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An Analysis of the Challenges and Development Strategies for Metallic Mines and Downstream Industries in East Azerbaijan Province

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Abstract

Research Objective: The mining industry is one of the major drivers of the global economy and occupies a primary position in the supply chain of resources required by many industries. Mines can be considered one of the key factors for achieving a promising future. The role of mining and mineral industries in national economies can also contribute to achieving the goals of global sustainable development. Although the development of mineral resources is an important factor for economic growth, if carried out through accurate and systematic planning, it can also act as a driver of economic development at both national and provincial levels. Since the objective of the present research is to prepare a strategic development document for metallic mines and downstream industries of the province with an emphasis on challenges, barriers, and solutions, this study aims to identify the key strategies of the mining sector through a field-survey study using expert opinions and structured questionnaires.

Research Method: This research was conducted as a field survey using expert and specialist opinions along with designed questionnaires to identify the main strategies of the mining sector. In the qualitative part of the study, thematic analysis was applied to analyze the conducted interviews. Moreover, SWOT analysis along with PESTEL tools and the EFE and IFE matrices were used to analyze development strategies for metallic mines and downstream industries in the province.

Findings: The results obtained from identifying strengths, weaknesses, opportunities, and threats indicate that in the field of metallic mines and downstream industries, 16 strengths, 24 weaknesses, 18 threats, and 10 opportunities were identified. Considering that the score of the Internal Factors Evaluation (IFE) matrix was 2.43 and the External Factors Evaluation (EFE) matrix score was 2.67, the intersection of these two scores indicates that a conservative strategy is the main and overall strategy for the provincial mining sector.

Conclusion: Since the overall strategy of the mining sector has been identified as conservative, it is recommended that the metallic mining and downstream industries in the province utilize existing opportunities to compensate for internal weaknesses. Given the richness of East Azerbaijan Province in high-tonnage porphyry-type deposits and the absence of a smelting plant in the province, attracting domestic and foreign investors to establish a smelting plant for active mines in the province (such as Sungun and Anjerd) and similar deposits is suggested.

Ethical Considerations: This project was conducted by the Research Institute for Development and Planning using expert opinions, and no interference in the results occurred.

Keywords:

SWOT Analysis, Strategic Document, Downstream Industries, Metallic Mines, Barriers and Challenges

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1. Introduction

The mining and mineral industries sector is considered one of the fundamental pillars of economic development in many countries. It plays a key role in supplying raw materials for industries, creating value added, generating employment, and strengthening intersectoral linkages. In the literature of economic development, mineral resources are regarded as a source of comparative and competitive advantage for countries, and their efficient management can significantly enhance sustainable economic growth and industrial development (Radetzki, 1982). In this context, the transition from an economy based on the extraction and export of raw materials toward the development of processing and downstream industries is recognized as a key policy approach in resource rich countries. Creating value added in the later stages of the production chain not only increases productivity but also strengthens backward and forward linkages and improves the level of technology and innovation in related industries (Toledano & Maennling, 2018).

Due to the diversity and volume of its mineral reserves, Iran holds a significant position among the world's mining countries. Considerable reserves of iron ore, copper, lead, zinc, coal, chromite, and gold, as well as various nonmetallic minerals and decorative and construction stones, provide substantial potential for the country's economic and industrial development (Abiyat & Abiyat, 2025). However, optimal utilization of these capacities requires the development of industrial infrastructure, investment in processing technologies, and the adoption of a strategic approach aimed at completing the mineral value chain. Otherwise, similar to many resource dependent economies, challenges such as raw material exports, revenue volatility, and inefficient resource utilization may arise (Söderholm & Svahn, 2015).

East Azerbaijan Province, as one of the country's major mining hubs, also possesses a considerable diversity and volume of mineral reserves. The existence of more than 400 active mines and various mineral resources such as copper, gold, manganese, iron, kaolin, silica, and different types of construction materials has created extensive potential for the development of mining activities and related industries (Kakha et al., 2019). Despite these advantages, the mining sector in the province still faces challenges such as raw material exports, weak industrial infrastructure, and slow development of processing industries and value chain completion. These issues have prevented the available potential from being fully utilized for regional economic development (Akhgar et al., 2020).

The experience of successful countries in managing natural resources indicates that the sustainable development of the mining sector requires a strategic approach based on systematic analysis of the internal and external environment. The complexity of the economic environment, rapid technological changes, investment limitations, and infrastructural challenges have further increased the importance of strategic planning (Kursunoglu et al., 2025). Under such conditions, identifying internal strengths and weaknesses as well as external opportunities and threats forms the foundation for formulating effective development strategies. Furthermore, aligning development programs in this sector with the country's upstream policy documents-including the policies of the resistance economy and national development plans-can increase the share of the mining sector in gross domestic product and facilitate the achievement of industrial development goals (Moerenhout & Jobet, 2026).

Given the considerable mining potential of East Azerbaijan Province and the structural challenges in developing downstream industries, establishing a strategic framework for this sector is essential. Accordingly, the present study aims to identify and analyze the key factors influencing the development of the mining sector and downstream industries in the province. Using a field survey approach and relying on the perspectives of experts and specialists in the mining sector, this study seeks to evaluate the current situation and propose appropriate development strategies. The results can serve as a basis for policymaking, strategic planning, and executive decision making in the mining and mineral industries sector, thereby

facilitating more efficient utilization of the province's mineral capacities and strengthening regional economic development.

The remainder of this paper is organized into five sections. Section 2 reviews the relevant literature and previous studies; Section 3 explains the research methodology; Section 4 presents the results and model outputs; and Section 5 provides conclusions and suggestions for future research.

2. Literature Review

In recent decades, the mining and mineral industries sector has attracted significant attention in the literature on economic development and industrial policy. This sector plays a strategic role due to its contribution to supplying raw materials for industries, creating value added, generating employment, and strengthening both backward and forward linkages within the economy. However, the experience of many countries shows that merely possessing mineral resources cannot guarantee economic growth and industrial development. Rather, the way resources are managed, the quality of policymaking, the level of technological development, and the degree of completion of the mineral value chain play decisive roles in transforming these capacities into sustainable economic advantages. Therefore, a considerable body of research has examined the development of the mining sector within the framework of strategic planning, environmental analysis, and value chain based approaches.

