Environmental impact of mining industry in Khyber Pakhtunkhwa and Balochistan

Shahid Ali[1], Turab Khan Jadoon[2], Abdul Sattar[2], Shahid khan[1], Janan Khan Jafar[1], Ahmad Kamal[1], Lt. Col Ijaz Ahmed[2], Arz Muhammad[1]

1) 37th Domain Specific, Mid-Career Management Course, Pakistan Provincial Services Academy Peshawar.
2) Pakistan Provincial Services Academy, Peshawar.

Abstract

The mining industry in Khyber Pakhtunkhwa (KP) and Balochistan has been a vital driver of economic growth, but its environmental impact has raised significant concerns. This comprehensive research study on existing studies on the environmental consequences of mining in these regions, reveals the intricate relationship between resource extraction and ecological equilibrium. While coal mining in Balochistan stands as a historical pillar of economic activity, it has come at the cost of pollution, soil degradation, and ecosystem disruption. Similarly, gemstone mining in areas like Swat Valley presents unique environmental considerations. The echoes of chromite mining's impact reverberate across KP and Balochistan, while riverbed and terrace mining in the upper Indus Basin also face scrutiny. Beyond the regional scope, global and South Asian implications of mining and smelting are explored. The research highlights the need for sustainable practices, robust impact assessments, and restoration efforts to harmonize mining with the environment. The study focuses on evaluating environmental degradation caused by mining operations, resource depletion, and regulatory gaps in KP and Balochistan. By examining the complex interplay between economic growth and ecological preservation, the research aims to propose sustainable solutions to mitigate mining's negative impact on the environment. The study's geographic focus covers KP and Balochistan, where mining has contributed significantly to economic growth. These regions grapple with striking a balance between economic benefits and environmental sustainability. The methodology involves exploratory research through interviews with key stakeholders, along with the analysis of primary and secondary data. This approach provides insights into current mining policies, their environmental implications, and regulatory gaps. The research findings underscore the urgent need for stronger regulatory frameworks, enhanced monitoring and enforcement, community engagement, and sustainable mining practices. Balancing the interests of stakeholders is essential to achieve sustainable development, ensuring economic growth while safeguarding the environment for present and future generations.

Keywords: Minning Industry, Environmental Impact, Sustainability, Pollution, Impact Assessment, Restoration Efforts.

Introduction

Mining in Khyber Pakhtunkhwa (KP) and Balochistan has been a driving force behind economic growth, but concerns about its environmental impact have ignited widespread research efforts. This comprehensive review amalgamates a multitude of existing studies delving into the intricate environmental repercussions of mining in these regions, shedding light on the dynamic interplay between resource extraction and ecological equilibrium.

Balochistan's coal mining, a historical cornerstone of economic activity, stands as a testament to the region's industrial vigor. However, this economic prosperity has been accompanied by formidable environmental challenges. Haq et al. (2020) conducted an extensive analysis that underscores the distressing implications of pollution, soil degradation, and the broader impact on local ecosystems. In parallel, Khan and Haroon (2017) cogently emphasize the urgent need for the adoption of sustainable practices within the coal mining sector.

The allure of gemstone mining in regions like Swat Valley cannot be understated, yet its ushers in a unique set of environmental considerations. Akhtar et al. (2017) meticulously dissects the far-reaching ecological consequences of such operations, thereby advocating for an ethos of responsible resource management. This ethical approach aligns harmoniously with the broader discourse on mining practices and their potential effects on intricate local ecosystems.

The echoes of chromite mining's impact reverberate across both KP and Balochistan. Ahmed and Mahmood (2018) venture into the environmental panorama of Sukinda Valley, drawing parallelisms with the challenges encountered on Pakistani soil. Meanwhile, Khan, Akhtar, and Mahmood (2020) delve into the profound ecological perturbations associated with limestone mining and ardently advocate for a robust set of protective measures.

The environmental impacts and risks entailed in riverbed and terrace mining in the upper Indus Basin have not escaped the scrutiny of researchers. Qureshi et al. (2019) meticulously scrutinize the multifaceted implications, accentuating the paramount importance of systematic risk assessment and the implementation of sustainable practices. Meanwhile, Tahir et al. (2017) offers a broader perspective, addressing the profound ecological ramifications that extend beyond the immediate operational realms, as seen in the case of Mansehra.

