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Coal, energy and the environment in Pakistan

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ABSTRACT: *Some major policy initiatives and decisions are needed to encourage the mining and utilization of indigenous lignitic quality coal resources of the country, particularly recently discovered Thar Parker mega-coal-deposits for power generation through investment by the private sector. As future coal utilization in the country is expected to rise manifold replacing petroleum products. This makes it mandatory for the environmental protection Agency of the country to formulate rules and regulations and strict controls for preserving the ambient air quality to protect the ecological-system and human health, in and around the mining areas.*

INTRODUCTION

In the past, and still Pakistan continues to be depended almost totally on oil imports. The need for developing indigenous energy resources to reduce the dependency and perpetual uncertainty in the world oil market, was first recognized during the oil crisis of 1973, when oil prices jumped to record level and put tremendous strain on the national economy. The second oil crisis of 1980 further strengthened the governments resolve to explore and develop its own energy resources for use in power generation. Besides natural gas from Sindh, Balochistan and Punjab and crude oil from Sindh and Punjab, an increase in the utilization of coal is now a regular feature in Pakistan's energy plan.

Currently, coal accounts for approximately 5 to 6% of the commercial primary energy demand, rest of the energy demand is met by as follows: indigenous and imported oil 40%, natural gas 35%, hydel 17% firewood 2%. The share of coal in commercial energy requirements at the time of independence was about 60%, and with the discovery of natural gas in the following years, gradually replaced coal utilization, confining the use of coal to the brick kiln industry and domestic use only. But successive energy crisis have prevailed upon the planners to devise energy strategies for using indigenous resources. Therefore, in the future, the share of coal is expected to increase further to become a major fuel for power generation.

The first test of this resolve in Pakistan will be initiated with the commissioning of the WAPDA's three 50-MW coal-fired units based on Lakhra coal in Sindh. Dong Fong Electric Corporation of China is in the final phase of construction of these three units, which are geared to use the fluidized bed combustion technology, most suited for the high sulfur Pakistani coal. The price of using coal as a cheap fuel with large domestic reserves and a stable international price is however, not free from environmental degradation. Besides land surface disturbances, excessive dust concentrations and contaminated mine drainage, coal burning for power generation and industrial uses releases emissions that contributes to respiratory problems, damage to vegetation, acid rain and green house effect.

However, proper planning, data collection, reclamation and restoration of the mining areas can help to drastically reduce the environmental degradation problems attached with coal mining. But Pakistan's energy needs now have reached a serious crisis level and with fewer alternate energy option available, the indigenous energy resources need to be utilized with updated technology, planning and management techniques, which had been consistently ignored until now.

COAL RESOURCES AND UTILIZATION IN PAKISTAN

Coal resources and quality

The estimated resources of coal in Pakistan are approximately over 90 billion short tons from 27 deposits (Fig. 1). The largest deposits are located in the Thar Parkar desert in the south-east of Sindh province and have alone estimated to be about 80 billion short tons (USGS Coalreap exploration source, 1993; also see

