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The way forward for Mineral Beneficiation in Pakistan

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Abstract

Pakistan is blessed with a vast variety and volume of minerals but has been unable to receive due benefits in the upgrading of its economy and growth. The mining sector currently contributes less than 1% in total GDP of the country. Pakistan can extract full benefits from the primary development and beneficiation of minerals, by avoiding Dutch disease and Resource curse.

This paper presents the scenario for charting a way forward for beneficiation of mineral resources in Pakistan. The methodology focuses on the top challenges faced by the country, which serve as impediments for the sound formulation of a strategy for beneficiation of its minerals. However, there is still room for improvement in the development and beneficiation of Pakistan's mineral resources. By addressing the challenges discussed in the paper, it would be highlighted that Pakistan would be able to use the primary development and beneficiation of its mineral resources to improve the state of its declining economic growth.

Keywords: Economic Growth, Thar Coal, Beneficiation Strategy, Challenges, Mining in Pakistan.

I. Introduction

Mineral beneficiation is the process of adding value to minerals with the aim of improving the quality of minerals in order to allow for better usage and trading, by removing the impurities. Starting from the exploration, extraction of mineral resource to marketing the final fabricated good, all stages of beneficiation hold a specific value for each commodity. The price of commodities or minerals rises with increase in its value or forward movement along the value chain (Mtegha, 2014).

Despite Pakistan being richly endowed with diversified mineral resources, the mineral sector has not made the desired impact and the reasons for this low growth need to be investigated. The total Natural Resource rent of Pakistan is 3.7% of GDP (2012), which was 0.7% less than the previous year (World Bank, 2014). Of the natural resource rent, mineral resources portion contributed less than 1% in GDP (2012). The complete mineral profile of the country is shown in Table 1.

Table 1: Major mineral deposits in Pakistan.
Source: Geological Survey of Pakistan (2013).

Mineral	Location	Deposits (Approximately)
Gold	Riko Diq sandak, Quetta,	1.656 Billion Tonnes
Copper	Riko Diq, Sandak, Quetta, Chaghai	6 Billion Tonnes
Iron	Diband, Fata, Balochistan, Kala Bagh, Chitral, Khuzdar, Chulgari	1.4 Billion Tonnes
Coal	Thar, Sind, Badin, Quetta, Machh, Zhoab, Salt Ranges in Kohistan	186 Billon Tonnes
Silver	Baluchistan, NWFP	618 Million Tonnes
Lead Zinc	Lasbela-Khuzdar region holds great promise for further exploration of deposit	23.72 Million Tonnes
Manganese	NWFP and Baluchistan	0.597 Million Tonnes
Chromites	Zhob District in Baluchistan, specifically in Muslimbagh, Khanozai, Nisai and Gwal	2.527 Million Tonnes

With the availability of these vast mineral reserves in Pakistan, the level of beneficiation of minerals in the country has remained very low, which is indicated by the percentage share of mineral industry in GDP of the country. The output value of the mineral industry was recorded as 2.5% of GDP in 2012 (USGS, 2011). However, mining and quarrying sectors of Pakistan showed a positive growth of 7.6% against the estimated figure of 4.6% in only extraction regime in 2012 – 2013 (GOP, 2014a). With the extraction of minerals being at an increasing trend in the country, even in adverse political and security conditions

(GOP, 2014b), the country is still at a losing end for beneficiation (see Table 2).

