DOI: 10.71317/jgst.2.7.2026.252
Journal of Global Social Transformation
Journal homepage: https://rjsaonline.org/index.php/JGST

Strategic and Systematic Planning of Coal Mining Industry of Sindh, Pakistan through Hybrid Delph-SWOT framework

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ARTICLE INFO

Submission:
June 03, 2026
Revised:
June 17, 2026
Accepted:
July 03, 2026
Available Online:
July 19, 2026

Keywords:
Coal, Delphi-SWOT, Strategic Planning, Sustainable Development, Management

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ABSTRACT

Pakistan possesses huge mineral resources with lignite coal being the most abundant of all commodities. Despite having huge lignite coal potential, the industrial development of these coal reserves remains limited due to a lack of strategic planning. To address this underdeveloped potential, this study employs a hybrid Delphi-SWOT approach to identify and evaluate strategies for sustainable development and efficient utilization of lignite coal reserves of Pakistan. This study comprises two stages in 1st stage, selection of experts and parameters identification from relevant articles was performed while in second stage, SWOT matrix was developed. An initial set of parameters was identified; in the second round, these were narrowed to 30. In the final round, 16 key parameters based upon the feasibility and socio-economic dimensions were finalized in consultation with field experts. Then, these were categorized as Strength, Weakness, Opportunity and Threat (SWOT) matrix. The study revealed that weaknesses like outdated mining practices, poor infrastructure availability, and unavailability of skilled workers with environmental had weight 0.08, 0.05, 0.03 and 0.04. Thus, these could be one of the reasons for lack in industrials growth of coal in the province of Sindh. However, the strengths of substantial lignite reserves with maximum weight of 0.08, rising domestic demand with weight of 0.07, and government support could drive extensive growth in coal-based industries. While opportunities such as growing energy demand with highest weight of 0.13, trade potential in global markets, and technological advancement in the mineral sector could open avenues for investors. Finally, threats such as tightening environmental regulations with maximum weight of 0.06, growing reliance on renewable energy, and political instability were identified as the primary risks to sector growth.

Introduction

The coal mining industry in Pakistan has vast untapped potential, with significant reserves located in the provinces of Sindh, Balouchistan, and Khyber Pakhtunkhwa. Pakistan's coal reserves, particularly in Sindh's Thar desert and Lakhra, are among the largest in the world (Malkani, 2012; Siddiqui et al., 2015a, 2015b). Challenges like outdated infrastructure, inefficient mining practices and less use of technology due to less investment in technology poses tremendous challenges for the sector (Chalgri, Memon, et al., 2025; Jiskani, Shah, et al., 2020a) The role of coal for power generation in the Pakistani power sector is essential as the country facing severe power crisis, despite its potential for power generation, coal still is not fully utilized (Chalgri, Memon, et al., 2025). Coal is considered as one of the most important energy resources globally which is contributing significantly to electricity generation and industrial processes (PPIB, 2004). Nonetheless, country like Pakistan is endowed with vast indigenous lignite coal reserves which holds immense potential for utilizing this resource to overcome the growing energy demands and ultimately support the economic growth (Malkani, 2012). Moreover, Pakistan has an estimated 186 billion tons of coal reserves which is primarily located in the Sindh province as shown in Figure 1 specially on Thar desert (Siddiqui et al., 2015a). Country ranks among the top nations in coal resources as reported in previous studies (Malkani, 2012; Malkani & Mahmood, 2017). Despite this abundance of lignite coal reserves, the coal mining industry remains underdeveloped due to constrained by several technological, structural and policy challenges. In previous years, country faced a persistent energy crisis due to frequent power outages, heavy reliance on imported fuels such as oil and liquefied natural gas (LNG) and rise of energy costs (Tang et al., 2024a). However, reliance on important fuels places considerable strain on the foreign exchange reserves of the country and leaves its energy sector vulnerable to global market fluctuations. Coal due to its environmental impacts remains a contentious source of energy due to global climatic change and emission of gases (Bell & York, 2010; Xie et al., 2021). Therefore, internationally intensifying pressure for the cleaner energy transition creating a challenging situation for the countries with dependency on coal usage for their economic growth. Pakistan is amongst those countries which despite having such coal potential is unable to exploit coal utilization (Tang et al., 2024). Balancing economic development with energy security by keeping environmental sustainability makes a rigorous and difficult task for the policymakers and stakeholders of the industries (Ma, 2016).