In recent years, with the increasing global demand for minerals used in emerging technologies and clean energy systems, the strategic importance of mineral resources has become even more prominent. Reports by the International Energy Agency indicate that the development of technologies such as electric vehicles, batteries, electricity transmission networks, and renewable energy systems has created a growing dependence on critical minerals including copper, nickel, lithium, cobalt, and rare earth elements. Consequently, many countries have oriented their industrial and mining policies toward developing mineral value chains, expanding processing capacities, and reducing dependence on either the import or export of raw materials. In this regard, World Bank reports also indicate that the global transition toward a low carbon economy will significantly increase demand for certain minerals in the coming decades, highlighting the necessity of strategic planning for mineral resource management (Hund et al., 2020).

In addition, studies conducted by the Organisation for Economic Cooperation and Development (OECD) and the United Nations Conference on Trade and Development (UNCTAD) show that the geographical concentration of extraction and processing of many strategic raw materials has created significant risks for global supply security. As a result, many countries are attempting to enhance their economic and industrial resilience against global market shocks by developing downstream industries, diversifying supply chains, and expanding domestic processing capacities (Ghiasvand, 2013). These developments demonstrate that the development of the mining sector in contemporary economies is no longer limited to increasing mineral extraction. Instead, it requires a comprehensive approach that includes the development of extraction and processing technologies, sustainable resource management, strengthening downstream industries, and addressing environmental requirements.

Alongside economic and industrial considerations, several studies have examined the environmental and sustainability dimensions of mining activities. Research findings indicate that while mining activities offer significant economic benefits, they may also pose environmental and health challenges. Therefore, the development of this sector must be carried out within the framework of sustainable development principles, responsible management of natural resources, and the application of environmentally friendly technologies (Mancini et al., 2020; Jowitt et al., 2020). In this context, some studies have also investigated policies for reducing carbon emissions and improving environmental management in the mining industry, demonstrating

that appropriate policy instruments can play an important role in mitigating the environmental impacts of industrial and mining activities.

Another stream of research focuses on the economic evaluation of mining projects and the management of uncertainty in mining investments. Due to fluctuations in mineral prices, changes in exchange rates, and risks associated with global markets, decision making in mining projects involves a high degree of uncertainty (Khajezadeh Dezfouli & Khajezadeh Dezfoli, 2021). In this regard, several studies have applied advanced analytical methods such as real options models, decision trees, and multi criteria decision making approaches to provide more accurate frameworks for evaluating mining projects. Furthermore, some research has utilized systems analysis methods and fuzzy logic to develop models for evaluating innovative projects in the mining industry, which can improve decision making processes under complex and uncertain conditions.

In addition to these approaches, the use of strategic analysis tools to assess the status of the mining sector and formulate development strategies has received increasing attention in the research literature. Tools such as PESTEL environmental analysis, SWOT analysis, and internal and external factor evaluation matrices have been widely used in regional and industrial development studies to identify opportunities, threats, strengths, and weaknesses (Walgama et al., 2026). The application of these tools enables systematic analysis of internal and external environments and facilitates the formulation of appropriate strategies for economic sector development, thereby playing an important role in the strategic planning process of the mining and mineral industries.

In Iran, numerous studies have also examined the development of the mining and mineral industries sector. The results of these studies indicate that mining activities can play an important role in the economic development of less developed regions, job creation, and the development of regional infrastructure. Some studies have emphasized the importance of developing downstream mineral industries and have shown that factors such as technological development, investment attraction, infrastructure improvement, and supportive government policies are among the key determinants in enhancing the value chain of mineral industries.

Garshasbi and Dadashi (2022) conducted a study aimed at identifying key issues in the industry, mining, and trade sectors in preparation for the Seventh Development Plan. The results indicated that the most important challenges include limitations in creating high value added, weak industrial and mining investment, low technological content in production, declining competitiveness, and limited employment generation within the production chain. The roots of these challenges were identified in factors such as macroeconomic instability, international sanctions, centralized policymaking, complex bureaucracy, financial constraints, weak infrastructure, and human resource challenges.

Hazrathosseini and Afrapoli (2023) examined intelligent fleet management systems in open pit mines. Their findings indicated that the use of smart systems within the framework of Mining 4.0 can improve the efficiency of equipment allocation and dispatching, providing advantages over traditional methods. The study also proposed strategies to mitigate weaknesses and threats associated with these systems. Li et al. (2024) investigated dynamic hazards in underground metal mines and found that roof collapse, rock bursts, ground subsidence, and water inflow are among the most significant safety threats. The study emphasized the development of monitoring systems, early warning mechanisms, and preventive technologies to reduce these risks. Jia Chaka and Rupprecht (2024) explored project risk management in mining companies and found that many mining projects lack systematic risk management frameworks, with risks often addressed reactively based on managerial judgment. The study highlighted the importance of developing training programs and adopting standardized risk management approaches in the mining sector.

Soleimani Bafghi et al. (2024) investigated uncertainty in ore transportation within open pit mines. They developed a multi objective mathematical model based on robust fuzzy optimization for assigning trucks to loading points. The results indicated that using higher capacity trucks can reduce both transportation costs

and environmental pollution under uncertain conditions. Rouhani et al. (2025) examined soil contamination in copper mining regions of Iran. Their findings showed that elements such as copper, lead, and molybdenum are among the most significant potential soil pollutants in copper mining areas, particularly in the Sarcheshmeh mine. The study suggested phytoremediation as one of the most effective sustainable approaches for reducing contamination caused by these elements. Meaza et al. (2025) investigated the environmental impacts of gold mining activities. Their results demonstrated that gold extraction can lead to environmental degradation including deforestation, soil erosion, and water pollution. The study emphasized the need for environmentally compatible technologies and stronger regulatory frameworks to ensure sustainable mining development.

Mehla et al. (2026) analyzed the rapidly increasing demand for critical minerals and the challenges associated with their production. The results indicate that with current technologies, the production of these minerals may not be sustainable in the long term due to environmental impacts, declining ore grades, and increasing geological complexity. The study highlighted the importance of developing innovative technologies for the sustainable production of critical minerals in the future. Grozev et al. (2026) examined policies and challenges related to the development of critical minerals. Their findings indicate that despite the abundance of resources such as lithium, cobalt, and rare earth elements, fluctuations in global prices and market risks can significantly affect the operations of mining companies. Furthermore, projections of increasing demand for these materials in renewable energy technologies by 2050 underscore the importance of strategic planning and investment in this sector.

The Table 1 summarizes the main thematic areas and findings from prior research on mining and mineral industries. It highlights diverse approaches, from global analyses of critical mineral demand and supply risks to country-specific studies focusing on economic, environmental, and technological aspects. This synthesis reveals both the breadth of existing work and notable gaps, particularly the limited strategic and regional-level studies addressing the comprehensive development of mining and downstream industries, such as in East Azerbaijan Province. This contextualizes the current study’s focus and methodology within the broader literature landscape.