Table 2: Minerals and extractions in Pakistan

Minerals	Unit of Quantity	2010-11	2011-12	2012-13	% Change
Coal	M.T	3,291,617	3,178,986	3,079,176	-3.1
Natural gas	MMCFT	1,471,590	1,558,959	1,525,866	-2.1
Crude oil	JSB (000)	24,041	24,573	28,462	15.8
Chromite	M.T	148,034	179,203	161,045	-10.1
Magnesite	M.T	4,908	5,444	5,949	9.3
Dolomite	M.T	240,111	198,392	449,034	126.3
Gypsum	M.T	885,368	1,260,021	1,297,020	2.9
Limestone	M.T	32,020,996	35,016,411	38,756,783	10.7
Rock Salt	M.T	1,953,711	2,135,760	2,104,986	-1.4
Sulphur	M.T	27,645	25,560	18,162	-28.9
Barytes	M.T	31,836	48,510	259,941	435.9
Bauxite	M.T	9,033	30,223	48,958	62.0
Calcite	M.T	607	170	370	117.7
Soap stone	M.T	47,561	55,515	90,817	63.6
Marble	M.T	1,132,900	1,750,578	3,219,834	83.9
Copper	M.T	15,672	17,931	15,758	-12.1
Phosphate	M.T	30,950	69,400	58,204	-16.1

Source: Khan (2003).

Due to the presence of impurities, all the minerals mined in the country are not suitable for use in the country. They either have to be beneficiated in the country locally or exported. With Pakistan being weak in both forward and backward linkages along its mine value chain, all the minerals produced are not beneficiated within the country. Only a small portion of petroleum oil lubricants are processed in the country. With this, Pakistan imports mineral-based chemicals and finished goods, despite having a vast mineral base (Khan, 2003) (see Table 3). Pakistan is facing certain domestic and international challenges to the formulation of a beneficiation plan applicable to its local environment.

Table 3: Importation of mineral-based chemicals up until 2013.

Commodity	**Tons (000)**	**Rs (Mil)**	**Tons (000)**	**Rs (Mil)**	**Tons (000)**	**Rs (Mil)**	**Tons (000)**	**Rs (Mil)**	**Tons (000)**	**Rs (Mil)**
Zinc Oxide	1.1	16.7	0.9	15.1	1.1	17.3	0.6	10.7	0.6	13.6
Manganese Oxide	0.8	9.5	0.3	3.4	0.2	3.6	0.4	6.5	0.3	6.4
Iron Oxide	3.4	24.5	2.0	24.1	3.4	38.5	3.4	30.7	2.5	40.0
Titanium Oxide	3.6	139.4	1.8	88.8	0.1	76.3	1.2	64.0	1.1	61.4
Litharge		0.5		0.2		0.1		0.4		0.2
Lead Oxide	-		-		0.1	1.4	0.1	2.2	0.1	2.0
Red Lead	0.5	9.8	0.2	4.7	02	4.7	0.3	6.7	0.5	10.5
NaOH (Caustic Soda)	4.6	49.8	2.9	33.0	11.6	133.8	17.2	175.7	20.9	162.4
NaOH (aqueous Soln)	-	-	0.1	0.1	-	-	0.5	0.5		2.0
Potassium Hydroxide	0.2	3.4	0.3	5.1	0.1	2.6	0.4	7.3	0.3	6.2
Mag. Hydroxide	0.1	3.0	0.1	1.7	0.1	3.5	0.1	3.1	0.1	2.1
Al. Hydroxide	1.8	21.9	2.4	29.4	3.0	30.7	2.8	30.1	4.5	43.5
Artificial Corundum	0.1	1.6	0.1	2.5	0.2	4.2	0.1	2.5	0.1	3.2
Hydrogen peroxide	8.4	94.3	8.7	98.5	9.6	117.2	12.3	154.9	13.6	189.1
Sod. Dichromate	1.7	20.8	0.7	14.3	0.8	20.2	1.3	28.9	0.8	19.6
Pot. Dichromate	0.1	0.8		0.5	0.1	1.1	0.2	2.4	0.1	1.1
Calcium Carbonate	3.3	21.1	3.0	20.8	5.2	35.0	3.1	24.1	2.3	23.7
Sodium Sulphide	9.1	47.1	9.4	61.9	9.3	62.2	11.9	77.4	9.9	61.6
Total		**464.1**		**404.0**		**552.3**		**627.9**		**648.4**

Source: Khan (2003)

II. Domestic Challenges

Pakistan is being faced with multifaceted domestic challenges in its mining industry. One of these challenges is that Pakistan has undergone different epochs of political instability, since its inception as an independent State. Due to the continuous intervention of the armed forces in the political cycle, policies and systems have not received due attention (Fox, 2014). No mineral policy for extraction and beneficiation of minerals in the country was formulated till the 1990s. Pakistan's current legal framework for the mining sector consists of three different documents.

