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Coal and hard rock resources in Bangladesh

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Previously it was assumed that the geological setting of Bangladesh was more suitable for hydrocarbon accumulation than any other minerals, as major parts of the country are covered by thick alluvium. Now, it has been proved by geological and geophysical exploration that Bangladesh has huge deposits of coal and hard rock in its NW region. Total reserves of about 1,753 million tons of high-quality bituminous coal have been reported from three coal fields—Jamalganj, Barapukuria, and Khalaspir—and a huge reserve of hard rock from Maddhyapara. Proper development of these mineral resources will open a new era for Bangladesh to enter the industrial world. It is expected that extraction of about 70 million tons of coal will be possible from the Barapukuria coal field. From the Maddhyapara hard rock mine, about 1.65 million tons of hard rock can be mined each year. Full-fledged exploitation of these mineral resources will create thousands of new jobs at the mine site and later on in the industrial sectors. It will also help Bangladesh to save considerable amounts of foreign currencies, which will contribute a great deal to the national economy, and thus improve the socio-economic infrastructure of the country.

Introduction

Availability of natural resources and their proper application to overall development activities is the key factor for the economic growth of any nation. Bangladesh, though it is a small country of about 143,998 sq km, has a number of mineral resources within its territory. The mineral resources so far discovered are mineral fuels (oil, gas, coal, peat), hard rock, limestone, white clay, glass sand and heavy mineral sands. It was previously assumed that the geological setting of Bangladesh was more suitable for hydrocarbon accumulation than for any other mineral deposits as the greater part of Bangladesh is covered by thick alluvium. Nowadays, the assumption has been changed as it is proved by detailed geological and geophysical explorations that Bangladesh is rich not only in hydrocarbon accumulation but that it also has huge deposits of coal and hard rock in its north-northwestern part.

Coal and hard rock deposits

Coal: High-quality bituminous type Gondwana coal of Permo-Carboniferous age has been discovered at five places—Barapukuria, Dighipara and Phulbari in Dinajpur district, Khalaspir in Rangpur district and Jamalganj in Bogra district. Besides these, coal is also recorded from Kuchma in Bogra and Maddhapara in Dinajpur dis-

trict. All these coal fields are located in the north-northwestern part of the country.

The Jamalganj coal field, discovered by the Geological Survey of Bangladesh (GSB) in 1962, is the largest deposit in the country, with probable and proved reserves of 1,460 and 1,053 million tons, respectively. The coal field covers an area of 11.66 km². The number of coal beds is 7, the average thickness of which is 64 m. But the coal seams lie at a considerable depth of 640–158 m, the extraction of which is not economically feasible.

The Barapukuria coal field in Dinajpur district and the Khalaspir coal field in Rangpur district were also discovered by the GSB in 1985 and 1987, respectively. The Barapukuria coal field covers an area of 5.25 km². The coal is at a shallower depth of 116 m and coal beds extend to a depth of 506 m. The number of coal seams is 6, the average thickness of which is 51 m. The probable reserve of coal is about 389 million tons. But reserves of 300 million tons have been proved by Armstrong (1991).

The Khalaspir coal field occupies an area of about 12.26 km² and the coal bed occurs at a depth of 257 m, and the coal layer extends to a depth of 483 m. The number of coal beds is 8 and their average thickness is 42.30 m. The probable and proved reserves are 685 and 143 million tons, respectively (Islam et al., 1997).

The coal fields of Dighipara and Phulbari, in Dinajpur district were discovered in 1995 and 1997 respectively by GSB and BHP, an Australian company working in Bangladesh. At Dighipara, coal is

Figure 1 Coal and hard rock deposits in Bangladesh.

Table 1 Details of coal fields of Bangladesh.