Therefore, strategic planning for the development of coal-based industries is an essential task. A comprehensive evidence-based Strengths, Weakness, Opportunities and Threats (SWOT) analysis could provide understanding about the internal and external factors impacting the coal mining sector and offers insights into strategic decision-making (Leigh, 2009; Teoli et al., 2019). A detailed analysis of (SWOT) along with Delphi hybrid technique could assist in the identification of effective strategies to unlock its potential (Jiskani, Cai, et al., 2020a). The objective of this study, therefore, is to evaluate the strengths, weaknesses, opportunities and threats pertaining to the lignite coal strategic development, with a view to formulating a strategy. The effectiveness of the Delphi-SWOT tool in the sustainable strategical development at the indigenous level will be established, illuminating key parameters for planning and assessment of the internal and external situation of the region, as well as the identification of the challenges and opportunities it encounters. This study focused on comprehensive evidence-based SWOT analysis of coal mining industry of Sindh Pakistan, exploring status, challenges faced, and future opportunities of coal mining industry. Furthermore, it evaluates the potential contribution of coal mining industry to overcome power crises of Sindh province and Pakistan and obstacles faced by coal mining industry for achieving sustainability. Moreover, this study would provide preliminary guidelines to different stakeholders, investors and policymakers about various critical factors which reshapes the future status of coal mining industry in Pakistan.

Research Methodology

Study Area

In this study, the lignite coal reserves of Sindh Pakistan were studied for their strategic planning to make this coal reserves sustainable. Country has vast reserves of coal deposits throughout the country. However, Sindh and Baluchistan have major share of coal deposits as shown in Figure 1. In addition, Sindh has more than 90 % of share in overall coal reserves of the country, Thar coal field has major share with 175 billion tons of coal reserves (Siddiqui et al., 2015a). The major coal fields are Thar, Lakhra, Mach, Sor range and Chamalong as shown in Figure 1. The major coal type is lignite and sub-bituminous.

