resources often raises environmental and social concerns, necessitating a paradigm shift towards sustainable practices. In this context, prioritizing sustainable indicators for the mineral industry of Pakistan becomes imperative. This approach seeks to strike a balance between economic development and environmental stewardship, acknowledging the finite nature of mineral resources and the need for responsible exploitation. By focusing on sustainable indicators, Pakistan can not only enhance the long-term viability of its mineral sector but also foster environmental conservation, social equity, and community well-being. This introduction sets the stage for a comprehensive exploration of the sustainable dimensions that should be prioritized in shaping the future trajectory of the mineral industry in Pakistan. Though mining sector have major role in the economic development of any country, however, due to inadequate policies, measures, outdated mining laws and socio-political influence, mining sector of Pakistan cannot contribute substantially to GDP of Pakistan. Pakistan, being a developing country, has been facing number of social as well as

environmental challenges in mining sector. For example, land insecurity, migration, resettlement, employee well beings, Biodiversity, land degradation, dust and ecological etc., thus, comprehensive research is required to develop practices for mining at par with socio-economic and environmental standards. For sustainable mining, there has been a considerable gap in the research, and earlier works have not comprehensively considered surface as well as underground mining. This research will also address the risk factors pertaining to issues of organization in implementing the sustainability in mining sector.

2. Research Objectives

The aim of this research work is designing an integrated sustainable model for Surface and Underground mines using decision support system. Following objectives have been designed to meet the aim:

1. To identify and assess the criteria of sustainable mining in Pakistan (Completed).
2. To explore barriers in adopting sustainable mining practices (In progress)
3. To propose strategies to overcome barriers and promote sustainable mining (In progress).
4. To develop a tool to measure the level of sustainability in mining industry of Pakistan (In progress).
5. To apply the proposed tool in underground and surface mining industry of Pakistan (In progress).

3. Literature Review

Naqib ullah khan, peng et. al. (2023), This research planned to conduct a systematic review of the existing literature and institutional guidelines to explore and create a code of international best mining guidelines (IBMC) focusing on sustainable mineral resources growth. The study also planned to explore and compare the mining and minerals governance mechanisms of Pakistan against IBMC.

Mahdi Hossein pour et.al. (2022), studied Semiquantitative model that offered to assess positive and negative impacts of mining on sustainable development (SD) together. TOPSIS Technique is used to select the most impacting mining factors on SD.

Monteiro, Bezerra et al. (2021), the study found shortcomings in Brazilian mining law which may delay the implication of sustainability in mining sectors specially environment and social pillar of sustainability.

Jiskani, Cai et al. (2020), discusses the advancement in safety standards of the industry and pursue sustainable development, the safety of mines must be analyzed and improved through a continuous assurance.

Shahani, Sajid et al. (2020), reveals that the mining operations are still performed with exploitation approaches that are outdated and no longer practiced by advanced nations.

Nie, Bai et al. (2019), the study highlights the effectiveness and verification of safety supervision.

Tost, Hitch et al. (2018), the study reveals the major parameters which may affect the sustainable development goals are the environments economy and social in order to design optimum pit design.

Ma and Dai (2017), discusses the index system-based studies have also been conducted for warning system of coal mines.

Basu and van Zyl (2006), this research work presented the industrial ecology framework which may lead to sustainable development.

Joy Jacqueline Pereira and Ibrahim Komoo (2000), this paper describes indicator development initiatives for the minerals industry in Canada, Australia and Malaysia. The Canadians are in the process of developing a conceptual framework to identify sustainable development criteria and indicators for the mineral industry to fulfill institutional requirements.

4. Methodology

The research methodology employed in prioritizing sustainable indicators for the mineral industry of Pakistan involves a comprehensive and systematic approach. Initially, a thorough review of existing literature on sustainable development, mineral industries, and relevant indicators specific to Pakistan is conducted. This literature review serves as the foundation for identifying potential indicators. Subsequently, qualitative and quantitative data are collected through surveys, interviews, and analysis of official reports from governmental and non-governmental organizations. Stakeholder consultations are undertaken to ensure a holistic understanding of perspectives within the industry. The collected data is then analyzed using statistical tools and qualitative coding methods to identify key indicators that align with sustainability goals. A prioritization framework is developed, taking into account environmental, social, and economic factors, to rank the identified indicators based on their significance to the sustainable development of the mineral industry in Pakistan. This rigorous methodology ensures the reliability and validity of the selected indicators, providing a robust foundation for guiding sustainable practices in the mineral sector.