Coal fields	Years of discovery	Discovering organizations	Depth of coal bed (m)	Number of coal beds	Average thickness of coal bed (m)	Type of coal	Area of coal fields (km ²)	Reserves in million tons	Remarks
Phulbari (Dinajpur)	1997	BHP	150		38.41	Bituminous		Not yet Determined	
Dighipara (Dinajpur)	1995	GSB	328		42.00	Bituminous		Not yet Determined	
Khalaspir (Rangpur)	1989	GSB	257–482	8	42.30	Bituminous	12.26	400	Mining is under consideration
Barapukuria (Dinajpur)	1985	GSB	116–506	6	51	Bituminous	5.25	300	Mining work is going on
Jamalgonj (Bogra)	1962	GSP	640–1158	7	64	Bituminous	11.66	1053	Extr. of Methane Gas is under consideration
Kuchma (Bogra)	1959	SOVC	2380–2876	5	51.82	Bituminous	Not recorded	Not recorded	

(Source: GSB, Petrobangla)

recorded at a depth of 328–422 m and the overall thickness of the coal layer is 42 m. In the case of Phulbari, coal is recorded at a shallower depth of 150 m and the overall thickness of the coal layer is 38.41 m (Rahman, 1997). The extension of coal field areas and the reserves of coal have not yet been determined.

The Gondwana coal of bituminous type was first recorded in this country in the Kuchma area in Bogra district in the same region by SVOC in 1959. The coal beds lie at a depth of 2381–2867 m. The number of coal beds is 5 and their average thickness is 51.82 m (Rahman, 1997). The area of the coal field and its reserves have not been determined, as coal extraction has not been considered economically feasible from such a great depth. Since then, work by geoscientists to find other prospective zones resulted in the above described economically viable coal fields. Some more prospective areas for coal have been pointed out in the same region, i.e. in the northwestern part of the country, which need to be explored. The locations and details of the present coal field of Bangladesh are shown in Figure 1 and Table 1.

Coal of the lignite type is reported from the districts of Bandarban, Netrokona and Sunamganj, the economic feasibility and reserves of which are yet to be ascertained. Peat deposits of economic value, though not as valuable as coal, have also been found in a number of places such as Madaripur, Khulna, Moulvi-Bazar, Sunamganj and Brahmanbaria. Extraction of peat is going on from the Madaripur and Khulna peat fields. Peat occurrences are also reported from many other districts, including Dhaka city. The reserves of peat in Bangladesh are about 470 million tons (Hussain, 1995).

Hard rock: An unlimited reserve of hard rock consisting of granodiorite, quartzdiorite and gneiss of the Pre-Cambrian has been discovered at a shallow depth of 128 m in Maddhapara in the Dinajpur district. Pegmatite, pyrite, chalcopryrite and siderite have been observed in the vicinity of granodiorite, quartzdiorite and gneiss. Hard rock deposits are also recorded in Ranipukur and Pirganj in Rangpur district at a depth of 171 m and 265 m respectively, and from Bogra, Joypurhat-Jamalgonj, and Kansat of Rajshahi district at depths of 2,150 m, 600–667 m and 615 m respectively (Rahman, 1997).

Besides these, there are surface deposits of construction materials such as boulders, gravels etc. at Tetulia-Panchagarh in Dinajpur district; Kaptai-Alikadam-Ukhia-Teknaf-St. Martin's Island in greater Chittagong district and some other places in greater Sylhet district.

Mining development of coal and hard rock

With the assistance of Petrobangla (BOGMC- Bangladesh Oil, Gas and Mineral Corporation), an advisory organization of the UK, Wardell Armstrong carried out a feasibility study of coal in the Barapukuria coal field in Dinajpur, and confirmed 6 coal beds within the depth range of 116–506 m having an area of 5.25 km² and reserves of 303 million tons of high-quality bituminous coal, the extraction of which is economically feasible. It was also assured that it will be possible to extract one million tons of coal per year and it will be continued up to 64 years. And on the basis of this study, Petrobangla initiated a project named 'Coal Mine Development Project' with a total estimated cost of US\$ 203 million, including US\$ 160 million in foreign currency, in March 1993. Later on, to implement this project a contract was signed on Feb. 1994 by Petrobangla on behalf of the Bangladesh Government and CMC (China National Machinery Import and Export Corporation) on behalf of the Chinese government at a total cost of US\$ 197 million, including foreign currency of US\$ 172 million from CMC.