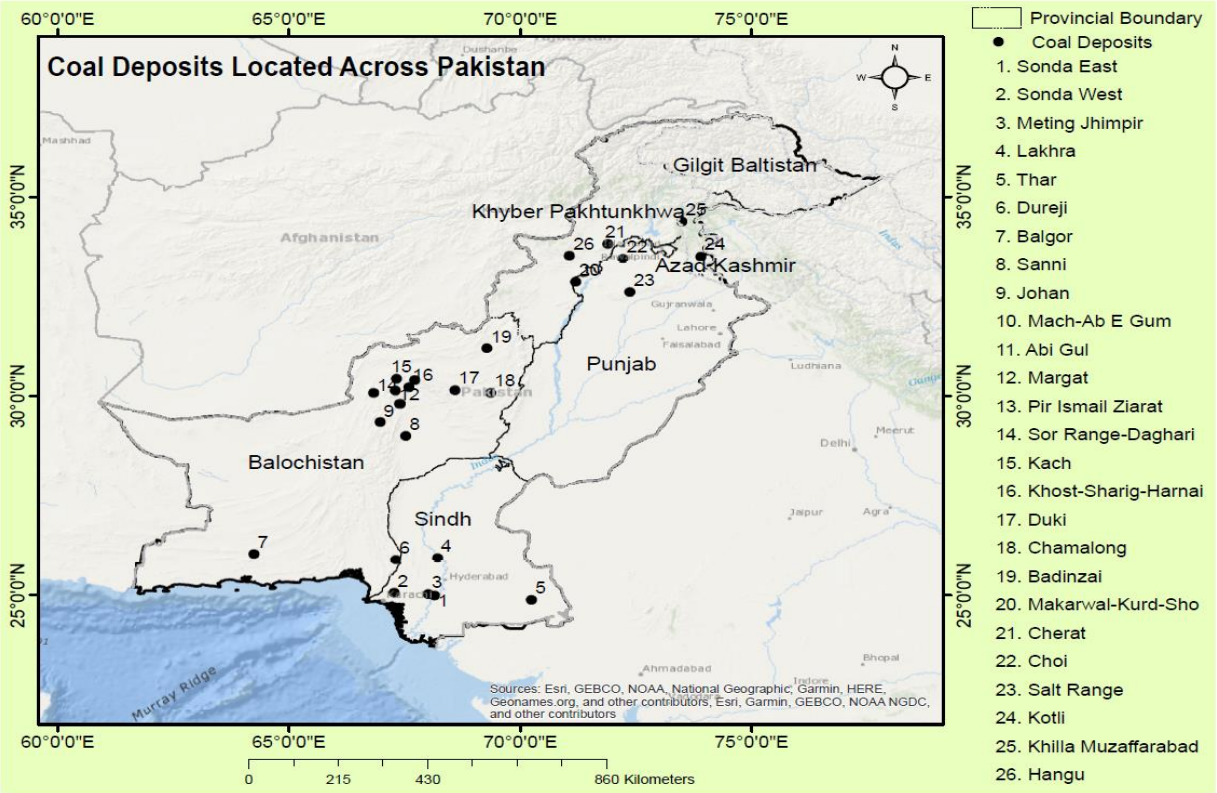

Figure 1: Map of Pakistan with Coal Potential

Major Utilization of Lignite Coal around the Globe

Lignite coal has number of applications in different industries as shown in Table 1. Lignite is considered as low rank coal makes up around 95–97% of Pakistan coal reserves. However, Lignite is mainly used for power and heat recovery due to its low energy density and poor transport economics (Abbas et al., 2025). Lignite coal is also widely used in district heating and industrial boilers where mines and plants are co-located (Pudasainee et al., 2020). Underground coal gasification for syngas (Liu et al., 2026), chemical recovery such as humic acid (Ofoe et al., 2025) has been also reported in literature. In addition, recovery of solid briquetting and activated carbon preparation from Lignite Coal is also reported in literature (Self et al., 2012).

Table 1. Utilization of Lignite Coal Reserves around the globe

Utilization of Lignite Coal		
Energy Conversion	**Chemical & Fertilizers**	**Carbon Materials**
Mine Mouth Power Generation	Ammonia / urea from coal syngas	Activated Carbon (water and gas treatment)
Surface Gasification (syngas)	Humic and fulvic acids	Semi-coke / metallurgical reductant after carbonization
Coal to liquids / pyrolysis liquid fuels	Tar & chemical feedstocks (Fischer tar > 20 wt%)	Leonardite / drilling muds additives

Development of Delphi-SWOT hybrid Paradigm

Developing strategy is a complex and ambiguous process that identifies and analyses the alternatives to achieving the core objective of any organization (Gurl, 2017). The main reason for this process being vigorous is actual uncertainty and perceived ambiguity. Therefore, effective strategic planning requires the input from and cooperation of many stakeholders. The hybrid Delphi-SWOT paradigm suggested in this study is used to recognize and evaluate the strategies for sustainable development and efficient utilization of lignite coal reserves of Sindh. Delphi is an established technique of obtaining a collective view from individuals about different challenges, where opinion of individuals is important (Chalgri, Bawani, et al.,

2025). This is an iterative questionnaire exercise with controlled output for a group of panelists who are anonymous and aware of the field. Each round in Delphi process engages a written survey of participants which is followed by statistical feedback. While Strength, Weakness, Opportunity and Threats (SWOT) technique was developed in 1960 (Ghazinoory et al., 2011). This technique is considered as an effective management tool for strategic development (Piercy & Giles, 1989). However, its isolated use casts some doubts on its effectiveness. Therefore, in this research a hybrid Delphi-SWOT approach was used. Initially various factors which were considered for the strategic planning of coal industry collected from government reports, books and research articles. Integration of SWOT with Delphi technique, experts chose various parameters in two rounds (Helms & Nixon, 2010). Afterwards, SWOT matrix was developed by assigning weights to each parameter furthermore the methodology framework is presented in Figure 2.