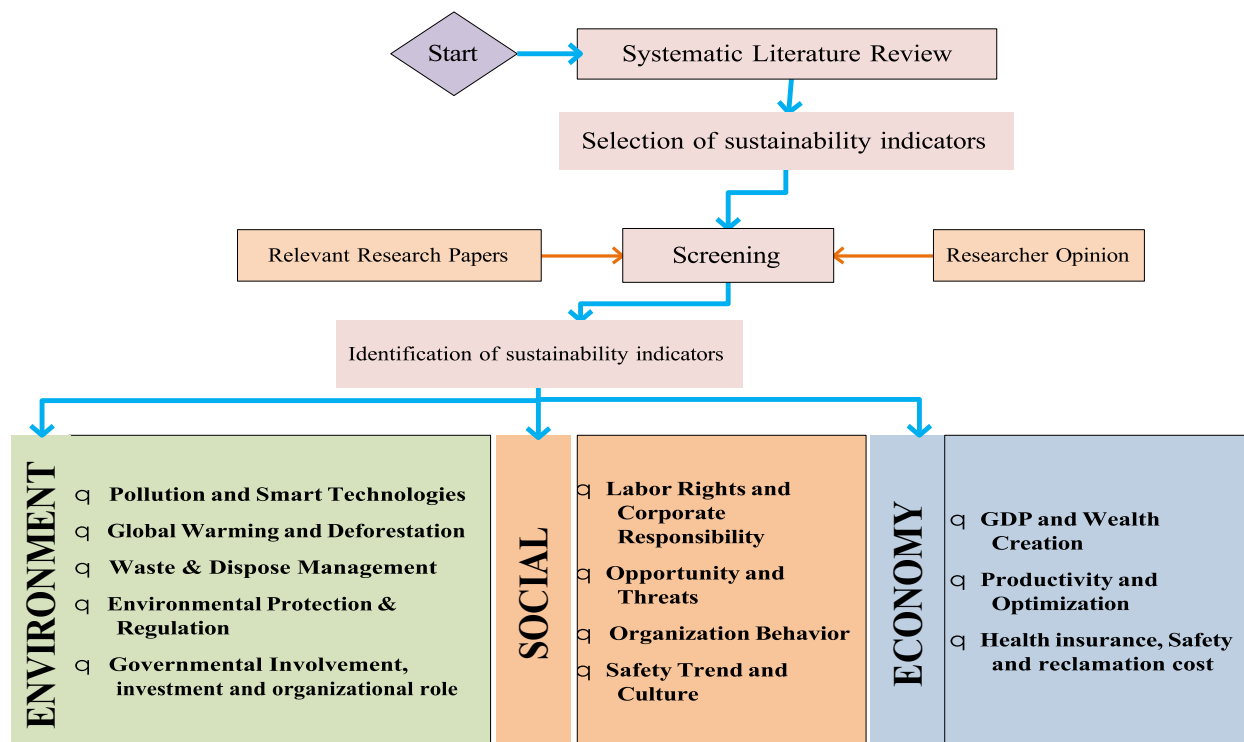


Figure 1. Research methodology flow chart

5. Results and Discussions

Prioritizing sustainable indicators for the mineral industry of Pakistan is imperative for fostering responsible and environmentally conscious resource management. This endeavor aims to strike a balance between economic development and ecological preservation, ensuring that the exploitation of mineral resources aligns with long-term environmental sustainability goals. By identifying social, environmental and economic criteria and prioritizing key indicators, Pakistan can pave the way for a more resilient and sustainable mineral industry. This strategic approach not only addresses the immediate economic needs of the nation but also safeguards the ecological integrity, promoting a harmonious coexistence between industrial progress and environmental stewardship. As Pakistan continues to navigate the challenges of mineral resource utilization, prioritizing sustainability indicators becomes a cornerstone for fostering a robust and ethically responsible mineral industry that meets the needs of the present without compromising the well-being of future generations.