Mining work has been going on since June 1994, and it is stated that 5 years will be required to complete the project. It is now hoped that from 1999 partial, and from 2,000–2,001, full-fledged extraction of coal will be possible on a commercial basis.

The exploitation of coal from the Khalaspir Coal Field, which is also economically feasible, is under consideration, and negotiations are being held with some foreign countries to procure funds to carry out mining work. From the Jamalgonj coal field, according to some experts, methane gas can be extracted from coal beds, but exploitation of this coal is not possible because it is too deep to be mined economically. Bangladesh is seriously considering extraction of methane gas from this field. There are more deep-seated coal fields which may be prospective for methane gas but further detailed studies are needed.

To extract hard rock in the Maddhapara area of Dinajpur district, another mining contract was signed on March 1994 by Petrobangla and the South-South Cooperation Corporation (Nam Nam) on behalf of the governments of Bangladesh and North Korea, respectively, at a total cost of US\$ 153 million, including US\$ 116 million in foreign currency provided by North Korea. At present, mining development is ongoing, and 6 years will be required to com-

Table 2 Mining development of coal and hard rock in Bangladesh at a glance.

Barapukuria Coal Mine Project	Maddhapara Hard Rock Project
Mining Contract Signed in March 1994 between Petrobangla (Bangladesh) and CMC (China)	Mining contract signed in March 1994 between Petrobangla (Bangladesh) and Nam Nam (North Korea)
Total Cost :US\$ 197million US\$ 172 million in F.C. US\$ 25 million in L.C.	Total cost : US\$ 153 million US\$ 116 million in F.C. US\$ 37 million in L.C.
Mining work started in 1994	Mining work started in 1994
Time required to complete work is 5 Years	Time required to complete the work is 6 years
Initial extraction will start in 1999	Full-fledged extraction from 2000
Full-fledged extraction from 2000–2001	Expected annual production is 1.65 million ton
Expected annual production is 1.2 million tons	Market price is US\$ 47.18 million
Market price is US\$ 90 million	Annual production cost US\$ 13.71 million
Annual production cost US\$ 40.8 million	Foreign currency worth US\$ 33 million will be saved per annum
Foreign currency worth US\$ 45 million will be saved per annum	After a few years, the expected rate of extraction will be 2 million tons per year
64 years will be required to extract 300 million tons of coal at the above rate	Extraction will continue for 64–70 years at the above rate
Several thousands of new jobs will be created both on the mining site and later on in industrial sectors	Industries will develop and thousands of new jobs will be created on both mining and industrial sites
10,000–15,000 people will benefit through employment directly or indirectly	10,000–15,000 people will benefit through employment directly or indirectly

(Source: Petrobangla and daily news papers)

plete the project. After three years of starting mining work i.e. from 1998, partial, and from 2000, full-fledged extraction of hard rock will be possible. The mining development of coal and hard rock is shown in Table 2.

Benefit to the national economy

The total reserves of coal of the three coal fields discovered at Barapukuria, Khalaspir and Jamalgonj, respectively is 1753 million tons.

From 2000–2001, full-fledged extraction of coal from the Barapukuria coal mine will start, and the target of extraction of coal per day is 3,300 metric tons i.e., 1.2 million tons per year. At the above rate, 64 years will be required to extract 300 million tons of coal from Barapukuria. As Barapukuria coal is of a high quality bituminous type, having a heating value of 11,040 BTU/lb with low sulfur content, it is good for combustion to produce power. In power generation, 80% of the coal will be used for this purpose, and there is a

plan to build a power plant with a 300 MW capacity at the village of Sherpur near the Barapukuria coal field. As a result, the electrification problems of northern Bangladesh will be solved, and both industrial and agricultural sectors will benefit from electrification. The remaining 20% of the coal will be used in brick fields and for household purposes. The qualities and various uses of coal are shown in Tables 3 and 4.