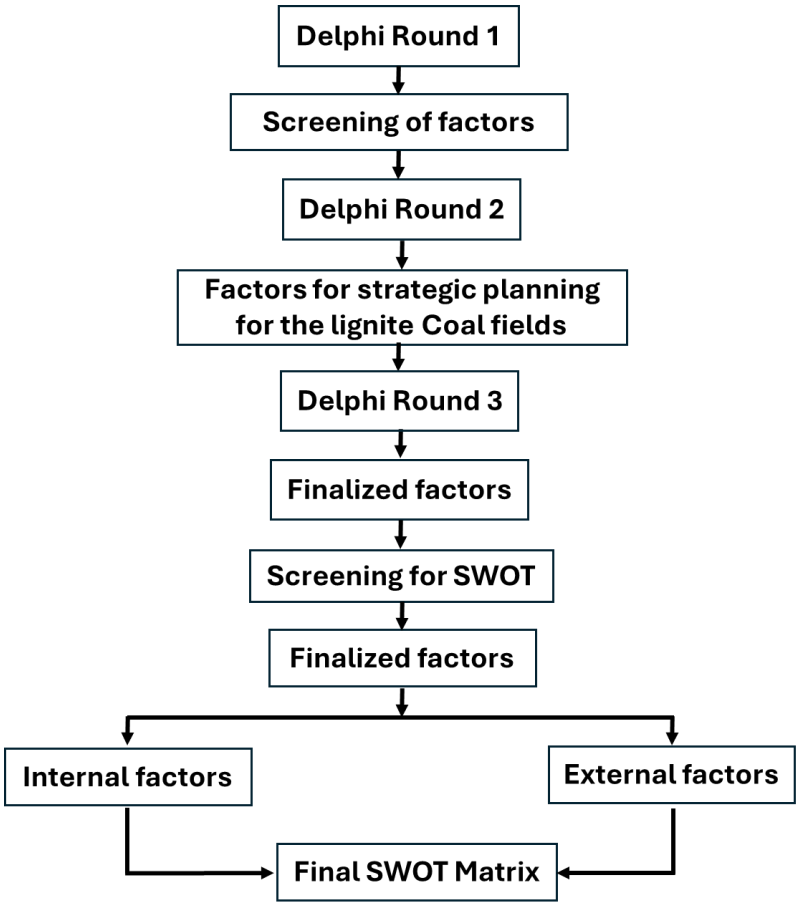

Figure 2: Research Methodology Flowchart

Results and Discussion

Demographics of Participants

The credibility and effectiveness of a hybrid SWOT–Delphi analysis depend on the diversity and expertise and representativeness of the participants of the subject (Osuna & Aranda, 2007). In present study, SWOT-Delphi assessment for a lignite coal reserve of Sindh province has been performed. A purposive sampling method was adopted to select respondents with noticeable professional experience and relevant subject-matter expertise. The Delphi panelist consisted of experts from industry, academia, government, and professional practice for ensuring a balanced and comprehensive assessment of SWOT. A total of 30 experts participated in the Delphi rounds. The age groups of experts remained in the 30->50 as presented in Table 2. However, higher number of experts around 10 was in the range between 41-45 as shown in Table 2. In terms of education, 73.33% of the participants have bachelor's degree. In addition, three doctorate holders related to mining field were also included as shown in Table 2. All participants met predefined inclusion criteria, including a minimum number of years of professional experience, involvement in decision-making or policy-related roles, and familiarity with strategic analysis tools such as SWOT. In addition, most of the participants were senior mining engineers as shown in Table 2. Demographic characteristics of the participants are presented in Table 2.

Table 2: Demographics Information for Experts

Sr #	Demographic Factors	Frequency	Percentage (%)
Age Group			
1	30-35	5	16.6
2	36- 40	8	26.6
3	41-45	10	33.3
4	46-50	4	13.3
5	>50	3	10.0
Educational Levels of Experts			
1	PhD	3	10.0
2	Masters	5	16.6
3	Bachelors	22	73.33
Job Title			
1	Academician	5	16.6
2	Mining Engineer	6	20.0
3	Mine manager	7	23.3
4	Senior Mining Engineer	12	40.0
Total Number of Participants N=30			