Table 1. Comparative Overview of Key Themes and Findings in Mining Sector Research

Research Focus / Topic	Key Findings and Insights	Methods and Analytical Approaches	Representative Studies and References
Importance and Role of Mining Sector	Strategic for raw materials, value creation, employment; resource ownership alone insufficient	Literature review	General economic development literature
Global Demand and Critical Minerals	Rising demand for tech-critical minerals; need value chains and reduce raw imports/exports	Market and energy reports	IEA, World Bank (Hund et al., 2020)
Global Supply Risks and Resilience	Supply risks from geographic concentration; focus on resilience and diversification	Risk and policy analysis	OECD, UNCTAD (Ghiasvand, 2013)
Environmental and Sustainability Aspects	Economic benefits vs. environmental challenges; need sustainable management	Environmental impact assessments	Mancini et al., 2020; Jowitt et al., 2020
Economic Evaluation and Risk Management	Market volatility complicates investment; advanced models aid decision-making	Real options, decision trees, MCDM	Khajezadeh Dezfouli & Khajezadeh Dezfoli, 2021
Strategic Analysis Tools in Mining Sector	PESTEL, SWOT, IFAS/EFAS widely used for strategy formulation	Strategic planning tools	Walgama et al., 2026
Iran-Specific Mining Development Studies	Mining key for regional economy; emphasis on tech, investment, infrastructure	Case studies, policy reviews	Garshasbi & Dadashi, 2022
Specialized Technical Studies	Tech improvements in fleet management, safety, risk management	Case studies, technical evaluation	Hazrathosseini & Afrapoli, 2023; Li et al., 2024; Jia Chaka & Rupprecht, 2024
Environmental Challenges in Iranian Mines	Soil pollution and environmental degradation critical; phytoremediation recommended	Pollution and environmental studies	Rouhani et al., 2025; Meaza et al., 2025
Critical Minerals' Production Challenges	Sustainability threatened by resource decline and complexity; need innovation	Scenario and policy analysis	Mehla et al., 2026; Grozev et al., 2026
Research Gaps and Opportunities	Limited integrated regional studies; focus often narrow on economics or environment	Literature gap analysis	Present study rationale

Overall, the review of previous studies indicates that successful development of the mining and mineral industries sector requires a combination of appropriate policymaking, management of economic uncertainties, technological development, consideration of environmental factors, and strengthening of the mineral value chain. However, the literature also shows that many existing studies have primarily focused on economic evaluation of mining projects, environmental issues, or macro level mining policies, while relatively few studies have comprehensively examined development strategies for the mining sector and downstream industries at the regional level. This research gap is particularly evident in the case of East Azerbaijan Province, despite its significant mineral potential and its potential role in the development of processing and downstream industries. Therefore, the present study seeks to identify and analyze development strategies for the mining sector and downstream industries in East Azerbaijan Province by employing environmental analysis approaches and incorporating the perspectives of industry experts.

3. Research Methodology

The present study is applied in terms of purpose and qualitative in nature, adopting an exploratory approach aimed at identifying influential factors and formulating development strategies for the mining sector in East Azerbaijan Province. The qualitative approach was selected due to the complex and multidimensional nature of mining sector development and the need for an in depth understanding of the perspectives and experiences of experts in this field. In this regard, the grounded theory method was employed as the main research framework, as it enables the systematic extraction of concepts, categories, and relationships from empirical data and is particularly suitable for developing conceptual frameworks in relatively underexplored domains.

The geographical scope of the study is East Azerbaijan Province, which is considered one of the country's major mining regions due to its significant reserves of copper, gold, and other metallic and non metallic minerals. In addition to the diversity of mineral reserves, the province benefits from industrial infrastructure, access to domestic and international markets, and a favorable geographical location, making it a potential hub for the development of mining activities and related industries. Therefore, examining the capacities, challenges, and opportunities for mining sector development in this region can play an important role in policymaking and development planning.

The statistical population of the study consists of experts and specialists in the mining sector who possess relevant knowledge and professional experience in mining activities, mineral industry management, and policymaking. These participants include university faculty members in related disciplines, managers and experts from government organizations associated with the mining sector, as well as managers and specialists from mining companies and related industries. Purposeful sampling was applied, meaning that individuals with specialized knowledge and practical experience relevant to the research topic were selected. The process of participant selection and interviews continued until theoretical saturation was reached, indicating that no new information or concepts emerged from additional interviews.

The required data were collected through both library research and semi structured interviews. In the first stage, scientific sources, research articles, specialized reports, and documents related to mining sector development were reviewed to establish the theoretical foundations and design the preliminary interview framework. In the second stage, semi structured interviews were conducted to obtain in depth insights from experts. This type of interview allowed the researcher to follow a general question framework while maintaining flexibility to ask follow up questions and explore emerging issues in greater detail. With the consent of participants, interviews were recorded, fully transcribed, and prepared for analysis.

Qualitative data analysis was conducted based on the grounded theory coding process in three stages: open coding, axial coding, and selective coding. During the open coding phase, interview transcripts were carefully reviewed, and initial concepts were extracted from the data. In the axial coding stage, the identified codes were organized into main categories based on conceptual similarities, and the relationships among them were analyzed. Finally, in the selective coding stage, the main categories were integrated into a coherent conceptual framework, leading to the development of a final model of the factors influencing mining sector development and related strategies. This analytical process enabled the identification of meaningful patterns within the data and the formulation of a theory grounded in empirical evidence (Gharachorloo et al., 2021).

To enhance the validity and reliability of the findings, qualitative research evaluation criteria-including credibility, transferability, dependability, and confirmability-were applied. To strengthen credibility, preliminary findings were reviewed with several participants, and their feedback was incorporated into the final analysis. Moreover, all stages of data collection and analysis were carefully documented to ensure transparency and allow for process evaluation. Efforts were also made to provide a detailed description of the research context and participant characteristics to facilitate the application of findings in similar studies.

Ethical principles were observed throughout the research process; participants were fully informed of the study's objectives, participated voluntarily, and their information was kept confidential.