Extending our gaze beyond the geographical confines of KP and Balochistan, Jan et al. (2017) broadens the scope by probing into the global ramifications of quarrying, thereby resonating the dynamics that hold true in the context of Pakistan. Moreover, Shah and Ullah (2017) initiate a discourse on the broader South Asian implications of mining and smelting, exposing the intricate tapestry of regional interdependencies.

In conclusion, the amassed body of research on mining's environmental impact in KP and Balochistan paints a vivid canvas that encapsulates the delicate equilibrium between economic advancement and ecological preservation. The clarion call for sustainable practices, robust impact assessments, and the concerted implementation of restoration measures emerges as the collective aspiration to harmonize mining endeavors with the intricate tapestry of the environment.

The research study aims to revolves around addressing the challenges and consequences posed by mining practices in these regions. Specifically, the problem lies in understanding and evaluating the extent of environmental degradation caused by mining operations, assessing the depletion of natural resources, and identifying the gaps in regulatory frameworks that contribute to these adverse effects. This problem statement aims to shed light on the delicate balance between economic growth and ecological preservation, seeking to find sustainable solutions to mitigate the negative impact of mining on the environment in KP and Balochistan.

Study Area

The research focuses on two key regions, Khyber Pakhtunkhwa (KP) and Balochistan, within the geographical expanse of Pakistan. Khyber Pakhtunkhwa, located in the northwestern part of the country, boasts a rich diversity of minerals and resources, rendering mining a pivotal driver of economic growth. Balochistan, situated in the southwestern region, similarly showcases a robust history of mining activities that have historically contributed to the region's economic landscape. These regions are marked by a delicate balance between the undeniable economic benefits accrued from resource extraction and the burgeoning concerns surrounding environmental sustainability. By delving into the nuanced interplay between mining, economic expansion, and ecological preservation in these distinct geographical contexts, this research seeks to shed light on the complex dynamics that underpin the delicate equilibrium between resource-driven progress and environmental stewardship.

Methodology

Research Design

The research design employed is exploratory in nature, aiming to attain a comprehensive and profound understanding of the mineral policies in the regions of Khyber Pakhtunkhwa (KP) and Balochistan. This qualitative approach serves as a lens through which to delve into the intricate fabric of these policies and their subsequent implication.

Data Collection

Primary Data Collection

Primary data is acquired through interviews conducted with an array of pertinent stakeholders. These encompass policymakers, government officials, and other relevant individuals. The insights garnered from these interviews offer invaluable perspectives that enrich the understanding of mineral policies and their consequences.

Secondary Data Collection

Secondary data forms an integral component of the research, drawing upon diverse sources. These sources include reports, government databases, legislative documents, scholarly literature, newspapers, research articles, and reports generated by think tanks. This assemblage of secondary data is instrumental in conducting trend analyses and enhancing the depth of analysis.

Data Analysis

The data analysis methodology encompasses several key approaches:

This approach sheds light on the current landscape, encapsulating the current state of mining policies in KP and Balochistan. A meticulous examination of the legal and institutional underpinnings provides insights into the regulatory framework shaping the mining sector. By juxtaposing the best practices within the sector, observed globally, against those in KP and Balochistan, a comprehensive understanding of the divergence and convergence is garnered. This approach allows for the identification of gaps between existing policies and optimal practices, underpinning the formulation of recommendations.

Results and Analysis:

The analysis encompasses both legal and illegal mining, considering their cumulative impacts on the environment. In KP, mining activities cover a wide spectrum of minerals, including limestone, chromite, and gemstones. These resources play a significant role in various industries, contributing to the economic well-being of the province. Similarly, Balochistan is rich in natural resources, particularly coal and minerals like chromite and gypsum. These resources are vital for energy production and industrial processes. However, the extraction processes, often involving open-pit mining and quarrying, raise concerns about habitat destruction, soil erosion, and landscape alteration.

The existing regulatory frameworks governing mining practices in KP and Balochistan exhibit shortcomings in terms of monitoring, compliance, and environmental protection. Inadequate implementation of regulations and lax enforcement have allowed unsustainable practices to continue, exacerbating the environmental challenges. Moreover, the participation and engagement of local communities in decision-making processes related to mining activities remain limited, further undermining sustainable resource management.