SWOT-Delphi Paradigm

The Delphi-SWOT analysis highlighted the integrated influential parameters for the sustainable development coal industry of Sindh Pakistan. The study was conducted in two phases, in the 1st phase of study Delphi method which consisted of three rounds, the method is commonly used for strategic planning (Powell, 2003). In first round various parameters were identified from Thar coal related research articles published in reputable journals, then in the second a total of 30 parameters were selected from relevant literature. For the 3rd and final round 16 key parameters based upon the feasibility and socio-economic dimension were finalized by expert panelists. These parameters were subsequently then categorized within SWOT framework (Helms & Nixon, 2010; Sammut-Bonnici & Galea, 2015). The aggregated result revealed that abundant coal reserves and growth in domestic demand are most critical strengths. While outdated mining methods with poor infrastructure system could challenge the growth of coal industry of Pakistan (Jiskani, Shah, et al., 2020b). There are opportunities for investors due to energy security and demand in different industrial sectors of the country while addition of export potential could enhance the opportunities in the coal sector (Tang et al., 2024a). Current global environmental policies with strict environment regulations and competition in renewable energy could threaten the development of coal industry of Pakistan.

Parameters for Strategic Development

The selection process for most influential and key parameters suitable for the sustainable development of coal industry was done with the help of extensive literature review. Initially those identified factors were communicated with the experts after the brainstorming of experts. In the 1st Delphi round all the experts agreed upon those identified factors. Then for the 2nd round of Delphi, they were asked to finalize the parameters. A total of 30 key parameters shown in Table 3 were identified by the expert input. For the 3rd and last round of Delphi, experts were asked to finalize the most influential parameters pertaining to coal industry of Sindh Pakistan. Experts encompassed critical parameters that affect long-term viability and sustainable utilization and finalized 30 key parameters as listed in Table 3. These parameters include Growing Domestic Demand for Energy, Abundant Coal Reserves, Strategic Geographical Location, government support and investment, poor infrastructure, environmental concerns, and lack of skilled workforce. Moreover, few more parameters like outdated mining technology, Export potential, Technological advancement, global shift towards Energy diversification, Energy Security and Demand, Competition from renewable energy, environmental regulations, political instability and volatility in global coal prices were included. These parameters not only address technical feasibility but also align with the country's objective for energy security and socio-economic growth.

Table 3: Key Parameters for Strategic Development of Lignite Coal Reserves in Sindh

S.No.	Parameters	Code of Parameter	Reference
1	Quality of Coal	P1	(Lin & Raza, 2020; Siddiqui et al., 2015a)
2	Potential for Power Generation	P2	
3	Availability of Water Resource	P3	
4	Coal gasification Facilities	P4	(Malkani et al., 2016; Malkani & Mahmood, 2017)
5	Environment Management	P5	
6	Government Energy Policy Alignment	P6	
7	Investment and Taxation Policy	P7	
8	Enhanced Local business	P8	(Malkani & Mahmood, 2016; PPIB, 2004)
9	Local community Development	P9	
10	Academia-Industry Linkage	P10	
11	Strategic Geographical Location	P11	
12	Environmental Concerns	P12	(Abbas et al., 2025; Abro et al., 2021; Malkani, 2012; Raza et al., 2022)
13	Energy Security and Demand	P13	
14	Technological Advancements	P14	
15	Competition from Renewable Energy	P15	
16	Volatility in Global Coal Prices	P16	
17	Average Depth of Deposit	P17	
18	Extraction Technologies	P18	
19	Stripping Ratio	P19	
20	Availability of Infrastructure	P20	(Ishtiaq et al., 2018; Lin & Raza, 2020)
21	Licensing and Regulatory Bodies	P21	
22	Public-Private Partnership	P22	
23	Indigenous Employment	P23	(Ishtiaq et al., 2018; Raza et al., 2022)
24	Research Development Collaboration	P24	
25	Growing Domestic Demand for Energy	P25	
26	Outdated Mining Technology	P26	(Jiskani, Shah, et al., 2020b; Tang et al., 2024a)
27	Lack of Skilled Workforce	P27	
28	Export Potential	P28	(Abbas et al., 2025; Jiskani, Cai, et al., 2020b)
29	Global Shift Towards Energy Diversification	P29	(Kalisz et al., 2022; Lin & Raza, 2020; Zhou et al., 2022)
30	Political Instability	P30	