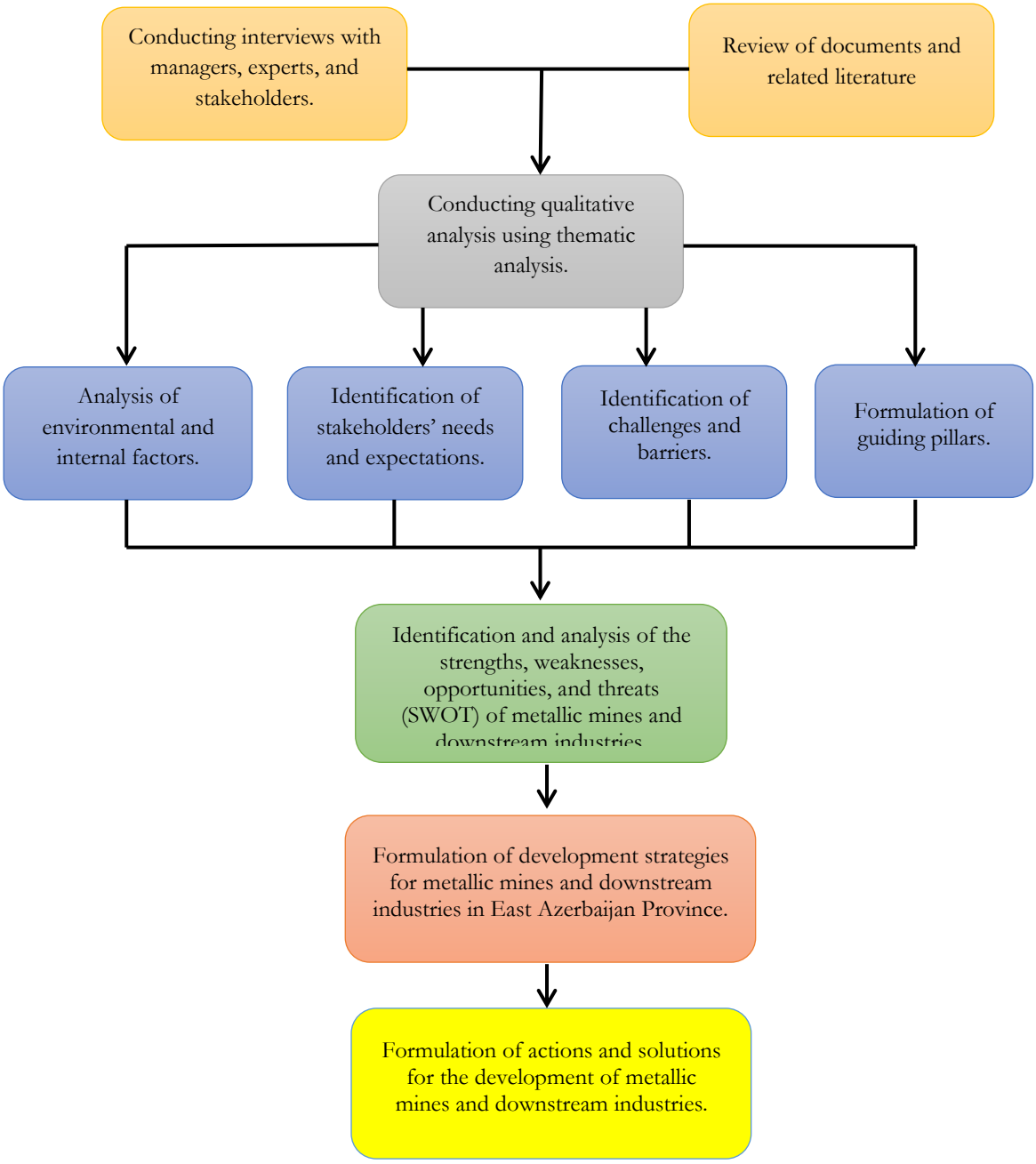


Fig. 1. illustrates the stages of the research methodology.

4. Findings

In this section, the information obtained from interviews with managers, experts in metallic mines, downstream industries, and relevant executive organizations were first analyzed using a qualitative thematic analysis approach. Subsequently, through the analysis of the general external environment and the internal environment, the strengths, weaknesses, opportunities, and threats related to metallic mines and their downstream industries were identified. Based on these analyses, development strategies for metallic mines

and downstream industries in East Azerbaijan Province were formulated. Finally, executive actions were developed for each of the proposed strategies.

In the following, the PESTLE analysis is presented, which includes political, economic, social, technological, environmental, and legal factors.

- **Political Factors**

Political factors refer to the nature and extent of government intervention in the economy or in a specific industry. Essentially, all the impacts that government policies and actions have on businesses can be categorized under this factor. These may include government policies, political stability or instability, corruption, foreign trade policies, taxation policies, labor laws, environmental regulations, and business restrictions. In addition, governments may exert a significant influence on the educational system, national infrastructure, and health regulations. All these elements are important considerations when evaluating the attractiveness of a potential market.

Table 2. presents the analysis of political factors affecting metallic mines and downstream industries

Raw	Political Factors
1	Regional and global wars, including the conflict between Ukraine and Russia
2	Domestic tensions at the national and regional levels
3	Sanctions and exchange rate fluctuations
4	Lack of political stability domestically and globally
5	Problems related to labor laws and taxation
6	Insufficient government support in certain areas, including financial and environmental issues
7	Political interference in investment processes, recruitment of specialized workforce, and the location of downstream industry plants
8	Environmental challenges
9	Increasing administrative corruption in the mining sector

- **Economic Factors**

Economic factors determine the performance of a particular economy. These factors include economic growth, exchange rates, inflation rates, interest rates, consumers' disposable income, and unemployment rates. Such factors may directly or indirectly affect a company in the long term, as they influence consumers' purchasing power and may change supply and demand patterns within the economy. Consequently, they also affect how companies price their products and services.

At this stage, various aspects should be examined, including economic growth (for example, Gross Domestic Product), interest rates, exchange rates, inflation, disposable income of consumers and businesses, saving and investment rates, the propensity to spend, taxation, wages (both the absolute level and the rate of growth), employment and unemployment rates, financial markets, property prices, prices of goods and raw materials, availability of financial and credit resources, supply and demand factors, as well as economic cycles and bubbles. Table 3 presents the analysis of economic factors affecting metallic mines and downstream industries in East Azerbaijan Province.