Impacts on Environmental Degradation and Resource Depletion:

Habitat Destruction and Biodiversity Loss:

1) Removal of vegetation and topsoil disrupts ecosystems and habitats for plants and animals, leading to loss of biodiversity.
2) Displacement of wildlife due to habitat destruction can have long-term consequences for local ecosystems.

Soil Erosion and Land Degradation:

1) The removal of vegetation and topsoil exposes bare soil to erosion by wind and water, leading to soil degradation and reduced soil fertility.
2) Eroded soil can end up in nearby water bodies, affecting water quality and aquatic life.

Water Pollution:

1) Runoff from mining sites can carry sediments, chemicals, and pollutants into nearby water bodies, contaminating them.

2) Chemicals used in the mining process or present in the exposed rocks can leach into the water, affecting aquatic ecosystems and potentially harming human populations that rely on these water sources.

Air Quality Degradation:

1) Dust generated during mining operations can degrade air quality in surrounding areas, impacting human health and vegetation.

2) Airborne particulates can contain hazardous substances like heavy metals that pose health risks to both humans and animals.

S.no	Name of Mineral	Location	Mining / Extraction Method	Environmental Impact	Steps to mitigate the Env: impact
1	Coal	Mach, Chamalang, Duki, Kingri, Khuzdar, Sharigh,	Old Conventional underground mining	Release of Carbon mono oxide and Sulphur dioxide , Dust/ Air Pollution, Water Pollution, Soil Contamination, accidents, Land subsidence	Lungs disease, Sulphur, fluorine, cancer,
2	Chromite	Muslimbagh, Khanozai, Kharan, Washuk, Khuzdar & Chagai, Ziarat	Old Conventional underground mining	-do-	By controlled Blasting, Water Spray, De-watering
3	Marble	Loralai, Khuzdar, Lasbela, Chagai	Old conventional blast mining. But somewhere wire saw cutters are also used.	Dust/ Air Pollution. Water Pollution. Soil contamination. Range Land depletion.	By controlled Blasting, Water Spray, De-watering
4	Lead, Zink	Duddar, Gunga Surmai, Lasbella & Khuzdar,	underground mining	Dust/ Air Pollution. Water Pollution. Soil contamination. Range Land depletion	By controlled Blasting, Water Spray, De-watering

		Kharan			
5	Gold, Silver & Copper	Saindak, Chagai, Lasbella, Killa Saifullah	open pit mining is used to process Gold , Silver and Copper.	Dust/ Air Pollution. Water Pollution, Use of chemical in Smelting Process is dangerous for grazing	By controlled Blasting, Water Spray, De-watering
6	Lime Stone, Gypsum, Clay (Aluminum, Iron)	DG Cement, & Attock Cement Hub, Pishin, Chagai,	Quarrying method .	Air Pollution, Water pollution. dangerous air pollution	Forest bio diversity,
7	Manganese	Bela, Washuk, Khuzdar, Chagai, Kharan, & Killa Saifullah.	Underground blasting	Carbon , mono, hydro sulfide, Sulphur di oxide, methane,	By controlled Blasting, Water Spray, De-watering
8	Barite	Khuzdar, Mastung, Ziarat	Surface mining	Dust/Air Pollution.	Water Spray, De-watering
9	Natural Gas	Sui, Dera Bugti	Drilling ,		
10	Sulphur	Loralai	Surface Mining	Dust/Air Pollution	
11	Iron	Khuzdar, Lasbela, Kohlu	Surface mining	Dust/Air Pollution	
12	Fluorite	Loralai	Underground mining	Dust/ Air Pollution. Water Pollution. Soil contamination. Range Land depletion	By controlled Blasting, Water Spray, De-watering
13	Granite	Chagai	Underground Mining	Dust/ Air Pollution. Water Pollution.	By controlled Blasting, Water Spray, De-watering

Loss of Agricultural Land:

1) Surface mining can lead to the destruction of fertile agricultural land, impacting local food production and livelihoods.

Disruption of Hydrology:

1) Alterations in land topography due to mining can disrupt natural drainage patterns and hydrological cycles, potentially leading to flooding and erosion downstream.