The first document is the 1948 Act of Minerals and oil gas Sector. Majority of the rules governing the upstream petroleum sector were made pursuant to section 2 of the 1948 Act. Another main purpose of the 1948 Act was to provide the basis for the legislation of the mineral resource industry, thus, providing the guidelines for many sectors in Pakistan. (Harianawala, 2014). The second document is the National Mineral Policy (NMP) 1995**.** Due to the growing interest of international mining companies in its mineral potential, it was imperative to legislate the mining and beneficiation activities. Some of the international projects in the mining sector were bogged-down due to inland legal disputes and weak contracting owing to non-implementation and absence of a solid policy framework. The neglect of the mining sector can be judged by the non-involvement of provincial ministers, chief ministers and prime ministers in the biannual meetings, which were specified by the National Mineral Policy 1995 as being mandatory (Dawn, 2012). The third document is the National Mineral Policy 2012, which was drafted and implemented in 2012 through a joint inter-provincial coordinated effort. The results are still awaited but there was no inclusion of beneficiation in this policy as well.

Infrastructure provides a pivot around which mineral extraction and beneficiation activities revolve. The provision of efficient and reliable infrastructure e.g. transport, road network, communication facilities and utility provisions, create an enabling environment for a successful growth process (Sajjad, 2012). So far, Pakistan does not have such supportive infrastructure to undergo capital-intensive ventures like Smelting, Solvent Extraction and Electro-Winning (SXEW) or Matting etc. See Table 4.

Table 4: Global Infrastructure Ranking.

Country	Transport (Rank)	Electricity and Telephony (Rank)	ICT (Rank)	Education (Rank)	Health (Rank)	Security (Rank)	Public Institutions (Rank)
Malaysia	14	48	57	91	52	48	32
China	29	69	74	93	71	68	46
India	35	116	117	109	109	89	72
Sri Lanka	52	79	100	89	61	59	49
Pakistan	80	126	111	126	111	137	111
Philippine	104	101	93	83	97	117	112
Benin	115	118	120	123	120	95	91
Bangladesh	117	137	132	118	107	103	112

Source: Adapted from Global Competitiveness Report (2014).

Furthermore, Pakistan does not have a dedicated Mining University for the production of skilled labour for the mining sector. However, The National University of Sciences and Technology took the initiative for capacity-building by starting a programme in collaboration with the University of the Witwatersrand, Johannesburg, South Africa. 7 students for Master in Science and Doctor of Philosophy were sent between 2012 – 2013 for necessary skill development, in order to start a mining school dedicated to mining and beneficiation of minerals in Pakistan.

Additionally, power shortage has been documented as being one of the most critical challenges to mineral beneficiation in the country, which appears to shave off 2% of Pakistan's annual GDP (Kazmi, 2013). Currently, Pakistan's installed capacity is 22,500MW but it is producing only 15,500MW. There are two main hubs of power generation in the country. One is hydro-electric, which is producing 6,500MW and the other is that of the IPPs (Independent Power Producers) producing almost the same capacity. The gap in power is due to the outdated power plants in the hydro-electric sector and the inability to buy the furnace oils on time, which interrupts the generation of full capacity of IPPs. Current deficiency in power generation is 10,000MW in peak summer season which has forced the power-generation companies to call for 12 – 16 hours load-shedding (Hasnain, 2014).

