BANGLADESH
NATIONAL CONSERVATION STARTEGY

ENERGY AND MINERALS

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1 INTRODUCTION

1.1 GENERAL

Natural resources had been from the historical times considered as input to productions and therefore extracted for the use to support economic growth and advancement of material welfare. They continue to play the same role but in recent times a few more roles have been recognized for them widely. For national economic and social development with increased emphasis on eradicating poverty we have to sustainably use mineral resources and primary energy sources we have within the reachable limits of our national boundary. All development efforts have economic, social and environmental dimensions for securing balanced and inclusive growth. Bangladesh is no exception in this respect and the energy and mineral resources available on and under the ground of our country contributes significantly for the development of our industries and infrastructure.

The growing demands for energy and mineral resources have significantly been increased with the growth of population, urbanization and with industrial developments. Extraction of resources has been increasing primarily to meet the growing demands and the finite reserves of energy and mineral resources have been declining fast. Now a days the rapidly declining natural gas resource (the major primary energy source of the country) threats economic growth of the country as more than 70% of the primary commercial energy supply solely rely on natural gas. Apart from the primary energy supply shortage, the rapid depletion of the major energy resource threats to forest and bio-diversity conservations. Extraction practices of other mineral resources offer no exception. Rather, the existing practices of economic interest dominated extraction of white clay, sand and construction stone care little about conservation of environment and people living in and around the mineral extraction sites.

Apart from the direct economic development aspirations, the services natural resources offer additionally are scenic values, support for outdoor recreation, biodiversity preservation and the preservation of meaningful natural heritage. So the conflicts between the extraction of natural resources and preservation have been emerged as the issues of major discourse. Extraction of mineral resources usually results in irreversible changes of natural resources assets. In our part of the world land uses are linked to agricultural preservation including for scenic, cultural and for food supply reasons. Therefore efforts have been made for slowing the process of converting land for its alternative uses. In view of the above, conservation of energy and mineral resources and securing their rational extraction and use have emerged as an important issue.

1.2 RELATIONSHIP OF THIS SECTOR WITH OTHERS

Energy and Minerals sector has direct links with our industries and infrastructural development and economic development sectors. Although not very aggressive but

continuous efforts have been made in our country to explore and assess new deposits and to develop resource for extraction. Various policies and regulations and institutional infrastructure have been established in the country to promote exploration and development of energy and mineral resources with environment care. But there are challenges to enforce the policies and regulations and to monitor their impacts on a regular basis for securing the sustainable extraction and environment conservation. The equity of benefit sharing from the extraction of mineral resource and utilization are not necessarily explained to the project affected people; as a result the national and local interests sometimes see conflicts. United Nations Sustainable Development Goals (SDG goals) for 2030 strongly propagates for a balanced and inclusive development initiatives. In view of this various regulatory and policy tools have been developed such as land zoning, conservation restrictions, limiting commercial and industrial activities in the sensitive areas etc.

1.3 ANALYTICAL CONTEXT WITHIN THE FRAMEWORK OF SDGs

United Nation member countries have adopted "Transforming Our World: The 2030 Agenda for Sustainable Development (SDG)" in September 2015 and a set 17 goals and 169 targets which are to be fulfilled within 2030. The agenda for SDG is a successor framework for the Millennium Development Goals agreed for the period 2000-2015. The goals and targets for SDG represent the agenda for equitable, socially inclusive and environmentally sustainable economic development of UN member countries.

Extraction of minerals and mining activities for extraction of beneficial minerals and primary energy resources usually are located in remote and less-developed areas in most of the countries. Mining activities create jobs, bring investment, enable infrastructure development, create opportunities for business and help improve livelihood, contribute to improve health and wellbeing of the people and development of the society. Thus the mining industry has an important role to play in the SDG agenda.

On the other part, mining and mineral resource extraction activities contribute to many of the problems that the SDGs are trying to address (for example, environmental degradation, carbon emissions, displacement of populations, worsening economic and social inequality, social and political conflicts, tax evasion and corruption, increased risk for many health problems).

From the experiences of global mining and extractive industries our country can understand the challenges of our time having relation to this sector. Our mining industry, be it small can use to assess the policies and actions of other mining countries, evaluate its partnerships, and scale up its efforts to incorporate many areas of sustainable development into its practices. Although our mining and mineral resource extraction industry is insignificant compared to many other mineral resource rich countries, but the already existing resource extraction practices offer similar problems and threats to environment conservation and social and economic conflicts among the mining companies and mine affected people. In the later part of this report we can elaborate some of the issues and challenges for SDGs and identify the action plans to address those issues.