Table 3. Analysis of Economic Factors of Metallic Mines and Downstream Industries

Raw	Economic Factors
1	Low level of trade and exports with other countries
2	Increasing costs of transportation and mining operations
3	Rising wages and other operational costs within the country
4	Increase in fuel costs
5	Rising costs of mining machinery parts
6	High volatility in exchange rates
7	Lack of liquidity and insufficient working capital
8	Difficulty in obtaining production loans at lower interest rates
9	Decrease in domestic and foreign customers
10	Price instability in the market
11	Deprivation of local communities and failure to allocate 15% of government mining revenues for regional infrastructure through local administrative authorities
12	Price differences between exported copper and copper sold to domestic buyers
13	Despite extensive investment in upstream copper industries, the development of copper downstream industries has been neglected. Industrial actors face challenges in accessing raw materials, procurement of equipment and machinery, infrastructure, and import/export processes, which has hindered the development of industries such as copper and brass wire production, copper ingot production, and other downstream industries in the province
14	Raw material export (lack of value-added processing)
15	Establishment of special economic zones for downstream industries in the mining sector (particularly copper)
16	Lengthy process for obtaining permits to import mining machinery, along with complex, non-transparent, and time-consuming bureaucracy

- **Social Factors**

This dimension of the general environment represents the demographic characteristics, norms, customs, and cultural values of the population in which an organization operates. These demographic trends include population growth rate, age distribution, income distribution, job attitudes, emphasis on safety, health awareness, lifestyle attitudes, and cultural barriers. These factors are particularly important for marketers when targeting specific customers.

Items that should be examined at this stage include demographics, population growth, age distribution of the population, birth and mortality rates, family size and dynamics, marriage, divorce and cohabitation patterns, standards of living, wealth distribution, ethnic and religious perspectives and norms, health and health awareness, educational standards, career choices and attitudes, work patterns and preferences (including attitudes toward retirement), customer preferences and purchasing trends, leisure activities and lifestyle, cultural trends, fashion trends, consumer confidence, organizational image, and attitudes toward government, business, and equality. Table 4 presents the analysis of social factors affecting metallic mines and downstream industries in East Azerbaijan Province.

Table 4. Analysis of Social Factors of Metallic Mines and Downstream Industries

Raw	Social Factors
1	Low level of education in the community
2	Failure of governing authorities to fulfill their roles according to regulations
3	Local opposition groups and conflicts with local communities
4	Increasing demands from villagers to carry out activities outside mining laws and regulations
5	Ethnic tendencies and tribalism in surrounding villages
6	Lack of awareness about mining activities and perceiving miners as environmental destroyers rather than economic contributors
7	Absence of designated mining access roads
8	Mining culture not being institutionalized in the region, along with negative perceptions among local residents due to lack of awareness about the need for mineral extraction and biased negative media and social network campaigns
9	Environmental conditions such as topography, fault lines, and weather/climatic conditions

10	Entry of provincial universities into fields related to downstream mining industries
11	Availability of educated and relatively low-cost human resources in the copper industry, which could significantly support the development of copper downstream industries if properly utilized
12	Cultural challenges and the lack of promotion of mining culture in the region

- **Technological Factors**

These factors relate to technological innovations that may positively or negatively affect the performance of an industry and market. They refer to technological incentives, the level of innovation, automation, research and development activities, technological changes, and the degree of technological awareness within a market. Such factors may influence decisions regarding whether or not to enter specific industries, launch particular products, or outsource production activities abroad. By understanding ongoing technological developments, organizations may avoid investing heavily in technologies that could soon become obsolete.

The checklist for this stage includes the production and distribution of goods and services, communication infrastructure, digital technologies, mobile technologies, automation, the Internet of Things (IoT), emerging technologies, technological life cycles, target market communications, copyright and patent protection for intellectual property (IP), the increasing training required for using new technologies, the potential return on investment from new technologies, as well as technical awareness and skills. At this stage, organizations should ask themselves what technological innovations currently exist or are emerging on the horizon, and how they may affect the company. Table 5 presents the analysis of technological factors affecting metallic mines and downstream industries in East Azerbaijan Province.

Table 5. Analysis of Technological Factors of Metallic Mines and Downstream Industries Province

Raw	Technological Factors
1	Entry of knowledge-based companies into serious economic and technological activities
2	Depreciation and wear of equipment
3	Increasing maintenance costs of machinery due to outdated technology
4	Lack of access to new technologies due to sanctions and the high cost of mining machinery
5	Absence of a complete turnkey processing plant line within the country and difficulties in importing the required machinery
6	Limited access to required chemical materials within the country
7	Lack of complete mining equipment and tools for proper mine development
8	Absence of up-to-date mining machinery
9	Lack of research and development (R&D) units aligned with mining sector activities in the province and universities
10	Aging transportation fleet and mining machinery, along with lack of after-sales services from manufacturing companies due to economic sanctions
11	Difficulties in importing new technologies, which is one of the challenges faced by copper ingot producers
12	Very low quality of some imported machinery despite their high cost
13	Lack of support for experts and innovators in developing domestic mining machinery

- **Environmental Factors**

Environmental factors have recently gained increasing attention. Their importance has grown due to the rising scarcity of raw materials, pollution targets, and carbon footprint goals set by governments. These factors include ecological and environmental aspects such as climate, environmental compensations, and climate change, which may particularly affect industries such as tourism, agriculture, and insurance. Furthermore, growing awareness of the potential impacts of climate change influences how companies operate and the types of products they offer. As a result, many companies are becoming increasingly engaged in practices such as corporate social responsibility (CSR) and sustainability.

The checklist for this stage of the PESTEL analysis includes the availability of raw materials, pollution and greenhouse gas emissions, positive business ethics and sustainability, carbon footprint, climate conditions,

natural disasters, renewable energy, waste management and recycling, environmental regulations, geographical location, and accessibility.

In analyzing environmental factors, organizations should consider how the physical environment is changing and how these changes may affect business operations. They should also assess how attitudes toward the impact of business activities on the physical environment are evolving. Table 6 presents the analysis of environmental factors affecting metallic mines and downstream industries in East Azerbaijan Province.

Table 6. Analysis of Environmental Factors of Metallic Mines and Downstream Industries

Raw	Environmental Factors
1	Excessive strictness of environmental and natural resource regulations
2	Lack of a comprehensive sustainable development policy regarding environmental issues
3	Delays in land allocation by natural resources authorities, leading to dust pollution
4	Need for continuous environmental monitoring of mining operations by environmental agencies
5	Environmental and natural resource permitting requirements for mining activities
6	Environmental degradation
7	Lack of awareness and insufficient environmental culture and education
8	Obstruction or barriers created by environmental authorities
9	Failure to utilize expert opinions in environmental matters
10	Pollution and greenhouse gas emissions
11	Water scarcity issues
12	Pollution of groundwater resources
13	Challenges related to the disposal of waste from metallic mines and downstream industries

- **Legal Factors**

Although these factors may overlap with political factors, they include more specific regulations such as anti-discrimination laws, antitrust laws, employment laws, consumer protection regulations, copyright and patent laws, and health and safety regulations. Clearly, in order to maintain a successful and ethical business, companies must understand what is legally permitted and what is not. This becomes more complex when an organization operates internationally, as each country has its own set of laws and regulations. Furthermore, organizations must stay informed about potential legal changes and their possible future impacts on business operations.