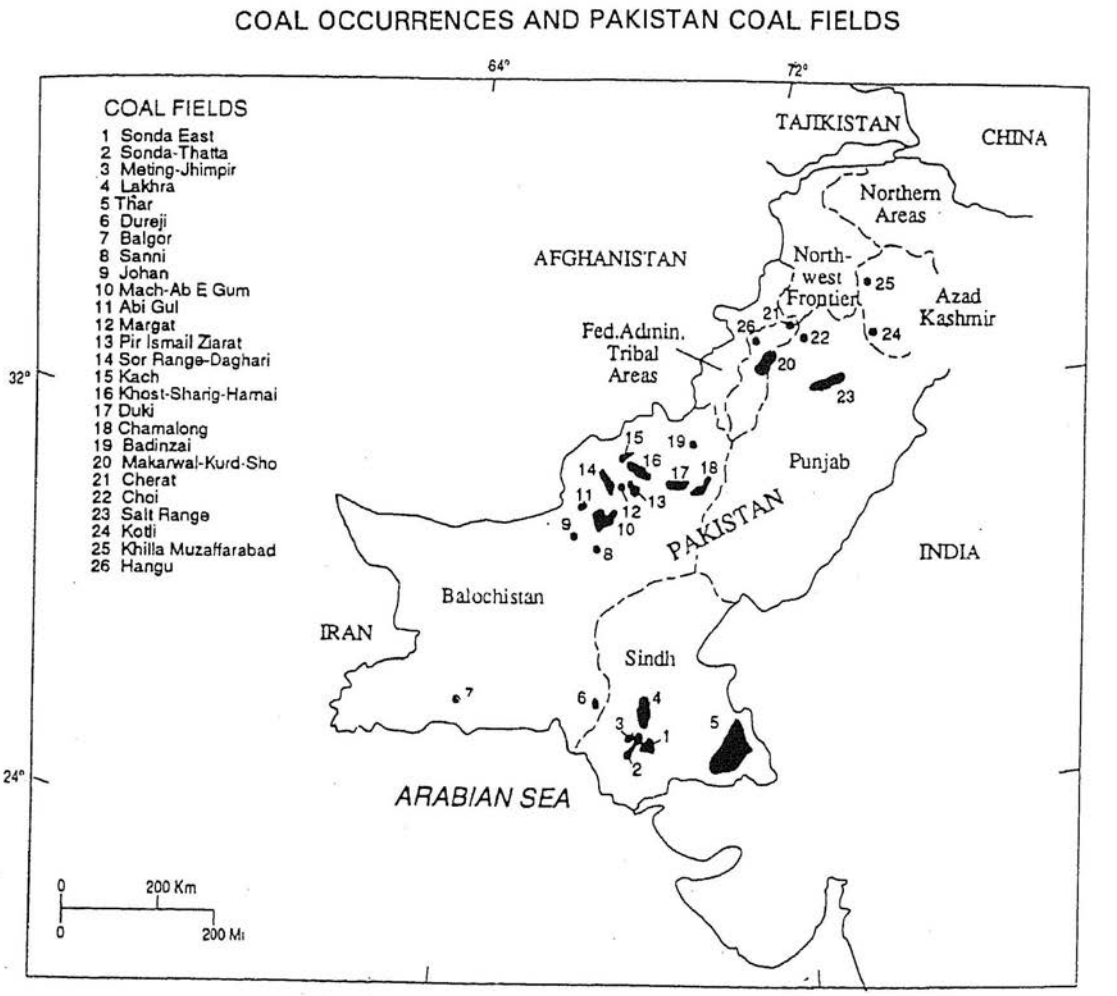

Fig. 1. Coal occurrence and Pakistan coal fields.

Fassett & Durrani, 1994). Most coal found in Pakistan is low-quality lignite and sub-bituminous. The Lakhra-Sonda-Jherruck-Thatta and east of Indus coal (Kazmi et al., 1990) has a fixed carbon from 26 to 59%, volatile matter from 41 to 74%, moisture from 7 to 30% and ash from 2 to 45% by weight, where as Calorific values vary from 2000 to 4,450 Kcal/kg. However, proximate analytical data (Table-1) for more than 252 samples collected from five drillholes in Thar Parkar indicate that sulfur (on as received basis) vary from 1.03 to 2.13%, ash (on as received basis) from 7.59 to 13.46% and moisture (on as received basis) from 45.23 to 48.68%, which is significantly very high. The as Calorific values (on as received bais) vary from 5,185 Btu (2882 Kcal/Kg) 6,012 Btu (3,324 Kcal/Kg) and the dry and ashfree calorific values vary from 10,935 to 11,369 Kcal/kg.

Pattern of coal utilization in Pakistan

Currently, about 3 to 3.5 million short tons of coal is produced per year. Pakistan's coal mining at present is in following three major areas of the country: north eastern Balochistan (Sor Range - Degari, Khost - Sharig, Mach and Dukki); northern Punjab (Makarwal and Salt Range); southern Sindh (Lakhra, Sonda - Thatta and Jhimpir). The largest user of coal in Pakistan are brick kilns, consuming more than 90% of the coal production (Seventh Five Year Plan of Government of Pakistan 1988-93). Brick Kilns consumption is likely to grow at 4.8% per year, with total requirement of coal in 1992-93 intimated at 5.3 million tones (Planning Commission, 1988 -1993). Household consumption of coal has been varying between 1.3 to 2.0% and the share of coal in power generation is negligible (0.7%). This share of coal will be increased when a total of 150MW of coal based generation capacity will come on line during the Seventh Plan.

Coal supply

The supply of coal for domestic use comes from the indigenous coal fields in Sindh, Punjab and Balochistan. 15MW generation unit at Quetta, Balochistan is the only coal based utility in Pakistan. The supply of coal to this is met from the private sector and partly from the Sor Rang and Degari coal mines operated by the Pakistan Mineral Development Corporation (PMDC), a public sector organization, mandated by the government to develop various mining activities in the country. Coal production over the years has increased greatly along with the increase in domestic demand. But for sophisticated industries like Pakistan Steel Mills at Karachi, high-quality coal, which has less sulfur and high heating values, is needed. As the indiginous coal does not satisfy the technical requirements, therefore, high coking coal is being purchased from Australia to meet the special requirements of furnace and large industrial boilers of Pakistan Steel Mills.