The Perspective Plan for 2010-2021 and the Bangladesh government's vision commitments and continued efforts are targeted towards attaining poverty reduction and elevating living standards of the population. For proper implementation of the Sustainable Development Goals (SDGs) leaving no citizen deprived off, various action plans are being developed by the government for each target of the SDGs. The 7th Five Year Plan (2016-2020) is prepared integrating the SDGs by targets for equitable and inclusive economic growth with appropriate measures for protection of environment. Energy and mineral resources will play important role in attaining SDG goals (Goal 9 and also Goals 12, 13 and 15).

Following framework is used for updating the energy and mineral sector in the context of SDGs : Review the present status of energy and mineral resource sector. This includes among others a brief review of NCS document and its changes specially the developments in the sector since then in relation to extraction of resources their trends and impacts on environment.

The interventions (policies, regulations, institutional, budgetary allocations, adequacy of resources, resource depletion and extraction impacts on environment). List of policies and laws and rules related to the sector. Provide an analysis of the mandate and scope of the laws and regulations and the relevant institutions/government authorities responsible for their implementation. Gap analysis in the existing policies and institutional mandates for securing conservation of resources and addressing SDGs.

1.4 SCOPE OF THE REPORT

The existing sectoral status report is updated based on the SDG Goal 7 directly and indirectly on the Goals no. 12,13 and 15 in view of ensuring access to energy and mineral resources for sustainable and primary energy supply for all at an affordable price. Review the existing energy and mineral resource sector policies and regulations, programs and actions, their strengths and weaknesses.

Analyze the sectoral issues for conservation of resources and the changes due to human interventions in resource extraction practices; impacts and linkages with other sectors of natural resources, actions required for improving the energy and minerals conservations, ensuring diversity of resources for improving the primary energy resource supply, better practices for mining of minerals and minimizing environmental degradations.

1.5 DATA AND METHOD OF ANALYSIS

For updating of the energy and mineral resource section secondary sources of information has been used. In this process relevant policies and regulations related to the sector, experience of the sector specialists have been consulted. The action plan has been updated with addition and subtractions to focus on conservation and SDG goals.

On the positive side, the share of culture fishers has considerably increased in the recent years keeping the total annual fish production increasing over time. However, this has been due to the culture of a few commercial varieties such as shrimp, major carps, catfish, tilapia, koi and pungas. The situation is comparable to monoculture in crop-agriculture - the increasing volume of culture fisheries has so far contributed little in conserving the fish.

2 STATUS

2.1 CURRENT STATUS OF THE MINERAL RESOURCE SECTOR

Bangladesh is not very rich in mineral resources. The known energy and mineral resources of economic importance in Bangladesh are : natural gas, coal, peat, construction rocks (including stones and gravels found in river beds and the construction rocks deposited underground), sand, heavy mineral sand, white clay, glass sand and limestone deposits. However, extraction of mineral resources received limited importance except for natural gas. In the backdrop of limited economic activities, natural gas and insignificant volumes of imported liquid petroleum fuels met the demands for the country. But the primary energy demand and supply scenario has been changed since 2008. Growing demands for primary energy and its limited supply started impeding development pace. Diversification of primary energy sources has emerged as a major demand from industries and businesses. But the presence of a few alternative primary energy source including coal resource could not offer ready solutions. The coal sector development in the country received little policy and investment supports. Issues of environment conservation, land and water uses practically stopped coal development initiatives in large scale. At the same time, primary energy supply has been gradually becoming import oriented. Import based primary energy including coal utilization is no panacea either, as it has its economic, environmental and development challenges. In this backdrop it is important to understand the existing major primary energy and mineral resource status in the country along with their extraction issues.

Natural Gas

Natural gas resource is the major commercial primary energy in the country and it supplies more than 62% fuel for power generation. Natural gas is also the major commercial and industrial fuel source that represents approximately 74% share of commercial energy balance in the country.