Items that should be examined in the legal dimension include health and safety regulations, equal opportunity laws, advertising standards regulations, consumer rights and protection, privacy and data protection laws, product labeling requirements, product safety requirements, safety standards, employment and labor laws, antitrust and competition laws, copyright, patents, and intellectual property laws. Table 7 presents the analysis of legal factors affecting metallic mines and downstream industries in East Azerbaijan Province.

Table 7. Analysis of Legal Factors of Metallic Mines and Downstream Industries

Raw	Legal Factors
1	Failure to properly enforce mining laws by the responsible authorities
2	Inactive or weak non-governmental organizations in the country
3	Insufficient and inappropriate regulations in the mining sector and frequent regulatory changes
4	Weak legal support from organizations such as the Ministry of Industry, Mine and Trade (IMT) and Natural Resources authorities
5	Very strict administrative bureaucracy in the country, particularly in East Azerbaijan Province
6	Need for coordination among all governmental bodies in issuing permits and preventing applicants from being referred to multiple agencies, as well as preventing different agencies from interpreting laws arbitrarily
7	Legal obstacles created by stakeholder executive organizations such as the Regional Water Authority and Cultural Heritage Organization
8	Ineffective regulations for attracting domestic and foreign investors
9	Lack of alignment between the directives of the Provincial Department of Industry, Mine and Trade (IMT) within the IMT Trade System and the realities governing mineral extraction and sales, causing serious production and marketing problems

10	Extra-legal demands by some governmental bodies and the creation of unrealistic expectations among local communities
11	Lengthy legal inquiry and approval processes in the mining sector
12	In some cases, failure to consider the directives of the Ministry of Industry, Mine and Trade and governing systems-for example, policies requiring domestic demand to be met before allowing exports have made it difficult for producers to access raw materials; therefore, raw materials produced in the province should first meet local industrial and community needs and only surplus should be exported
13	Low transparency in laws, directives, and issued guidelines
14	Failure of relevant authorities to comply with the Mining Law approved by the Islamic Consultative Assembly, including ensuring investor security, reducing investment risk, protecting operators' rights, and proper allocation of mining royalties
15	Low stability of mining laws and regulations, creating challenges for stakeholders given the long-term nature of mining projects
16	Limited allocation of 20% of government mining revenues to surrounding regions and villages, which has led to conflicts and threats against mining operators by local residents
17	Issues related to patent and intellectual property laws
18	Problems related to employment and labor laws

After completing the PESTLE analysis, the study proceeded to identify the strengths, weaknesses, opportunities, and threats (SWOT) of metallic mines and downstream industries in the province using the SWOT analytical tool.

SWOT analysis evaluates internal and external factors as well as the current and future potential of an organization or sector. It is designed to facilitate a realistic, fact-based, and data-driven assessment of an organization's strengths and weaknesses. The organization should conduct this analysis carefully, avoiding preconceived beliefs or ambiguous areas, and focus strictly on facts and realities. Companies should use this analysis as a guide rather than necessarily as a definitive recommendation.

Based on the analysis of previous studies, upstream policy documents, and information obtained from interviews, the strengths, weaknesses, opportunities, and threats of the metallic mining sector and its downstream industries were identified and analyzed. These are presented in Tables 8 to 11.

Table 8. Strengths of Metallic Mines and Downstream Industries

Raw	Strengths	Symbol
1	Presence of metallic and non-metallic mineral reserves	S1
2	Availability of industrial parks and zones in the province for the establishment of industrial units	S2
3	Potential for expansion of some existing active units	S3
4	High proportion of young people and university graduates at advanced academic levels in the province	S4
5	Large geographical area of the province and flexible conditions for industrial establishment without interference with environmentally sensitive zones	S5
6	Possibility of utilizing clean and low-cost energy sources such as wind and solar power	S6
7	Ease of access to production inputs	S7
8	Availability of skilled and experienced human resources	S8
9	Appropriate quality of manufactured products	S9
10	Presence of leading (mother) universities in various fields within the province	S10
11	Availability of relevant specialists in the Provincial Engineering Organization	S11
12	Presence of the Northwest Iran Geological Survey Organization in Tabriz	S12
13	Presence of major industries such as machinery manufacturing and tractor manufacturing in Tabriz	S13
14	Economic feasibility of investing in downstream industries due to the volume of mineral reserves	S14
15	Presence of investors with strong interest in investing in the province's mining sector	S15
16	High potential of copper reserves in the province	S16

Table 9. Weaknesses of Metallic Mines and Downstream Industries

Raw	Weaknesses	Symbol
1	Lack of organization and coordination among university experts and professional associations	W1
2	Predominance of traditional production methods in the province's economic activities	W2
3	Sectoral (fragmented) approach in development plans	W3
4	Absence of exhibitions, terminals, and storage/stockpiling centers for minerals ready for sale or transportation	W4
5	Lack of specialized and accredited laboratories in the industry and mining sector	W5
6	High production overhead costs, resulting in increased final product prices	W6
7	Low productivity and efficiency in mines and industrial operations	W7
8	Failure to use modern technologies in identification, exploration, and extraction processes	W8
9	Absence of research and development (R&D) units in the province's mining sector	W9
10	Traditional operational practices of mining enterprises	W10
11	Short-term and fragmented decision-making	W11
12	Frequent changes of managers within short timeframes	W12
13	Imposition or employment of non-specialized personnel in industries	W13
14	Inadequate infrastructure, including water, electricity, and land	W14
15	Power and gas outages and lack of proper planning for investors to develop or create new phases	W15
16	Opposition by various governmental organizations to mining activities based on non-expert considerations at the provincial level	W16
17	Prolonged administrative bureaucracy even when relevant authorities approve permit issuance	W17
18	Absence of smelting plants for copper and other metals in the province	W18
19	Time-consuming process for obtaining mining exploitation licenses	W19
20	Insufficient training of skilled labor in universities and lack of academic programs related to downstream mining industries in the province	W20
21	Lack of appropriate banking facilities and financial support for mines and processing plants	W21
22	Lack of coordination between the Provincial Department of Industry, Mine and Trade (IMT) and other governmental organizations in the province	W22
23	Limited expertise of provincial laboratories in metallic analysis	W23
24	Inadequate public awareness and cultural promotion regarding the benefits of mines and mineral processing plants	W24