III. International Challenges

Pakistan is an ally to the international communities in the war on terrorism but at the same time, it is facing the terrorism the most. Pakistan is currently ranked 2nd after Somalia in terrorism

globally (Tribune, 2014). Kidnapping of foreign persons is another issue which has put Pakistan on 5th rank globally (Red, 2012).

Due to the security situation in Pakistan, foreign investors are reluctant to invest in the country. Unfortunately, all the minerals are located in the areas where the security situation is the most significant. Pakistan has suffered about 43,000 casualties since 2003 and loss of about US$ 85Billion till 2014 (Strachan, 2012). This loss does not include the potential foreign investments, which could have occurred if the situation in the country was peaceful. Additionally, with International laws not being encouraging for the beneficiation of minerals in the developing countries, this has posed further challenges to Pakistan. As progress is made in the value chain towards beneficiation, the charge of constant nominal tariffs impose a bias against less developed countries (in that sector) (Yeats, 1981). Imposition of the tax on exports of scrap metals such as Copper and Zinc will further add to the unattractiveness of Pakistan's mineral industry. Hereto, Pakistan has to face the international market forces in order to plan for efficient beneficiation within the country for local consumption. With Pakistan having the fastest urbanization rate in Asia, in order to facilitate local consumption and support the urbanization, it has to look forward to address these challenges.

IV. The way forward for beneficiation in Pakistan

It has been mentioned previously that Pakistan is blessed with diversified mineral base coupled with supporting energy minerals. Despite this, the Country has been facing acute shortage of power generation since 2006, which is significantly needed for the extraction and beneficiation of its minerals, amongst other things (Kazmi, 2013).

World Bank has reiterated that the critical dearth of water, power and transport infrastructure has prevented Pakistan from extracting any minerals in large scale (Ahmad, 2013). This has placed Pakistan in a struggle to overcome the infrastructural issues faced by the country. Since 1996, the road infrastructure has improved by 13% to distance coverage of 259,618 kilometers, out of which 179,290 kilometers is of high grade. The national highways and motorways in Pakistan constitute 4.2% of total network and carry 85% of the country's traffic. The National highway Authority has recently increased its toll charge by 36% to make provision for increased maintenance. 30 new projects bringing an increase of a 1,000 kilometer road network would be added (Ahmad, 2013). Pakistan is also improving its rail infrastructure with route coverage of 8,775 kilometers. This will significantly enhance the dependency of mineral- based beneficiation on reliable and swift transportation of finished products.

Also, due to the lack of a transparent, equitable and efficient mineral policy, mega extractive and beneficiation projects have not yet started. Antofagasta-Barrick Gold debacle was the clear indication of a lack of clear policy and implementation (Jawwad, 2012). As per the terms of agreement, the government of Baluchistan (a Province of Pakistan) was expected to take 25% of the total agreed revenues while the company was to take away 75% of revenues. However, after the deal was signed, the government refused to permit the company to carry out its operation. After the Antofagasta-Barrick Gold debacle, Pakistan has been taking a serious look at forging a way forward for mineral beneficiation in the country.

At the moment, in order to address the non-readiness of Pakistan for mining and beneficiation, it is currently at phase 1 and 2, where formulation and implementation of sector policies is top priority. By developing infrastructure such as communication, transport etc. within the province, this would further enhance the opportunities for beneficiation (see Figure 2). After 1990, the process of policy-making has been at a faster pace. So far, the 2nd National Mineral Policy was made and implemented in 2012. Its aim was to address all the issues faced by the country in policy matters.

To address the power shortage problem, Pakistan has undertaken the UCG (underground coal gasification) project and the first UCG power plant was to start its production by December 2014 (Jabri, 2013). The expectation is that it will partially resolve the power issues that the country has been facing. Similar projects are expected to be undertaken at Thar coal project.