Impact on Local Communities:

1) Mining activities can displace communities living in the mining area, disrupting their way of life and potentially leading to social tensions.

2) Noise, dust, and other disturbances from mining operations can affect the quality of life for nearby residents.

Visual Impact and Aesthetic Value:

1) The altered landscape resulting from surface mining can have a negative visual impact on the surrounding areas, affecting their aesthetic value.

Climate Change Contributions:

1) The extraction, processing, and burning of coal contribute to greenhouse gas emissions, further exacerbating climate change impacts.

2) To mitigate these environmental impacts, responsible mining practices and effective regulatory frameworks are essential. This includes proper land reclamation, implementation of erosion control measures, monitoring of water quality, and engagement with local communities to ensure their concerns are addressed. Balancing economic benefits with environmental and social considerations is crucial for sustainable development in these regions.

The mining practices prevalent in KP and Balochistan have substantial impacts on environmental degradation and resource depletion. Environmental degradation arises from a multitude of factors, including air and water pollution, habitat disruption, and soil erosion. Dust emissions, chemical discharges, and waste disposal from mining operations contribute to air and water pollution, affecting the quality of both natural resources. The alteration of landscapes due to open-pit mining and quarrying leads to habitat destruction, impacting flora and fauna and disrupting ecosystems. Soil erosion further exacerbates these effects, leading to the degradation of fertile land.

Resource depletion is a critical concern linked to the mining practices in these provinces. The extraction of minerals occurs at varying rates, often surpassing the natural replenishment capacity of these resources. This imbalance can result in the depletion of valuable reserves, compromising the availability of minerals essential for economic activities. The extraction of coal and other minerals without proper resource management plans accelerates the rate of

depletion, potentially jeopardizing future generations' access to these resources. Inadequate regulatory oversight, insufficient enforcement, and illegal mining exacerbate the challenge of resource depletion.

The interplay between these impacts on environmental degradation and resource depletion is intricate and far-reaching. Addressing these challenges requires a comprehensive approach that considers technological advancements, sustainable mining practices, and robust regulatory mechanisms. Striking a balance between economic development and environmental preservation is paramount to ensuring the long-term well-being of these regions and the preservation of valuable resources for future generations.

Comparative Analysis of Performance

A. Khyber Pakhtunkhwa

Despite the presence of regulatory bodies tasked with overseeing mining activities in Khyber Pakhtunkhwa (KP), the persistence of enforcement challenges has resulted in significant adverse environmental outcomes. While the Mines and Minerals Development Department and the Directorate General of Environmental Protection Agency play vital roles in granting licenses and evaluating environmental impact assessments, respectively, their capacity for rigorous monitoring remains limited. Insufficient monitoring allows for practices that deviate from environmental best practices, leading to habitat destruction, air and water pollution, and soil degradation. Moreover, the lack of stringent penalties for non-compliance fails to deter unsustainable mining practices effectively. As a consequence, the fragile ecosystems of KP bear the brunt of these shortcomings, posing threats to biodiversity and the well-being of local communities.

B. Balochistan

In Balochistan, regulatory challenges arise from the province's extensive and rugged landscape, combined with limited oversight capacities. The Mines and Mineral Development Department, along with the Environmental Protection Agency Balochistan, has the responsibility to regulate mining activities. However, the province's challenging terrain facilitates illegal mining activities in remote and less accessible areas, where regulatory bodies struggle to maintain effective surveillance. This scenario leads to environmental degradation, as unregulated and often unauthorized mining contributes to soil erosion, deforestation, and depletion of precious resources. As a result, the balance between economic gains and environmental preservation is skewed, with the latter suffering from inadequate regulation and oversight.

Stakeholder Analysis Regarding the Environmental Impact of Mining Practices

Stakeholder analysis is crucial for understanding the diverse perspectives and interests of those who are directly or indirectly affected by mining practices and their environmental impacts in Khyber Pakhtunkhwa and Balochistan. Identifying and considering the viewpoints of various stakeholders is essential for formulating effective policies, regulations, and sustainable practices.

1. Local Communities: Local communities residing near mining sites are among the most directly affected stakeholders. They experience the immediate consequences of mining activities on their environment, health, and quality of life. Often, their livelihoods are intertwined with the surrounding ecosystems, making them vulnerable to disruptions caused by pollution, deforestation, and resource depletion. Engaging with these communities is crucial to ensure their concerns are addressed and their rights are protected.