Table 10. Opportunities for Metallic Mines and Downstream Industries

Raw	Opportunities	Symbol
1	Proximity to Turkey, Armenia, and Azerbaijan, enabling the export of industrial products to these countries	O1
2	Government interest in decentralization and investment in less-developed regions	O2
3	Easy access to energy resources	O3
4	Suitable access to target markets	O4
5	Availability of rail and air transportation links with both domestic and international destinations	O5
6	Potential for wealth creation and value addition within the province	O6
7	Increasing demand and favorable prices for metallic mineral resources	O7
8	Potential for the growth of sustainable downstream value chains	O8
9	Presence of specialized organizations and professional associations in the province	O9
10	Existence of large mines such as the Anjerd mine, which produces final copper ingots and can stimulate the development of copper downstream industries such as cable and wire manufacturing plants	O10

Table 11. Threats to Metallic Mines and Downstream Industries

Raw	Threats	Symbol
1	Limitations in water resources and the inability to expand water-intensive industries	T1
2	Problems in economic policymaking, including the banking, monetary, and foreign exchange systems	T2
3	High investment risk due to unstable and changing conditions	T3
4	Insufficient laws and incentive schemes for attracting private sector investment	T4

5	Inflation and fluctuations in exchange rates	T5
6	Low level of foreign relations and the presence of formal and informal sanctions	T6
7	Long average time required for project implementation and return on investment	T7
8	Unclear procedures and costs of activities and investments due to overlaps, conflicts, and lack of transparency in some laws and regulations	T8
9	Fundamental problems in the Mining Law and conflicts with local villagers within mining areas	T9
10	Unplanned imports of certain industrial and mineral goods	T10
11	Advancement of regional competitors due to higher rates of technology transfer	T11
12	High volatility in the prices of the relevant metals in recent years	T12
13	Foreign sanctions and the inability to import modern mining equipment	T13
14	Weak enforcement by judicial and executive bodies against opposition to mining activities	T14
15	Creation of illegal and unrealistic demands from mining investors by some government officials	T15
16	Obstruction by residents of areas with mining potential, particularly regarding transportation activities	T16
17	Time-consuming acquisition of agricultural lands through the Provincial Mining Council	T17
18	Unilateral restrictions imposed by organizations such as Natural Resources and Environmental Protection on industrial and mining activities	T18

After identifying the strengths, weaknesses, opportunities, and threats, the internal and external factor matrices for metallic mines and downstream industries were developed. This was done through collecting data using a researcher-designed questionnaire based on the identified strengths, weaknesses, opportunities, and threats.

Accordingly, Tables 12 and 13 present the Internal Factors Evaluation (IFE) Matrix and the External Factors Evaluation (EFE) Matrix for metallic mines and downstream industries, respectively.

Table 12. Internal Factors Evaluation Matrix for Metallic Mines and Downstream Industries

Symbol	Weight	Point	Rank	Symbol	Weight	Point	Rank
S1	0.035	0.1403	1	W1	0.020	0.0440	10
S2	0.041	0.1236	4	W2	0.018	0.0182	21
S3	0.034	0.1006	9	W3	0.029	0.0289	12
S4	0.037	0.1104	8	W4	0.018	0.0364	11
S5	0.028	0.0839	11	W5	0.019	0.0190	20
S6	0.024	0.0714	12	W6	0.038	0.0750	1
S7	0.018	0.0705	13	W7	0.037	0.0735	2
S8	0.033	0.1330	3	W8	0.035	0.0708	3
S9	0.016	0.0494	14	W9	0.035	0.0699	4
S10	0.039	0.1171	6	W10	0.020	0.0190	19
S11	0.028	0.1104	7	W11	0.023	0.0450	8
S12	0.032	0.0952	10	W12	0.032	0.0643	5
S13	0.033	0.1331	2	W13	0.013	0.0127	24
S14	0.012	0.0346	15	W14	0.022	0.044	9
S15	0.008	0.0305	16	W15	0.012	0.0239	17
S16	0.030	0.1196	5	W16	0.013	0.0266	13
				W17	0.013	0.0261	14
				W18	0.028	0.0566	6
				W19	0.015	0.0146	23
				W20	0.024	0.0240	16
				W21	0.020	0.0203	18
				W22	0.027	0.0542	7
				W23	0.016	0.0158	22
				W24	0.025	0.0252	15
Total Weight		1.5235				0.9081	

Table 13. External Factors Evaluation (EFE) Matrix for Metallic Mines and Downstream Industries

Symbol	Weight	Point	Rank	Symbol	Weight	Point	Rank
O1	0.059	0.237	1	T1	0.021	0.042	13
O2	0.054	0.164	6	T2	0.027	0.054	7
O3	0.044	0.176	5	T3	0.028	0.055	6
O4	0.054	0.217	2	T4	0.026	0.052	9
O5	0.051	0.155	7	T5	0.043	0.087	1
O6	0.035	0.142	9	T6	0.018	0.035	14
O7	0.038	0.153	8	T7	0.026	0.053	8
O8	0.039	0.118	10	T8	0.029	0.058	5
O9	0.050	0.203	4	T9	0.021	0.042	12
O10	0.051	0.205	3	T10	0.013	0.026	16
				T11	0.047	0.047	10
				T12	0.042	0.042	11
				T13	0.043	0.086	2
				T14	0.028	0.028	15
				T15	0.038	0.076	3
				T16	0.034	0.068	4
				T17	0.012	0.025	17
				T18	0.025	0.025	18
Total Weight		1.7731				0.899	

Considering that the score of the Internal Factors Evaluation (IFE) matrix is 2.43 and the score of the External Factors Evaluation (EFE) matrix is 2.67, the intersection of these two scores was used as the combined internal and external factor score. Based on this, a conservative strategy was identified as the main and overall strategy for the mining sector of the province. Given that the overall strategy of the mining sector is recognized as a conservative strategy, the goal of this strategy is to utilize existing advantages in opportunities to compensate for weaknesses.