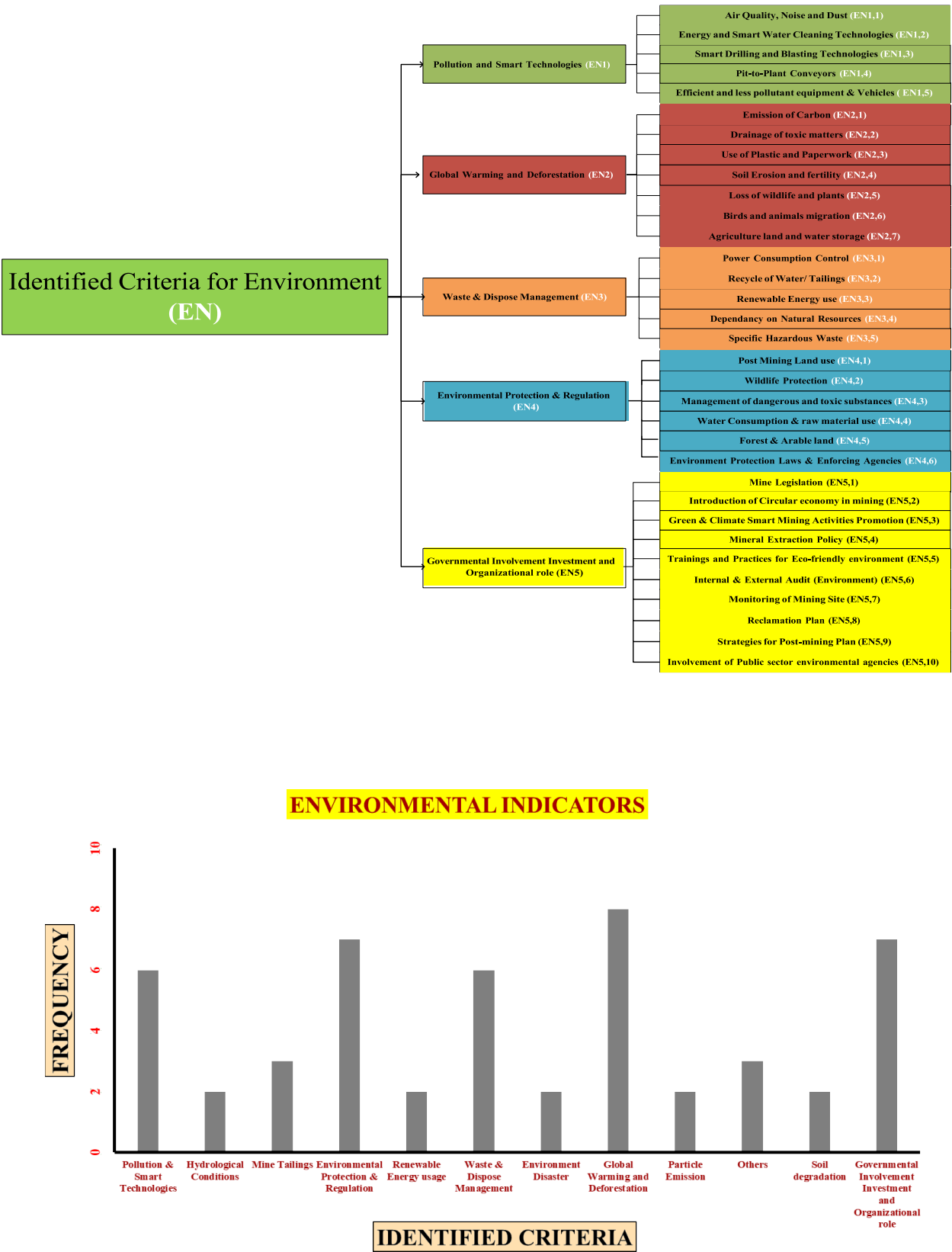


Figure 2. Identified Criteria and Corresponding Indicators (Environment)