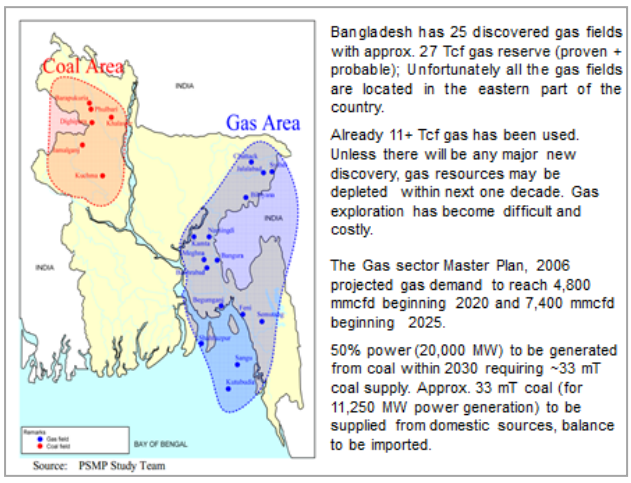


Figure 1. Major primary energy deposit map (locations of gas and coal fields in Bangladesh)

The available information suggests that the recoverable proven and probable gas reserve in the country is only 14 Trillion cubic feet (Tcf) as on June 2015. It is interesting to observe that the gas fields are located on the eastern parts of the country, on the contrary the coal fields are found in the western, north western part (Figure-1). The annual production from 104 wells stood 890.8 billion cubic feet (Bcf) was recorded in 2014-2015 financial year. There

are 26 discovered gas fields in the country and among them 20 gas fields are now in production. So far, the highest gas production record was established 2,786 million cubic feet per day (mmcfd) on 6 May 2015. But the demand and supply gaps have been increasing day by day as no major gas field was added to the gas producing stock. During 2000-2015 period a total of 8.26 bcf gas was produced from the existing gas fields of the country.

At the same time, a total of one tcf gas was discovered as an addition to the recoverable reserve of gas in the country during this period. Currently estimated daily gas demand is 3,200 mmcfd with suppressed demand forecast for industrial, commercial and domestic consumers. Responsible offices of the government admits that the domestic gas resources are depleting fast and the country's dependency on natural gas needs to be met from alternative sources.

Following discussions provides status (Source: Petrobangla official website) of daily natural gas productions from the existing wells, and distribution through different consumers. This table represents the natural gas productions from the producing wells and their distributions as on 08-09 March 2016.

In the backdrop of the rapidly declining recoverable natural resource reserve government has initiated a plan for enhance exploration efforts for oil and gas. As per the plans an ambitious ten drill oils per year for next five years will be drilled for securing discovery of new commercial gas resources. Bangladesh Petroleum Exploration Company (BAPEX) is expected to lead the exploration campaign for ten oil and gas drilling annually.

If implemented, BAPEX within 2021 should drill 108 drilling wells, including 53 exploration wells with a target to discover about 5.5 Tcf gas. Since 1908 (the first oil and gas well drilled in Bangladesh territory in Sitakund, Chittagong) till date 83 exploration wells were drilled in the territory of the country. After BAPEX was established in 1989, it could drill 8 exploration wells with 1.5 Tcf gas reserve. BAPEX has both shortages of equipment and material and of trained and experienced manpower to run at this stage the planned massive exploration drilling operations. So far BAPEX has not identified all of the exploration well sites. Also, extensive exploration drilling program if not properly managed may lead to wastage of valuable resources. The Haripur, Magurchara and Tengratila blow-outs have demonstrated how devastating could be an uncontrolled accident (blow-out) in oil and gas exploration. Such incidents in the recent past in our country shows the necessity for careful planning and implementation of good practices in oil and gas exploration. A race for rapid exploration for the search for new discoveries of oil and gas fields therefore demands carful techno-economic feasibility study, safe operational plans and mobilization of huge sources of risk capitals.

Oil and gas remain and will continue to be the major primary fuel source for power generation and for fueling economic development in our country. Mobilization of appropriate financing, advanced technology and trained manpower are important preconditions for successful exploration and exploitation of oil and gas resources and for their supply.

To achieve target 7.1 of SDG, to provide affordable and reliable energy to all, Bangladesh needs substantial financing for furthering exploration for oil and gas and coal resources and for their commercial productions. Allocation of Investment is required to enhance infrastructural and human development capacity addition with optimum fuel mix, sustained primary fuel supply for securing reliable electricity to all within the framework of government vision (2021) statement. It is indeed a highly challenging issue to arrange sustained supply of primary fuel for power generation as the energy sector is facing shortages of supply from indigenous natural gas resources, and uncertainty of development of domestic coal resources.