Findings of SWOT Analysis

The SWOT analysis framework is considered as a strategic planning approach which identifies and evaluates the SWOT related to any industry (Helms & Nixon, 2010; Sammut-Bonnici & Galea, 2015). Many organizations carry out SWOT analysis at the stage of strategic planning, attempt to identify and analyze the available existing resources, both internally and externally. Therefore, the present study used SWOT framework to analyses the strategic planning of coal mining industry of Pakistan. In this study, Internal factors (Strength and Weakness) and External factors (opportunity and threats) very closely analyzed for sustainable growth of coal industry of Pakistan as shown in Table 4.

Table 4: SWOT factors for coal mining industry of Sindh Pakistan

Internal Factors	
Strengths (S)	**Weakness (W)**
Growing Domestic Demand for Energy (S1)	Poor Infrastructure (W1)
Abundant Coal Reserves (S2)	Environmental Concerns (W2)
Strategic Geographical Location (S3)	Lack of Skilled Workforce (W3)
Government Support and Investment (S4)	Outdated Mining Technology (W4)
External Factors	

Opportunity (O)	Threats (T)
Export Potential (O1)	Competition from Renewable Energy (T1)
Technological Advancements (O2)	Environmental Regulations (T2)
Global Shift Towards Energy Diversification (O3)	Political Instability (T3)
Energy Security and Demand (O4)	Volatility in Global Coal Prices (T4)

The weights for the SWOT matrix were assigned based upon the strategic significance for the sustainable development of lignite reserves of Pakistan as reported in Table 5. Out of 1.0 each factor was provided weight upon the relative contributing factor for the development. The process of weighing was performed by expert evaluation, scholarly literature and government reports. The most influential parameters received more weights and least with minimum weight. The approach comprehended an empirical foundation for the prioritization of Strengths and Weakness (internal factors), and Opportunities and Threats (external factors). Following Table highlights the final SWOT matrix based upon the relative importance for the development of coal industry of Pakistan.

Table 5: Relative Weight of SWOT factors

Factors	Code	Weight	Rating
Internal Factors			
Strength			
Growing Domestic Demand for Energy	S1	0.01	2
Abundant Coal Reserves	S2	0.08	1
Strategic Geographical Location	S3	0.05	4
Government Support and Investment	S4	0.07	3
Weakness			
Poor Infrastructure	W1	0.05	2
Environmental Concerns	W2	0.04	3
Lack of Skilled Workforce	W3	0.03	4
Outdated Mining Technology	W4	0.08	1
External Factors			
Opportunity			
Export Potential	O1	0.1	2
Technological Advancements	O2	0.07	3
Global Shift Towards Energy Diversification	O3	0.05	4
Energy Security and Demand	O4	0.13	1
Threats			
Competition for Renewable Energy	T1	0.04	2
Environmental Regulations	T2	0.06	1
Political Instability	T3	0.03	3
Volatility in Global Coal Prices	T4	0.02	4

Strengths (S) Sindh Coal

Abundant Coal Reserves (S1)

Pakistan is home to one of the largest lignite reserves in the world, most of the share presented in thar desert of Sindh, Pakistan as shown in Figure 1, most of the share is present in the Thar Desert of Sindh. The rating of this factor was 1 in strength with a weight of 0.1 as shown in Table 5. Alone Thar coalfield possesses over 175 billion tons of coal reserves, that could serve as key source for domestic and global trade. The major strength lies in its abundance and could easily meet the country's energy requirement. In addition, only Sindh has around 185,457 million tons of coal reserves which was followed by Balochistan. Most of the coal is utilized for power generation in the country due to its properties as shown in Table 6. However, substantial amounts of indigenous coal are also used in the local industries of the country for the production of various finish goods as shown in Figure 2.