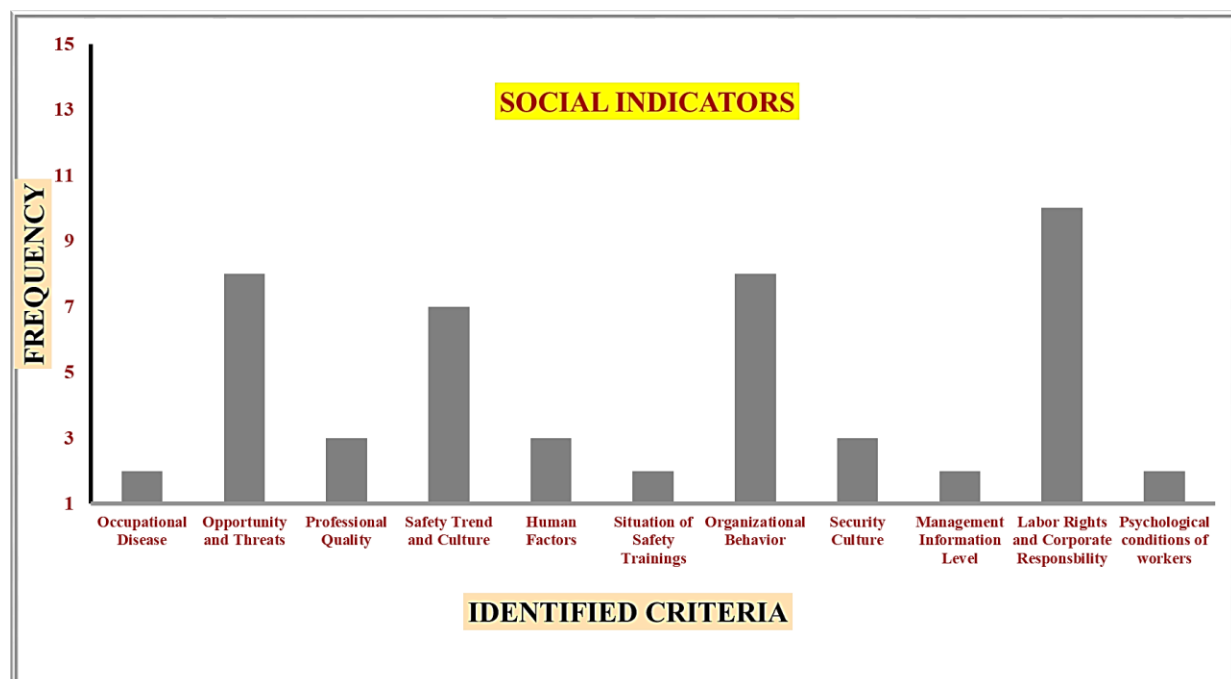
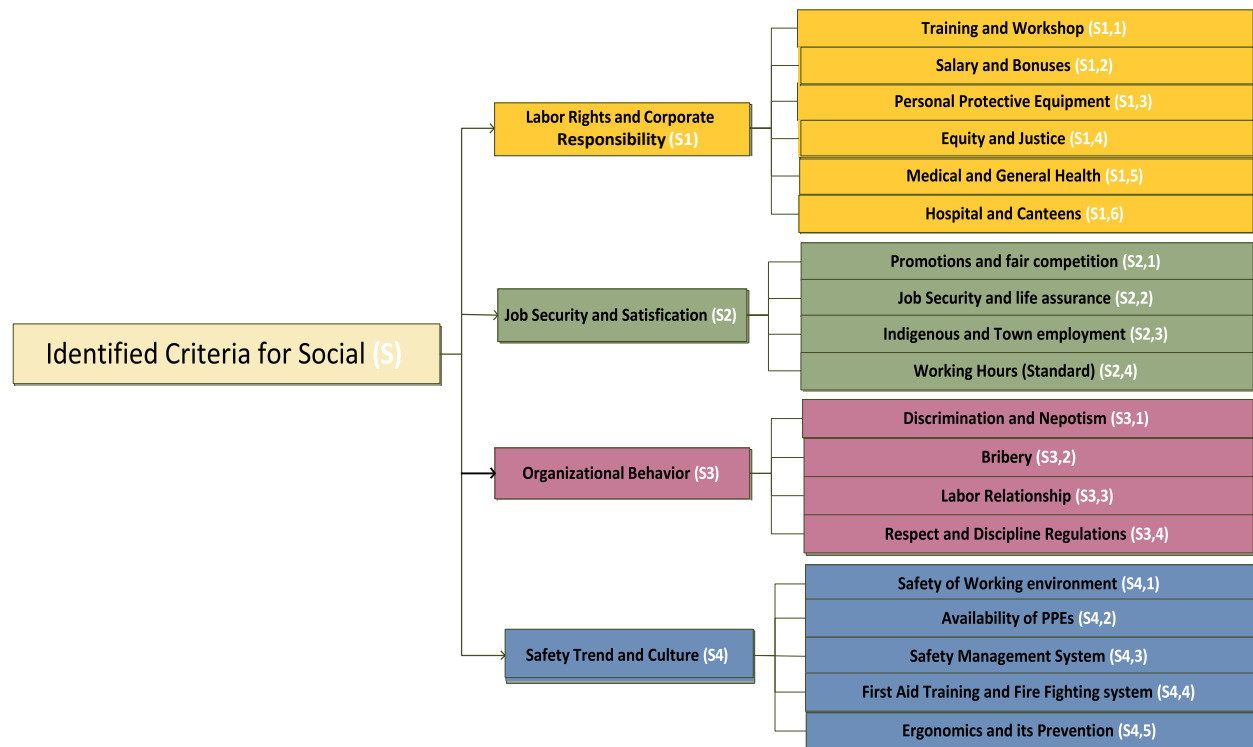


Figure 3. Identified Criteria and Corresponding Indicators (Social)