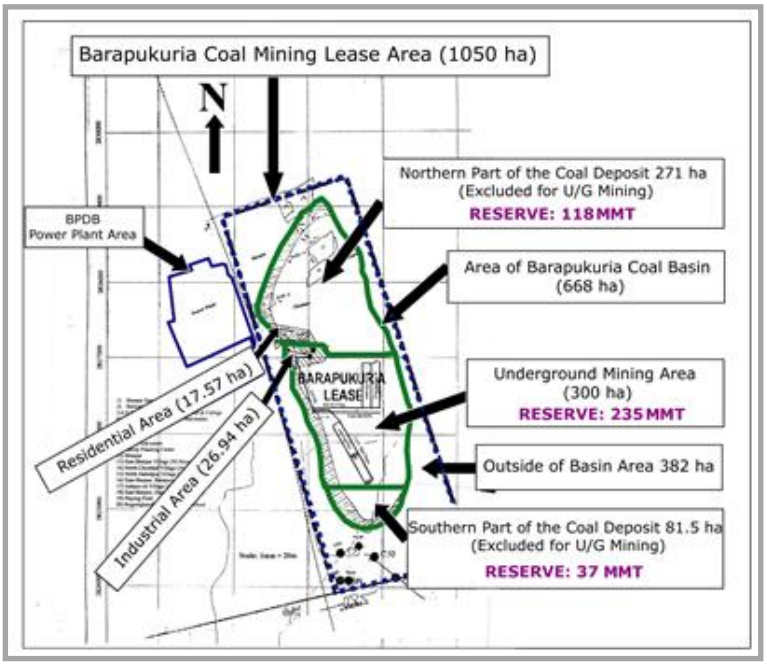
In the face of primary fuel supply constraints from indigenous sources, government has taken initiatives to import LNG in addition to liquid fuel oil and natural gas and coal for generating electric energy and for supplying to other consumers. In addition government decided to include nuclear power generation capacity development for 2400 MW within 2024 within a scope of government to government cooperation Agreement with Russian Federation. Also, electric energy has been imported from India. Further initiatives have been taken to import electricity from Nepal and Bhutan if their hydro-electric capacity development will allow to supply surplus energy to Bangladesh.

To achieve the target SDG 7.2, various initiatives have been taken to improve the use of renewable energy for power generation mainly from solar energy sources (presently renewable energy contributes for nearly 300 MW power generation from Solar Home Systems) Solar radiation induced renewable energy sources have been diversifying its use including for lighting, irrigation, communication devise charging, water heating etc. Government plans for more than 10 percent of total electricity generation and supply from renewable sources in the country by 2030.

Regarding the SDG target 7.3, Bangladesh needs to significantly improve energy efficiency (in both supply side and demand side) and energy conservation measures. Some endeavors have been initiated for energy efficient industrial technology development including the cogeneration. Some industries in textile and apparel sectors have been introducing cogeneration technology to reduce gas consumption and re-using the heat energy for multi-purpose uses in their industries. In addition, urea fertilizer industry like Shahjalal urea fertilizer factory, Jamuna urea fertilizer factory and Kafco have introduced advance technology for low consumption of natural gas for urea fertilizer production. Further fine tuning of integrated controlling system of urea fertilizer production system (advance process controlling system) will conserve significantly natural gas use. At the same time, age old urea fertilizer production factories and the old, inefficient single cycle power generation plants should be modernized, converted to fuel efficient combined cycle power generation plants and significantly reduce gas and fuel consumption not compromising the productions.

Coal

Since 2008 primary energy supply has emerged as one of the major challenges for power generation and industrial development of the country. The realization of the fact that the domestic natural gas supply sources has been shrinking and there is no guarantee for any major or easy gas resource findings in the near future compelled energy sector policy makers to look for alternative primary fuel supply sources. The national Energy Policy guides that the major portion of domestic coal is to be used for power generation in the west zone of the country.



'The Power System Master Plan, 2010 of the government of Bangladesh projects 50% coal based power generation capacity development within 2030. Bangladesh has five discovered coal fields namely Jamalganj, Barapukuria, Khalashpir, Dighipara and Phulbari in the north western part of the country. Primary estimate suggests that a total of approximately 3 billion tonnes of in-situ coal resources are deposited in the discovered coal fields. Among the coal fields Barapukuria coal field in Dinajpur district having an area of 668 hectares of land with 389 million tonne reserve has accommodated a small underground coal mine with an annual target production capacity of one million tonne (Fig. 2). The mine came into operation in 2005.