At present, most of the people of Bangladesh use wood and other plant materials to generate energy, and this causes deforestation and destruction of wild life, which are great threats to the environment. All these are again responsible for the imbalance of the environmental ecosystem. Not only that, drought, created by deforestation, affects agricultural land, and continuation of this may ruin the national production. Proper utilization of coal from Barapukuria will solve the energy problems and at the same time will help to stop wide-spread deforestation and keep the environmental ecosystem balanced, thus helping to upgrade the economic condition of the country.

Table 3 Characteristics of the coal in three coal fields.

Coal field	Carbon content %	Sulphur content %	Ash content%	Moisture content %	Volatile matter %	Heating value BTU/lb
Barapukuria	45.50–50.56	0.42–1.33	11.79–23.71	2.28–3.60	28.64–31.36	10,547–12,757
Khalaspir	32.09–80.81	0.24–3.15	7.60–50.57	0.33–5.99	3.73–28.86	14,224–15,168
Jamalgonj	36.7	0.65	24.25	3.58	36.72	11,872–12,100

(Source: GSB)

Table 4 Major uses of coal and hard rock of Bangladesh.

Coal	Hard Rock
<ul style="list-style-type: none"> - Generation of power - Railway transportation - Domestic uses as fuel for cooking purposes - Various industrial uses for producing heat & raising steam - Brick fields to produce heat - Carbonization to produce coke, tar, etc. 	<ul style="list-style-type: none"> As construction materials for - Housing apartments - Commercial buildings - Roads & Highways - Bridges, Dams, River Dykes - Embankments, Flood control - Railway ballast and sleepers - Decoration pieces - Tiles, etc.

At present, annual imports of hard rock are about 1.8 million tons and it is expected that 1.5–1.8 million tons of hard rock will be produced annually from the Maddhapara mine, which means 5,000–6,000 tons per day (Chowdhury, 1994). It can be said that Bangladesh will be self-sufficient in hard rock if the mine functions at full capacity. It is also hoped that sufficient granite can be mined for export. To meet the present demand, a major part of the stone used is imported from outside the country. The target of initial extraction of hard rock from the Maddhapara hard rock mine is 1.65 million tons per year. After a few years of initial extraction, it is expected to extract 2.0 million tons of stone per year. As there is a huge deposit of hard rock, it is also expected that it will be possible to extract this rock for about 64–70 years at the above rate.

These two projects will bring a remarkable change to the national economy of Bangladesh. Not only that, these projects will provide more than 30,000 new jobs opportunities both at mine sites and later on in industrial sectors which will also bring substantial benefits to the national economy.

Hard rock from Maddhapara will be used as construction materials to build housing apartments, bridges, roads, highways, dams, embankments, to control flooding and river erosion and will also be used as railway ballast, decoration pieces, tiles, etc. And the possible users of this hard rock are the authorities of Bangladesh Railways, Roads and Highways, Water Development Board, Power Development Board, and the Sea Ports, Housing and Settlement, and Local Government and Engineering departments.

Conclusion

The discovery of such huge deposits of coal and hard rock is a blessing for Bangladesh, and proper development of these resources will open a new era for the country to enter the industrial world. In the modern world, the sustainable economic conditions of any nation depend on how developed that country's industrial is, especially in the field of mineral resources. So, minerals based industries are an important factor for accelerating the economic growth of a country. Now, Bangladesh has an opportunity to build up mineral-based industries as she has sufficient mineral resources on which industries can develop. Full-capacity exploitation of these resources will create thousands of new jobs at the mine sites and later on at industrial sites, which will help to alleviate the country's poverty by providing jobs. All these together will accelerate the country's economic development. It may be concluded that proper development

and utilization of these resources will help us to save a considerable amount of foreign currency and will contribute a great deal to the national economy and reshape our socio-economic infrastructure.

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