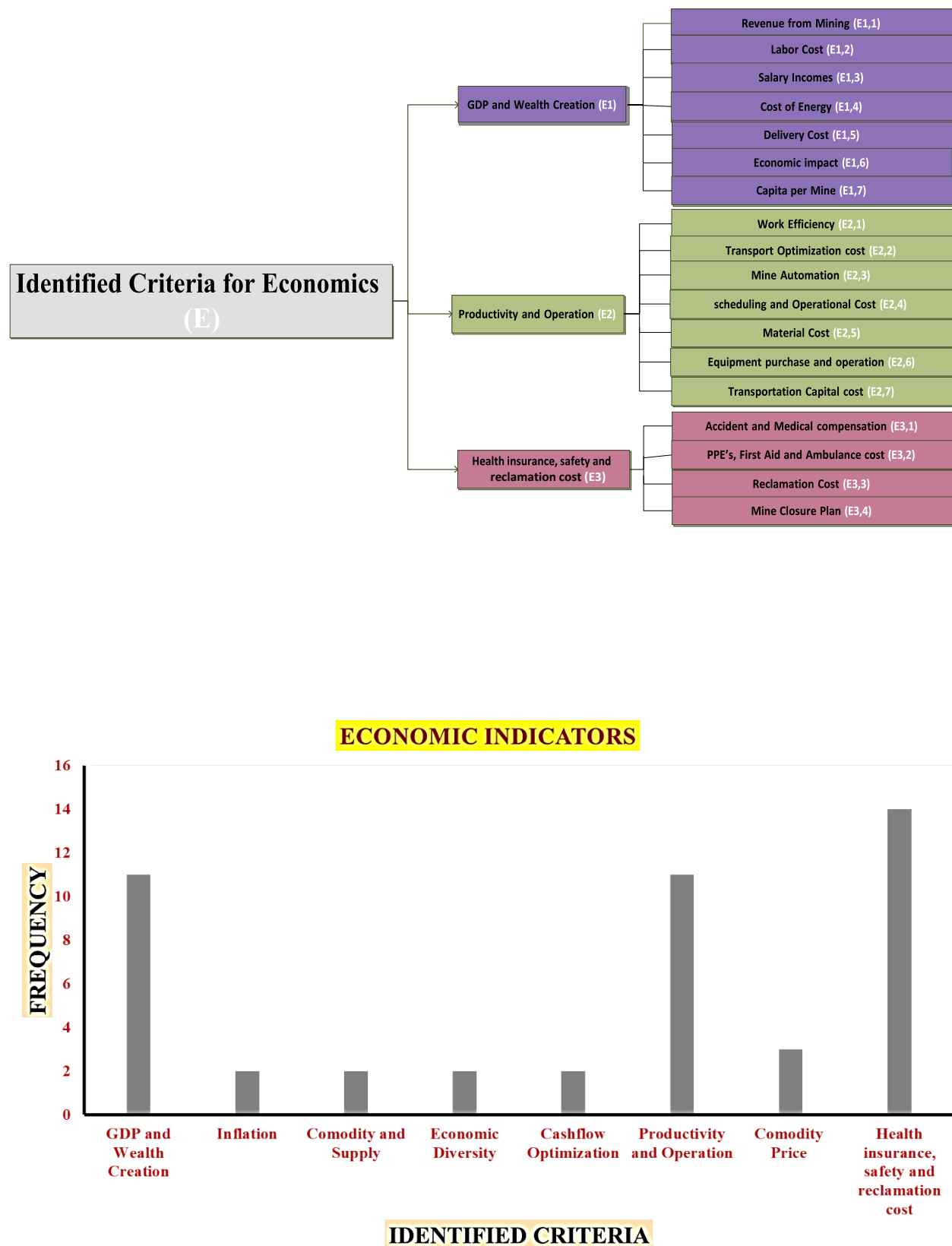


Figure 4. Identified Criteria and Corresponding Indicators (Economic)

6. Conclusion

Mining and mineral industry is growing at fast due to increasing demand in global mineral supply chain. On the contrary, developing countries are facing multiple challenges pertaining to mining which are posing threats to environment, economic and communities. These sustainability challenges must be addressed with some minor changes in their policies, initiative programs, research in sustainability must be part of government framework. This study has focused the mineral industry of Pakistan. Screening of more than 50 research articles identified various number of main indicators and sub-indicators related to environmental sustainability, social sustainability and economic sustainability that specifically associated with sustainable mining. Five main indicators with 33 sub indicators for environmental sustainability were finalized. Four main indicators with 19 sub indicators for social sustainability and at last three major indicator with 18 sub indicators for economic sustainability were categorized. These indicators and sub indicators were finalized in light of emerging challenges in mineral industry of Pakistan. Moreover, it was also observed that further study must be conducted to see the relationship between these sub indicators for proper implication of these parameters in formulating sustainable mineral policy and industry.

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