Growing Domestic Demand for Energy (S2)

The demand for electricity in Pakistan is continuously rising due to population growth and industrialization. The weight of the factor was 0.08 with rating 2 as reported in Table 5. Coal plays a key role in meeting the current energy demand of the country, especially in power generation due to its calorific values in table 6. Moreover, the expansion of coal-fired power plants especially in the Thar region, supports the overall growth of the coal mining sector of Pakistan. Indigenous lignite coal at Thar has huge reserves with moderate volatile matter (20–28)%, high moisture (45–50)%, low to moderate sulfur (0.3–1.2)%, low to moderate ash (8–16)%, and calorific values of around 3200 – 3500 Kcal/Kg as shown in table 6, showing clear picture for fuel potential with reference to power generation (Butt et al., 2021). In addition to this, various studies further concluded that Thar's lignite coal with reasonable heating value and (Siddiqui et al., 2015b; Zhou et al., 2022) low sulfur make it suitable for power generation plants, especially for circulating fluidized bed combustors and other clean coal technologies (Abro et al., 2021; J. A. Butt et al., 2023; Khan et al., 2025). Moreover, Lakhra and Meting Jhimpir contain lignite to sub-bituminous coal with higher sulfur (2–5%) and moderate to high ash (8–16%) but are still considered to have good power-generation potential if sulfur is reduced via clean-coal technology prior to power generation (J. A. Butt et al., 2023) .

Table 6 Properties of Sindh Major Lignite Coal Reserves on as received basis

Coalfield	TM (%)	VM (%)	FC (%)	Ash (%)	TS (%)	GCV (Kcal/Kg)
Lakhra	27 – 33	26 – 36	25 – 32	8 – 16	2.5 – 5.0	3900 - 4300
Meting–Jhimpir	27 – 37	25 – 34	24 – 32	9 –17	2.9 – 5.1	4200 - 4600
Thar	45 – 50	20 – 28	18 – 25	5–15	0.3 – 1.2	3200 - 3500

TM = Total moisture, VM= Volatile matters, FC = Fixed carbon, GCV= Gross calorific value

Note: The values of coal analysis based on as received basis.

Strategic Geographical Location (S3)

Country's strategic location between energy-hungry markets like India, China, Bangladesh and the Middle East, positions the Pakistan as a potential exporter of indigenous coal, especially with the expansion of transportation infrastructure under the CPEC initiative. This provides opportunities for export markets in addition to meeting domestic energy needs. Various authors have reported that Pakistani indigenous coal in suitable for power generation due to its properties (K. M. Butt & Butt, 2015; Fazal et al., 2023; Siddiqui et al., 2015a).

Government Support and Investment (S4)

The Pakistani government has shown interest in developing the coal mining sector. Initiatives like the Thar Coal Project and the China-Pakistan Economic Corridor (CPEC) have brought significant foreign investment into coal mining and power generation projects as shown in Table 6. The government's policy support, including subsidies and incentives, encourages further development of the sector.

Weaknesses (W) of Pakistani Coal

Poor Infrastructure (W1)

Though the infrastructure betterment plan is underway for enhancing the growth of the local coal mining industry of the country. However, the coal industry of the country still faces issues related to logistics and inadequate transport network. Further, lack of railway carriageway, poor road infrastructure and inefficient handling and storage facilities increased the operational costs and limit the ability to efficiently move coal from mines to power plants or export terminals.

Environmental Concerns (W2)

During coal winning process serious environmental degradation, including deforestation, air pollution, and water contamination occurs. The industry's inability to adopt cleaner and more sustainable practices has led to growing concerns about its long-term environmental impact. This can result in local community opposition and stricter regulations from the government and international bodies.

Lack of Skilled Workforce (W3)

The coal mining industry in Pakistan suffers from a shortage of skilled labour and professionals, which hinders productivity and safety standards. The lack of a trained workforce affects the quality of mining operations and technological adoption.

Outdated Mining Technology (W4)

Unfortunately, the coal mining sector in the country is suffering due to outdated coal mining practices and technology. Most of the coal fields in the country are mined coal through manual mining practices except Thar. Due to manual coal mining practices and lacking in modern equipment and automation system potential growth of the industry has been suppressed. Furthermore, relying on traditional coal winning process also results in environmental degradation, lower productivity, inefficiencies and creates health and safety issues for miners (Chen et al., 2020; Jiskani, Cai, et al., 2020a; Tang et al., 2024b).