2. Mining Companies: Mining companies are key actors in the industry and have a significant impact on the environment. Their operations can lead to land degradation, water pollution, and habitat destruction. Balancing their economic interests with environmental conservation is essential for sustainable development. Engaging mining companies in adopting responsible practices and adhering to environmental regulations is vital to minimize negative impacts.

3. Government Agencies: Government agencies at both the provincial and federal levels are responsible for regulating mining practices. Their role involves granting licenses, monitoring compliance, and enforcing environmental regulations. These agencies play a pivotal role in shaping the mining sector's environmental impact. Strengthening their capacity and coordination can lead to better oversight and more effective enforcement of environmental safeguards.

4. Environmental Activists and NGOs: Environmental activists and non-governmental organizations (NGOs) often advocate for ecological preservation and sustainable development. They raise awareness about the environmental consequences of mining practices, lobby for stricter regulations, and provide alternative solutions. Engaging with these stakeholders can lead to valuable insights and collaboration in shaping environmentally responsible policies.

5. Indigenous and Tribal Communities: In regions with indigenous or tribal populations, mining activities can disproportionately impact their ancestral lands, cultural heritage, and traditional ways of life. Their unique knowledge of local ecosystems can contribute to sustainable resource management. Involving these communities in decision-making processes is essential for respecting their rights and ensuring sustainable outcomes.

6. Academia and Researchers: Academic institutions and researchers contribute by conducting studies to understand the environmental impacts of mining practices. Their findings provide evidence-based insights that can guide policy formulation and sustainable practices. Collaborating with academia ensures that decisions are well-informed and grounded in scientific understanding.

7. International Organizations and Donors: International organizations and donors can influence mining practices through funding, technical assistance, and setting global environmental standards. Their involvement can encourage the adoption of best practices and the alignment of mining operations with international environmental commitments.

8. Media and Public: The media and the general public play a role in raising awareness about environmental issues related to mining. Their scrutiny and advocacy can hold stakeholders accountable and push for more transparent and responsible mining practices.

Conclusion

The mining practices in Khyber Pakhtunkhwa and Balochistan have played a significant role in driving economic development and contributing to the national economy. However, the impact of these practices on the environment cannot be overlooked. This comprehensive analysis underscores the complex interplay between mining activities and environmental degradation, highlighting the need for a balanced approach that prioritizes sustainable development.

The exploration of coal, gemstones, chromite, limestone, and other minerals has led to varying degrees of environmental harm, including air and water pollution, soil degradation, deforestation, and habitat loss. The situation demands immediate attention to mitigate these adverse effects and ensure the preservation of ecosystems, water resources, and biodiversity.

The comparison of mining practices and their environmental impacts in Khyber Pakhtunkhwa and Balochistan revealed disparities in regulatory effectiveness. While both provinces face unique challenges, they share the common goal of fostering a sustainable and hazard-free mining industry. To achieve this, it is imperative to strengthen regulatory frameworks, enhance monitoring and enforcement mechanisms, and engage local communities as active stakeholders in decision-making processes.

The stakeholder analysis highlighted the importance of considering the interests of all parties involved, including government agencies, mining companies, local communities, environmental organizations, and indigenous groups. Collaboration among these stakeholders is essential to develop and implement effective strategies that address environmental concerns while supporting economic growth.

In conclusion, the mining practices in Khyber Pakhtunkhwa and Balochistan have the potential to drive positive change through sustainable development. By adopting comprehensive regulatory reforms, embracing sustainable mining practices, and engaging in transparent and inclusive dialogue, it is possible to transform the mining and mineral industry into a model of responsible resource management. This transition will not only safeguard the environment but also ensure the well-being of present and future generations, establishing a legacy of balanced economic progress and environmental stewardship.

Recommendations

Balancing the interests of diverse stakeholders while fostering a sustainable and hazard-free mining and mineral industry in Khyber Pakhtunkhwa and Balochistan requires a comprehensive approach. The following recommendations aim to achieve this delicate balance:

1. Strengthen Regulatory Framework: Revise and strengthen existing mining regulations to ensure they are comprehensive, up-to-date, and aligned with international best practices. Establish clear guidelines for environmental impact assessments (EIAs), permitting processes, and reclamation requirements. This will provide a solid foundation for accountable and responsible mining practices.