Jamalganj coal field was discovered in 1962 in Jaipurhat district and contains more than one billion tonne (1053 million tonne) of coal within 11 sq. km area at the depth varying from 640-1158 m. During the exploration campaign carried out by UN-Pak Mineral Survey Project a total of 11 holes were drilled there confirming the presence of 7 bituminous coal seams in the Jamalganj coal field. The coal quality analysis shows that Jamalganj coal contains moisture -3%, Ash-20%, Volatile Matter- 32%, Sulphur-0.52% and the average calorific value of 5835 Kcal/kg. Jamalganj coal if mined can be used as good quality steaming coal for generation of heat and electric energy. Jamalganj coal field has the potential for Coal Bed Methane (CBM) production. A British Geological Survey study in 1997 indicated such a potential and Petrobangla with the assistance of Indian Mining Associates has been investigating the CBM related study in Jamalganj coal field now.

Barapukuria coal field in Dinajpur district was discovered in 1985 by Geological Survey of Bangladesh followed by a Feasibility study carried out by the British Wardell Armstrong for developing an underground coal mine in 1991. A total of 33 drill holes were drilled in the coal field which confirmed 6 bituminous coal seam presence within the depth range of 118-509 meters below the surface. Later Petrobangla signed a contract in 1994 with Chinese CMC consortium to develop an underground coal mine with annual one million tonne coal production capacity there. The coal analysis confirmed coal composition with : Moisture-10%, Ash-12.4%, Volatile Matter-29.2%, Fixed Carbon-48.4% and Sulphur-0.53% and calorific value of 6,135 Kcal/kg. Barapukuria Coal Mining Company Ltd, a subsidiary of Petrobangla obtained mining lease for 1050 hectares of land there and a coal deposit of 390 million tonne was made target for the mine. Since 2005 the Barapukuria coal mine started production of coal commercially from its 300 hectares mine area using Multi Slice Long Wall mining method. But mining coal from Barapukuria has been remaining as a major

challenge as all the possible mine hazards including mine fire due to spontaneous coal combustion , subsidence, rock cavings, water inrush, extreme high ground temperature, moisture, dust etc. have been restricting mine productions and miners productivity. There have been several poses of mine productions due to mine accidents. Already the miners (Chinese management contractor had to change the mining method to Longwall Top Coal Caving – LTCC since May 2013) to continue mining coal from the thick coal No. VII. Systematic mine subsidence has been affecting large surface area and adjacent 12 villages. Approximately 200 hectares of agricultural firm lands have been damaged and lost their use for cultivation. Several villages have been affected by land subsidence due to coal extraction from underground. The mine affected areas compelled the villagers to abandon their firm lands, houses and traditional livelihood (Fig. 3).

In the backdrop huge social unrest in the area, government has to allocate additional funds to acquire approximately 628 acres land to resettle mine subsidence affected people. The mine authority has initiated studies for extending underground mining area as the thick coal seam mining has technical limitations to continue within the present mine boundary of 300 hectares of land. Petrobangla also has taken initiative to conduct feasibility study for open pit mine development in the shallow northern part of the Barapukuria coal basin. Now, Petrobangla has been trying to understand by engaging consultants team the possibilities to expand mining areas adjacent to Barapukuria mine in operation. One should expect that the expansion of coal mining operations in and around Barapukuria mine will have a proper environment and social impact assessment study. The existing Barapukuria underground coal mine while obtained environmental clearance did not try to study the likely impacts of major mine hazards on the project affected people. Department of Environment did not hesitate to issue the 'environmental clearance' to Barapukuria Coal Mining Company, as a public enterprise. The EIA prepared by the BCMCL for obtaining 'environmental clearance' was prepared without considering the major mining impacts and their mitigation plans. When the inevitable land subsidence impact became obvious and the valuable firm lands lost due to mining coal, violent protests of the community have sparked. With the government's intervention and allocation of additional resources for compensation and resettlement the issue were resolved. This practice is no exception rather it demonstrates the inherent weakness of the evaluation of projects and its EIA study, issuance of environmental clearance for resource projects.

The mine development authority was compelled to compensate for the subsided lands in the Barapukuria mine area. But the issues of land and subsidence management, water issues have further demonstrated the mining and socio-environment conflicts. There is no effective mechanism worked out so far in the country to secure from the regulator's part effective control and monitoring of sustainable resource development through mining. No initiative has been taken to establish the office of the "mine's inspector", public grievance management instrument or regular effective monitoring of resource extraction. Therefore, unscrupulous 'miners' can continue their profit maximizing and unwise resource use.