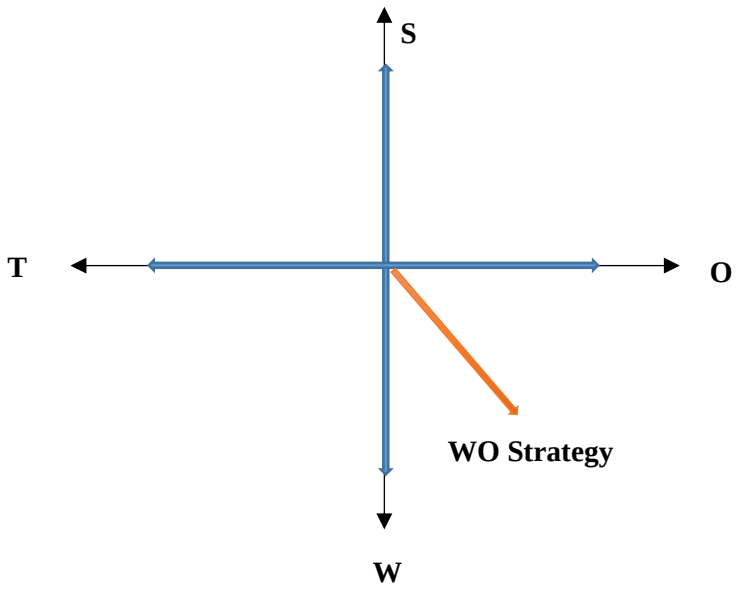


Fig. 2. Strategic Position of the Mining and Metal Downstream Industries Sector of the Province

The adaptive (conservative) strategy aims to maximize the use of existing opportunities by reducing weaknesses. An organization or company might recognize opportunities in its external environment but may not be able to exploit them due to internal weaknesses. In such cases, adopting an adaptive strategy can enable the utilization of these opportunities. It should be noted that the above analysis only clarifies the strategic

position at a specific point in time. Therefore, to monitor the temporal trend-given that environmental conditions (both internal and external) are dynamic and constantly changing-it is necessary to review these developments and extract strategies at different time intervals. Monitoring this trend helps to examine and predict various future scenarios. This stage relies separately on the key information identified through the SWOT analysis.

The first objective is to identify the key issues of the mining sector to better understand these matters. The second objective is to use the identified factors to set strategic goals and plan activities that can support making the province's mining sector more competitive. In general, the application of the SWOT model involves a systematic comparison between key external opportunities and threats with internal weaknesses and strengths, to identify one of four patterns between the organization's internal and external positions.

Following this, based on the SWOT analysis, development strategies for the metallic mines and downstream industries of East Azerbaijan Province have been formulated and presented.

Table 14. SWOT Matrix of Metallic Mines and Downstream Industries

SWOT Factors	Strengths (S)	Weaknesses (W)
Opportunities (O)	**SO Strategies (Use strengths to exploit opportunities)** 1. Attract foreign and domestic investors 2. Expand mining activities including exploration, extraction, and processing of metallic minerals 3. Invest in earth sciences, including data, technology, and international specialized training 4. Complete and expand the mineral value chain and downstream industries in the province	**WO Strategies (Overcome weaknesses by exploiting opportunities)** 1. Develop technology, innovation, and R&D for metallic mines and downstream industries 2. Develop modern technologies for metallic mines and downstream industries 3. Facilitate business environment to attract domestic and foreign investors 4. Develop necessary infrastructure for metallic mines and downstream industries such as transport, energy, water, and specialized industrial parks
Threats (T)	**ST Strategies (Use strengths to mitigate threats)** 1. Conduct technological studies of the mining sector by research centers and universities in the province 2. Develop clusters and business networks in metallic mines and downstream industries 3. Design special investment incentives for metallic mines and facilitate investment and production processes 4. Enhance competitiveness in metallic mines and downstream industries of the province	**WT Strategies (Minimize weaknesses and avoid threats)** 1. Establish export consortia in metallic mines and downstream industries 2. Engage in joint investments for technology management and transfer to diversify mining products 3. Develop marketing in target export countries and create robust soft and hard networks 4. Improve environmental laws and regulations and reduce air, soil, and groundwater pollution

5. Conclusion and Future Recommendations

The results of this study demonstrated that the mining sector, as one of the key pillars of economic development, can play an effective role in job creation, increasing production, and strengthening industrial value chains. East Azerbaijan Province, due to its diverse mineral reserves, favorable geographical location, and industrial and infrastructural capacities, has a high potential for developing mining activities. However, effective utilization of these capacities requires strategic planning and adoption of suitable policies in exploration, extraction, processing, and the development of domestic and international markets.

Based on the research findings, a total of 16 strengths, 24 weaknesses, 10 opportunities, and 18 threats were identified in the mining sector's development. Analysis of these factors led to the formulation of 16 development strategies that can be categorized within a strategic framework. These strategies focus on key axes such as attracting domestic and foreign investment, developing exploration and processing activities, completing the mineral value chain, advancing technology and innovation in mining, strengthening infrastructure, facilitating business environment, and enhancing competitiveness in global markets.

The results indicate that sustainable development of the mining sector in East Azerbaijan requires a comprehensive and coordinated approach among policymaking institutions, the private sector, academic and research centers, and investors. Furthermore, aligning mining development programs with the country's upstream documents, including resistance economy policies and the vision document, can pave the way for increased productivity, higher value-added, and expanded exports of mineral products and related industries. In this regard, attention to the development of modern technologies, improving transport and energy infrastructure, and creating support mechanisms for investors are of special importance.

Based on the study's results, the following recommendations are proposed for the development of the mining sector in East Azerbaijan Province:

- Attracting domestic and foreign investors through financial incentives and simplification of administrative and legal procedures.
- Developing exploration, extraction, and mineral processing activities to increase value-added and complete the value chain in mineral industries.
- Investing in earth sciences and modern mining technologies to improve efficiency and reduce production costs.
- Developing industrial and mineral clusters and establishing export consortia to strengthen presence in international markets.
- Supporting knowledge-based companies and startups active in mining technologies and related industries.
- Improving transport, energy, and logistics infrastructure to facilitate mining activities and reduce operational costs.
- Creating appropriate mechanisms for technology transfer through joint investments with international companies.
- Reviewing and improving environmental laws and regulations in a way that protects the environment without hindering the development of mining activities.

This research faced some limitations. First, the limited statistical population focused on mining experts and specialists may not fully reflect the perspectives of other stakeholders such as private sector actors and investors. Second, the use of questionnaires and interviews made data collection time-consuming and may have been subject to response limitations. Additionally, the cross-sectional nature of the study limits the ability to examine long-term changes in factors affecting mining sector development.

To expand the scientific literature in this field, conducting similar studies in other mineral-rich provinces of the country can help compare and generalize the results. It is also recommended that future studies employ multi-criteria decision-making (MCDM) methods and techniques to prioritize mining development strategies. Examining the perspectives of other stakeholders-including investors, industrial players, and local communities-can also contribute to a more comprehensive understanding of the challenges and opportunities in developing the mining sector.

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