2. Enhanced Enforcement and Monitoring: Invest in capacity-building for regulatory agencies to enhance their enforcement capabilities. Employ advanced monitoring technologies such as

satellite imagery and remote sensing to track mining activities in real-time, enabling prompt interventions against illegal and harmful practices.

3. Community Engagement and Consent: Prioritize the inclusion of local communities, indigenous groups, and affected populations in decision-making processes. Obtain their free, prior, and informed consent before granting mining licenses. Community participation can lead to more sustainable practices, reduced conflicts, and better management of environmental impacts.

4. Sustainable Mining Practices: Promote the adoption of sustainable mining practices that minimize environmental degradation. Encourage practices such as selective mining, reforestation, soil erosion control, and water management to mitigate adverse impacts on ecosystems and water resources.

5. Rehabilitation and Reclamation: Mandate mining companies to develop comprehensive plans for site rehabilitation and reclamation. Ensure that mining areas are restored to their natural state after operations cease, including measures to restore biodiversity and prevent soil erosion.

6. Capacity-Building and Training: Provide training and capacity-building programs for miners, workers, and regulatory personnel. Educate them about environmentally sound practices, safety protocols, and the use of modern technologies to reduce the industry's overall environmental footprint.

7. Incentives for Sustainable Practices: Introduce financial and non-financial incentives to encourage mining companies to adopt sustainable practices. Tax breaks, certification programs, and recognition for eco-friendly operations can motivate positive behavior while contributing to hazard-free mining practices.

By implementing these recommendations, a harmonious mining and mineral industry can be developed in Khyber Pakhtunkhwa and Balochistan. Such an industry would not only attract investment and economic growth but also ensure the protection of the environment, the rights of local communities, and the sustainable use of valuable natural resources for generations to come.

Acknowledgement:

We extend our sincere appreciation to Captain R. Usman Gul, Chief Instructor Abdul Sattar, Lt. Col Ijaz Ahmed, Mr. Turab Khan Jaddon and Dr. Ali Gohar for their invaluable inputs. Their expertise has greatly enriched our research study, and we are grateful for their guidance and dedication.

References:

1. Ahmed, K., & Mahmood, K. (2018). Environmental impacts of chromite mining in Sukinda Valley, India. Environmental Monitoring and Assessment, 190(2), 81.
2. Akhtar, N., Hayat, K., & Akhtar, G. (2017). Assessment of environmental impacts of gemstone mining in Swat Valley, Pakistan. Environmental Earth Sciences, 76(13), 484.
3. Khan, M. A., Akhtar, N., & Mahmood, K. (2020). Environmental impacts of limestone mining in Khyber Pakhtunkhwa, Pakistan. Arabian Journal of Geosciences, 13(7), 1-11.
4. Qureshi, M. S., Munawar, S., & Jan, F. A. (2019). Assessment of environmental impacts and risks associated with riverbed and terrace mining in the upper Indus Basin, Pakistan. Environmental Science and Pollution Research, 26(5), 4190-4207.
5. Haq, F., Mir, I. A., & Khan, S. A. (2020). Environmental issues of coal mining in Balochistan. Journal of Himalayan Earth Sciences, 53(1), 79-90.
6. Jan, F. A., Khan, S., & Ishaq, M. (2017). Environmental impact of limestone mining in the valley of the Kot Diji, Sindh, Pakistan. Environmental Monitoring and Assessment, 188(4), 227.
7. Tahir, A., Shah, M. T., & Khan, S. (2017). Environmental impact assessment of mining operations: A case study in the Quarzite Quarry, Mansehra, Pakistan. Environmental Earth Sciences, 76(6), 267.
8. Khan, M. A., & Haroon, Z. A. (2017). Environmental impacts of coal mining in Balochistan, Pakistan. Environmental Earth Sciences, 76(11), 393.
9. Shah, S. Q. A., & Ullah, Z. (2017). Environmental impacts of mining and smelting in southwestern Pakistan. Environmental Monitoring and Assessment, 189(10), 517.