Figure 3. Barapukuria mine subsidence area shows the flooded firm lands

Khalashpir coal deposit at Rangpur district was discovered by Geological Survey of Bangladesh (GSB) in 1989. A total of 18 (including GSB's 4 drill holes) were drilled in the field to confirm the presence of 8 coal seams within the depth range of 239-485 meters below the surface. Government issued an exploration license for further exploration in 2004 to Hosaf International Limited. The Licensee in collaboration with Chinese Shandong Ludi Consortium estimated 337 million tonne of bituminous coal resources having underground mine development potential there. Khalashpir coal quality analysis suggests that the coal contains : moisture-2.14%, ash-13.30%, Volatile Matter- 26.72%, Fixed Carbon-59.97% and Sulphur-0.67% with Calorific value - 6907 Kcal/kg. The study report was reviewed by the government authorities and considered necessity for further study prior to taking decision for mining coal from the field.

Dighipara coal deposit in Dinajpur district was discovered by Geological Survey of Bangladesh in 1995. A total of 5 exploration holes were drilled there. The exploration finding suggest that there are 7 coal seams present in the field at a depth ranging from 324m to 456m. The coal analysis indicates that the Dinhipara coal contains : Moisture-<2%, Ash-17-

20%, Volatile Matter- 27-30%, Fixed Carbon-50-53% and Sulphur-<1% and Calorific value: 6,668 Kcal/kg. GSB estimates in-situ resource in the Dighipara ranges between 150-500 million tonne. Barapukuria Coal Mining Company Ltd., the subsidiary of Petrobangla obtained lease for 4000 hectares of land in the Dighipara coal field area for developing a coal mine. Currently some exploration and mine feasibility study for coal development has been planned there.

Phulbari coal field in Dinajpur district was discovered by BHP Minerals in 1997 within the scope of its exploration licenses obtained from the government of Bangladesh. The exploration campaign identified bituminous coal seams within 150-270 meters depth and indicated finding of a large coal field there. Later the licenses for exploration were transferred to Asia Energy Corporation (AEC) in 1998. AEC conducted intensive exploration activities and completed a Bankable Feasibility Study and extensive environmental and social impact assessment in accordance with IFC performance standards, Equator Principles and ADB Setback Policies for developing an open pit coal mine with annual production capacity of 15 million tonne there. The exploration results established 572 million tonne coal reserve as per internationally recognized Joint Ore Reserve Committee (JORC) Code of practices category. Phulbari coal deposit extends 14 km towards north south direction and approximately 3 km east-west extension. A total of 124 boreholes were drilled during 1996-2005 study period. A total of 5 coal seams (90% of the resource is contained in two seams-Upper and Main separated by 2-5 m partings) have been deposited within the range of 150-270 meters depths. Coal quality analysis shows composition of moisture- 2.7%, ash - 15-19%, sulfur- <1%, Fixed Carbon- 53-57%, with Calorific Value- 6604 kcal/kg. The coal product ranges as : High Quality Thermal- 60%, Semi Soft Thermal - 20%, Domestic Thermal- 20%.

The concerns for land and resettlement of mine affected people encouraged policymakers to halt the mine development initiative with FDI involvement. In fact the domestic coal mine development issue has been withheld since the violent political agitations in 2006 in Phulbari. Government focus now has been shifted to import coal based power generation. The import coal option has been progressing slow as it involves huge public investment and to resolve several issues related to financing, infrastructural development, environment conservations and good practices in management.

On the other hand, India like many other countries of the world and the next door neighbour to Bangladesh has been continuing to increase coal use for power generation and for other industrial uses. In the Fiscal year 2015 India produced 624 Million tonne of coal -85% of which came from open pit mines. India's policy makers face increased pressure for reducing environmental impact from mining and use of coal as major primary energy source. Since 2008 India put increased efforts to coal mine reclamation and planned mine closer activities. Proper mine reclamation involves among others primarily replacement of overburden that was removed or repositioned to reach the resources under the surface. Proper reclamation of mine site can help mining risks including unstable spoil/overburden piles, acid drainage and underground and surface water quality issues and potential subsidence and cave-in issues.

The United States Natural Resources Conservation Service (NRCS) describes the purposes of mined land reclamation as follows :
'a. prevent negative impacts to soil, water and air resources in and near mined areas;

b. restore the quality of soils to their pre-mining level;
c. maintain or improve landscape visual and functional quality.'

The guidelines issued by Australia's Department of Industry and Tourism and Resources includes similar purposes for mine land reclamation with further recommendations of stakeholders consultation, reporting and monitoring during mine plan development and mining operations. (www.nrcs.usda.gov/internet//FSE_DOCUMENTS/stelprdb1253605.pdf and www.dmp.wa.gov.au/documents/mine_rehab.pdf). The mine site restoration and reclamation needs to be prepared prior to mining commencement and improved understanding of the mining impacts and mining operation activities may help changing social and political attitudes and pragmatically revisit mining coal for securing affordable energy. Figure-4 demonstrates challenges and possible avenues to way forward in coal development programs in Bangladesh.