Future coal utilization

Domestic consumption of coal is expected to increase in the future, especially in the power sector, followed by conversion of cement plants and coal briquatting to substitute for imported kerosene and scarce supply of indigenous fuelwood. Water and Power Development Authority (WAPDA) as envisaged in the Seventh Five Year Plan, plans to establish large-scale power plants at or near the major coal fields to meet the growing electricity demands, and the share of coal used for electricity generation will increase to replace petroleum products.

Coal consumption in the cement industry is also projected to increase due to expected high growth rate in this sector and government's policy will be to encourage cement plants to convert to coal based, subsituting the use of furnace oil. But this will only be possible after

TABLE 1: TOTAL-COAL ANALYSES FOR THE PARKER TEST HOLES

Hole Number	Total Coal thick-ness	No of Samp-les	Analyti-tical Labora-tory	AR Sulf	AR Ash	Ar Moist	Ar Btu	Dry Btu	Daf Btu	DAF Vols
TP-1[2]	18.86	24	Geo. Test	1.47	8.57	43.47	6,012	10,704	12,514	56,58
TP-2*	No Coal	—	—	—	—	—	—	—	—	—
TP-3	27.22	36	Geo. Test	1.03	7.59	46.07	5,334	10,342	12,057	55.32
TP-4[3]	10.49	17	GSP	2.13	13.46	45.23	—	—	—	60.17
TP-5	13.40	19	Geo. Test	1.11	10.16	48.48	5,185	10.144	12,496	65.97
TP-6*	No Coal	—	—	—	—	—	—	—	—	—
TP-7	16.24	21	FRC/PCSIR	1.81	10.12	48.63	5,210	10,375	12,535	59.82
TP-8	16.9	17	FRC/PCSIR	1.2	7.6	49.4	5,276	10,465	12,230	60,09
TP-9	27.1	37	FRC/PCSIR	0.91	9.79	46.98	5,163	9,987	11,910	57.00
TP-10	23.1	33	FRC/PCSIR	1.4	8.68	47.21	5,453	10,417	12,322	61.02
TP-11	4.7	05	FRC/PCSIR	0.57	5.53	50.59	5,416	10,958	12,339	60.07
TP-12	25.5	32	FRC/PCSIR	1.27	6.99	48.11	5,400	10,437	12,043	60.52
TP-13	13.7	17	FRC/PCSIR	1.47	10.03	49.37	4,816	9,558	11,841	59.13
TP-14	7.7	05	FRC/PCSIR	2.65	8.61	39.96	8,798	10,066	11,910	58.25
TP-15	13.3	15	FRC/PCSIR	1.79	8.93	38.34	8,479	9,778	11,548	59.12
TP-18	0.6	01	FRC/PCSIR	081	8.84	36.33	8,888	10,236	12,084	63.62
TP-19	2.83	03	FRC/PCSIR	1.50	9.11	—	9,284	10,559	12,503	58.53
TP-20	2.6	03	FRC/PCSIR	1.54	9.19	49.5	5,071	10,070	12,271	60.09
TP-22	9.1	11	FRC/PCSIR	1.69	7.36	46.47	8,674	9,961	11,613	57.77
TP-23	2.0	02	FRC/PCSIR	2.12	9.99	36.21	7,050	8,066	11,419	61.00
TP-24	606	NS	FRC/PCSIR	—	—	—	—	—	—	—
TP-25	1.70	03	FRC/PCSIR	1.98	6.03	44.67	9,179	10,450	11,921	59.84
TP-28	4.9	06	FRC/PCSIR	1.64	6.52	33.43	8,884	10,129	11,546	59.85
TP-30	1.52	02	FRC/PCSIR	1.50	6.9	46.89	8,565	9,705	11,375	57.45
TP-31	4.61	05	FRC/PCSIR	3.58	10.17	34.13	4,846	7,773	9,552	45.27
		Total		0.57	6.03	33.43	4,816-	2,773	9,552	55.32
		Samples		—	—	—	9,284	—	—	—
		312		3.58	13.46	50.59		10,958	12,535	61.02

(AR = As Received; DAF = Dry and Ash Free, Btu = British Thermal Unit; Vols = Volatile matter; * = Drill hole ended in granite)

Source: USGS/GSP COALREAP program. Data updated by N.A. Durrani on January 17. 1994

[1]Only includes coal beds that were sampled and analyzed.

[2]Some coal samples dried out before wrapping in plastic bags, thus the average Btu values may be too high.

[3]GSP's calorimeter broke down so Btu values for these samples are still pending.