In developing an efficient beneficiation strategy for Pakistan, a model has been made to determine the 3 levels of beneficiation tactics that the country can adopt so as to benefit from its minerals (see Figure 2).

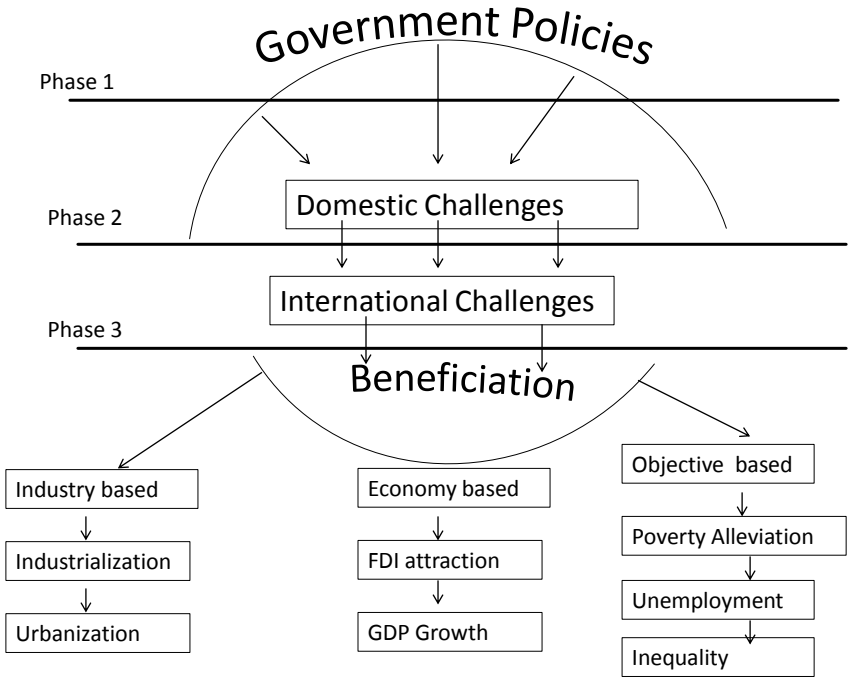

Figure 2: Beneficiation strategy model for Pakistan. Source: Asghar (2014).

Presently, Pakistan is showing eagerness towards realizing beneficiation of its minerals by addressing its phase 1 and 2 challenges (i.e. government policies and domestic challenges). In light of this, Pakistan's first mining school under the umbrella of National University of Sciences and Technology is expected to start functioning from 2015, with an average intake of 200 undergraduate students and 30 – 40 postgraduate students. It will not only address the skill shortage challenge, but also open the avenues for the research in mining industry.

V. Conclusion and Recommendations

Pakistan's numerous minerals can be extracted and beneficiated with sound planning and foresightedness. After the Barrack Gold debacle, the country has been showing eagerness in working towards realizing the beneficiation of its minerals. The Country is achieving preparedness of its mineral industry including beneficiation, by addressing the domestic challenges before planning of its beneficiation strategy. By developing infrastructure such as communication, transportation etc. the country will enhance the opportunities for beneficiation. Also, Pakistan should address the international challenges by adopting the level 1 and 2 strategies.

A Development corridor is essential for the beneficiation process to operate and Pakistan has a development corridor for Central Asian Republics (CARs) (Samange, 2014). Additionally, Pakistan has a natural harbor (Gawadar), which is close to the mineral deposits. By being strategically located around China, Russia, India and Central Asian Republics, Pakistan should explore the regional markets close to its origin. By this way, it can control the prices of inputs as well.

The development of its beneficiation sector can turn Pakistan's economic instability to economic strength. The Country is already diversified in manufacturing and agricultural sectors, therefore, its mining and beneficiation industry will have limited chances to result in to resource curse or Dutch disease. Pakistan should promote regional integration as part of its beneficiation strategy. By addressing all the local and international challenges we can adopt the beneficiation road which will lead to economic and social growth.

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