Peat Resources

Presence of peat resources in the beel areas of greater Faridpur district (currently Faridpur, Rajbari, Madaripur, Gopalganj and Shariatpur) was confirmed in the early nineteen fifties by the local geologists.

Peat, a form of biomass fuel is generated and transported and accumulated from the remains of plant and vegetation materials usually in the marshy lands. The team of geologists headed by F. H. Khan of the Geological Survey discovered Peat in 1953 during its field exploration drilling program in greater Faridpur beels call Baghia and Chanda beels (Source :F. H. Khan, 1957). The peat resources occupy most of the parts of the Baghia and Chanda beels, the vast flood plain swamps in the area. These swamps developed in depressions and are connected with the tributaries of the river Ganges, namely the river

Arial Khan, the Kumar and the Madhumati. During the rainy season, most of the Baghia and Chanda beels are submerged under 2.4-3.6 meters of water. Several other peat deposits are discovered in the adjacent beels and at a later stage in the other parts of the country including in Kola-Barasat , Khulna, Maulavibazar, Pagla of Maulvibazar and Shalla of Sunamganj, Chorkai of Sylhet and Katenga-Mukundpur of Brahmanbaria. The estimated total of peat resources from the known deposits in the country is 500 million tonne (Source : Q. S. Islam and Gordon M Butler, 1985).

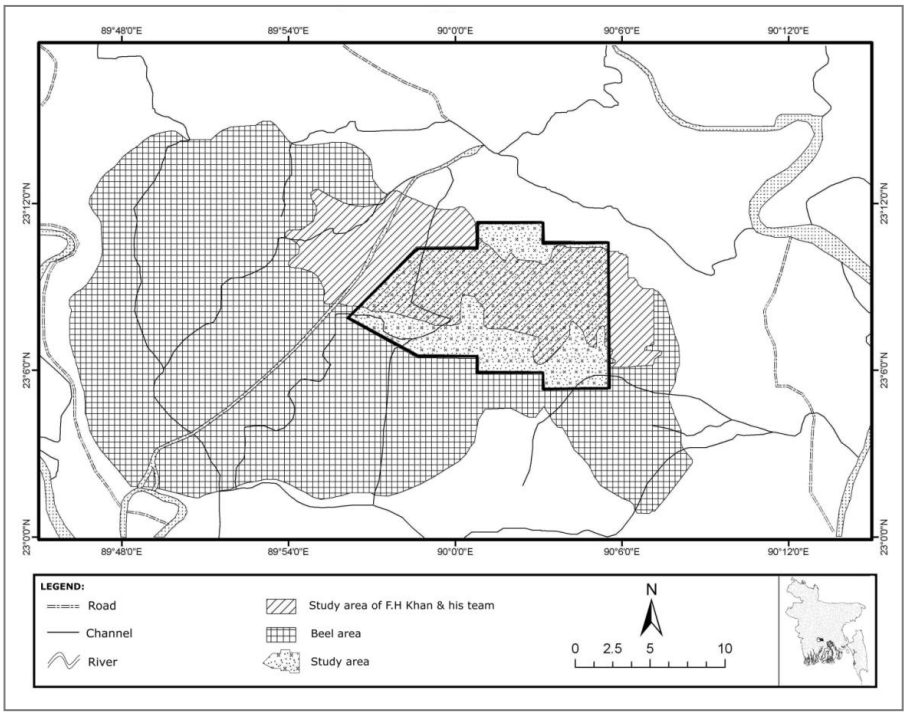
Part of the Baghia and Chanda beels are now geographically located in Rajoir Upazila of Madaripur district and Kotalipara Upazila of Gopalganj district. During 1953-57 geologists have carried out exploration works over an area of 518 sq. km of the Baghia and Chanda beels. Exploratory drilling holes were drilled at an interval of about 274.32 m with 7.62 cm diameter hand augers through the peat within 116.55 sq. km area sparsely in the adjacent areas. The natural levees surrounding the beels and bordering the rivers are comparatively high grounds and host the villages and settlements. The deeper parts of the beels although only a small part, preserve water for all the seasons. From the 1953-57 drilling campaign a total of 50 samples of peat were collected and analyzed in the Dhaka laboratory of the Geological Survey. The geological investigations made an quality assessment (F. H. Khan, 1957) of the peat resources of the Chanda and Baghia beels based on the laboratory tests for proximate analysis carried out in the laboratory of the Geological Survey. Following are the sample analysis results (mean) :