NS = No sampling.

overcoming the constraints of high sulfur in the indigenous coal and the problems of availability of supply of consistent quality and quantity of coal. Because, the low quality of local coal with its low calorific value, high ash content and high moisture content limits it use to particular types of energy-consuming equipment. Fluidized-bed combustion technology now ready to be put into commission for power generation in Lakhra (South Sindh) coal fields, if successfully managed, will open up a new horizon in Pakistan and will tremendously boost the coal-based power generation program in the country.

INSTITUTIONAL ARRANGEMENTS FOR COAL-RELATED ACTIVITIES

(PMDC), Lakhra Coal Mining Development Corporation (LKMDC) in Sindh and few other provincial government agencies such as Punjab Mineral Development Corporation (Punjmin) in the Punjab province and the Sarhad Development Authority (SDA), are involved in coal development in these provinces of the country. The national policy on coal resources is set by the Federal Energy Policy Board. The Mineral Coordination Board in the Ministry of Petroleum and Natural Resources acts as its coordinator to ensure that any investment of the government and state enterprises are in line with the energy policy of the country, and also liaises with related organizations, to conduct research on coal and to give advice on matters related to the exploitation of coal resources.

At the working level, the Geological Survey of Pakistan (GSP) is responsible for primary exploration and evaluation of mineral resources in the country. However, each provincial government is responsible for granting licenses for exploration and mining to appropriate applicants. The provincial inspectorates of mines are mandated by each provincial governments for enforcing all the provisions of the mining laws and for implementing relevant mining regulations.

The government agency concerned with environmental issues is the Ministry of Environment and Urban Development. Environmental Protection Agency (EPA), within the above ministry is responsible for environmental protection in all regions of Pakistan. EPA has been mandated to oversee the environmental impact of various mining and other industrial projects. It also establishes national standards for ambient air quality and surface water quality in all regions of the country and deals with pollution discharges from industrial plants.

THE IMPACT OF COAL PRODUCTION AND CONSUMPTION ON THE ENVIRONMENT

Environmental standards

It is envisaged that the coming years will witness a major breakthrough and flurry of activities in the coal mining sector in Pakistan. Mining activities in mega size Thar Parker Coal fields, is bound to generate environmental impact in every step of the coal cycle, from production to utilization. The main areas where the environmental impact will mostly be visible, includes land surface degradation, dust concentration and contaminated mine drainage. The utilization impact includes air pollution and solid waste disposal. To pre-empt the imminent danger of uncontrolled and hazardous mining and utilization of coal, the government needs to develop advanced inspection techniques, and efficient air pollution field enforcement, with regular atmospheric sampling combined with combustion evaluation. To prepare a comprehensive package for environment control in the country, the government needs to initiate and establish the following:

— Legal authority: federal, provincial, administrative, law, regulation and agency.

— Field enforcement: the role of the inspector.
— Principles of ambient air sampling and analysis.
— Criteria pollutants and reference methods for their measurements.
— Elements of air quality surveillance network.
— Standards and criteria: Clean Air Act and implementation plans.
— Legislative and judicial developments related clean mining environment.
— Meteorological and topographical factors affecting pollutant dispersion.
— Emission regulations.
— Source sampling of air pollutants.
— System for control of pollutant emission.
— Inspection report/documentation.
— Elements of a good safety program.

As a result of Pakistan's strong desire for economic growth and industrialization, the country's energy demand will continue to grow rapidly in the near future, and coal should be able to play a bigger role as an energy source for domestic consumption. However, the greater role of coal in energy consumption will also result in large scale increase in dust emmissions, if proper environmental controls are not maintained. Therefore, to prevent more serious environmental problems it is necessary to incorporate some of the above criteria in the regulatory system of the country's environmental legislation.

CONCLUSIONS

The environmental impact and future of coal utilization in Pakistan

Presently the environmental problems from coal production and utilization in Pakistan are not very serious compared to those in other countries. This may be attributed to the fact that most of the coal mining in Pakistan is done by the private sector on small leases, with the help of seasonal labourers. Coal consumption is also not very high. Private brick making plants over the country are the main customers for using the bulk of this production from the private sector mining.

However, it is expected that in the coming years, the conditions for the coal consumption will substantially increase. Government of Pakistan is driving hard on the privatization policy in the power generation sector and the encouraging the private sector for investment. With liberal reforms and incentives in the coal mining sector, production and consumption of coal for industrial power generation will increase..

The major finds of Thar Parker mega coal deposits is expected to play a vital role in the future national energy plan. Uncertain geopolitical conditions and ever changing oil prices combined with other factors have impeded the industrial growth in Pakistan. The popular demand for exploiting the indigenous resources for power generation, can now be made to come true, through good quality coal from Thar Parker desert located in the south east of Sindh province.

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