Opportunities (O) of Pakistani Coal

Energy Security and Demand (O4)

With increasing electricity demand, Pakistan's dependency on imported energy sources poses a risk to its energy security. Coal mining offers a reliable and domestically sourced alternative, reducing reliance on expensive and politically volatile imports. The expansion of coal power plants in the country might meet both current and future energy needs.

Export Potential (O1)

Pakistan has the potential to become a key exporter of coal to neighboring countries like China and India. The CPEC initiative, which includes the development of transportation corridors, provides a platform to increase coal exports, benefiting the national economy.

Technological Advancements (O2)

Adopting modern mining techniques and technology, such as underground mining, mechanized drilling, and automation may lead to higher productivity and environmental sustainability (Jiskani, Cai, et al., 2020c). Moreover, the development of clean coal technologies, including carbon capture and storage (CCS), can help mitigate the environmental impact of coal mining.

Global Shift Towards Energy Diversification (O3)

With global energy demands shifting towards a more diverse mix, including renewables and cleaner fossil fuels, there is an opportunity for Pakistan's coal industry to explore diversification and innovation in energy generation. Collaboration with international partners might enhance the capacity for producing cleaner coal technologies.

Threats (T) of Pakistani Coal

Environmental Regulations (T2)

Increasingly stringent global and domestic environmental regulations are a significant threat to the coal mining industry. Climate change concerns, particularly regarding greenhouse gas emissions, are leading to calls for reducing coal dependency. These pressures could lead to higher compliance costs and restricted market access for coal-based energy. After 18th amendment, environmental monitoring is managed by provincial Environmental Protection Agencies (EPAs). Various environmental laws are applicable in the country such as PEPA Act 1997, SEPA Act 2014, Punjab Environmental Protection Act 2017, Baluchistan Environmental Protection Act 2012 and Khyber Pakhtunkhwa Environmental Protection Act 2014.

Competition from Renewable Energy (T1)

As renewable energy sources, such as solar, wind, and hydroelectric power, gain traction in Pakistan, the coal mining industry faces competition from these cleaner, more sustainable alternatives. The declining costs of renewables could undermine the long-term viability of coal power. Therefore, global energy systems have been diversified away from fossil-fuel dominance toward broader and renewables-heavy mixes to meet economic, climate (environmental) and security goals.

Political Instability (T3)

Political instability and changes in government policies pose a threat to the coal mining industry. Shifting regulations, corruption, and inefficiencies in governance can create an unpredictable environment for long-term investments in the sector. Because the political instability is considered as the major external threat to coal mining industry of Pakistan, disrupting investment, increasing policy risk and accelerating destabilization or forced phase-out of mines. In literature, it is reported that Coal mining related industries rank policy uncertainty and considered as their most critical threat factor in SWOT-based strategic diagnosis (Limanskiy & Vasilyeva, 2016; Shah et al., 2019).

Volatility in Global Coal Prices (T4)

Global and regional coal prices are subject to fluctuations, which may impact the profitability of Pakistan's coal exports. Therefore, the price volatility might affect investment decisions and the ability to sustain mining operations at a competitive cost.

Conclusion

Pakistan is endured with vast reserves of lignite coal, and which possess noticeable industrial potential. However, despite being such a huge reserve, the province Sindh of Pakistan unfortunately is unable to utilize the lignite coal potential to compete with its capability. This hybrid study identified 30 key parameters which were further categorized in SWOT matrix. Though, with weaknesses like outdated mining practices, poor infrastructure availability, unavailability of skilled workers with environmental concerns could pose the lignite's industrial growth development. However, Strength of the huge Lignite Coal potential with increase in demand of domestic usage and government support could initiate the extensive growth of coal-based industries in the country. While the opportunity like demand of energy supply, trading opportunity in global markets and technological advancement in mineral sector could provide an open window for the investors. Finally, threats like growing environmental regulations, renewable energy reliance with political instability are the major threats. However, with effective strategic planning these threats could be overcome. Sindh can transform its lignite coal industry into a more sustainable and profitable manner, contributing to the country's energy security and sustainable development.

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