Thickness of the peat layer (average)	: 1.83 m
Resource (wet peat)	: 875 million tonne
Resource (air dried peat)	: 125 million tonne
Calorific value (dry peat)	: 15,606 kJ/kg
Moisture (as received)	: 85.4%
Moisture (air dried)	: 17.1%
Ash (air dried)	: 16.6%
Fixed carbon (air dried)	: 24%
Volatile matters (air dried)	: 42.3%
Specific gravity (wet peat)	: 1

Peat is a low grade fuel used mainly as domestic and industrial fuel in the forms of briquettes. Some studies (Source :M Rahman and Syed Humayun Akhter, 2001) were carried out earlier to determine the suitability of briquette manufacturing for domestic and industrial uses from the peat mined in the Baghia beel. A conceptual study was conducted for determining the suitability of peat uses for fueling a 10 MW pilot power plant in the Khulna area for generating power (Q.S Islam and Gordon M Butler, 1985). The study suggests that an estimated 100,000 tonne per annum peat with heating value of 14,820 kJ/kg and 35% moisture content would be required for fueling the power plant. If the wet peat is considered with 85% moisture content, the same plant will consume 600,000 cubic meters of peat annually (Q. S. Islam and Gordon M Butler, 1985).

Although peat is a known locally available fuel resource but no systematic study for commercial use of peat has yet been made. Several potential usages for peat resource have been envisaged from time to time but peat resource utilization remains limited in the country. Peat has been used as a fuel in many countries of the world as domestic and

commercial fuel. Countries like Finland, Ireland, Estonia, Sweden, Belarus Republic, Canada, Russian Federation and China and Indonesia are some examples who have been using peat resources for heating and power generation. In the back drop of the current primary energy crisis in the country, government focuses on development of all potential fuel resources in the country including the peat resources.



In Bangladesh a feasibility study for extraction and commercial utilization of peat from Baghia beel was conducted during 1985-86 by M/S SNC W. P London under CIDA Technical Assistant program. In 1993-94 a pilot briquetting plant was set up by Petrobangla based on the recommendations of the feasibility study, in Madaripur district. Approximately 2,300 tonnes of peat was extracted during the 1993-94 period from Baghia beel area and about 3,500 briquettes measuring 20 cm x 10.1 cm x 5.0 cm each were produced in the briquette plant established within the scope of the project in Madaripur. Efforts have been made to commercially market the peat briquette by the project proponent without success as local people found the new fuel little attractive for their domestic cooking (Associated Mining Consultants Ltd., 1995). Despite the fact that the local people of the peat resource area dig manually peat and use them as domestic fuel on a regular basis, Petrobangla peat utilization and demonstration project (1993-94) failed due to poor management, inadequate funding, in appropriate marketing strategies and pricing of peat briquette (Badrul Imam, 2005).

As the peat resource utilization has been emphasized as potential energy source for power generation, government of Bangladesh has issued a number of exploration licenses to encourage systematic exploration and resource assessment for understanding the suitability of local peat for power generation in the area. In particular, approximately 105 sq. km area within Baghia beel and its adjacent area has been licensed out to three local companies namely Padma Mining and Energy Corporation Ltd., Reliance Minerals and Power Ltd. and Shadhin Bangla Mines and Electricity Ltd. in 2010. Figure 5 shows the exploration licenses locations in relation to the peat exploration targets of F. H Khan (F. H. Khan, 1957).

Exploration for peat within these licenses had been conducted in the license areas during October 2010-February 2011 period. Several auger drilling units were deployed equipped with handheld GPS units to control the drilling positions accurately. Under this exploration

program 3,041 exploration drilling with 76-100 diameter Hand Auger drilling upto the depth of 6 meter at an interval of 200 have been accomplished. Figure 5. shows that the exploration activities carried out in the nineteen fifties cover comparatively larger area in the Baghia and Chanda beels of Rajoir and Gopalganj Upazila. But the exploration program within the present exploration licenses were intensive including collection of samples from more than 800 drill sites including the samples covering the full thicknesses of the peat seams for further analysis and interpretations.

Some of the depressions in the exploration license areas are located bellow the mean sea level. The prominent topographic features are roads and the artificially raised areas homestead and villages with a height of about 3 m above the surrounding area to secure from the annual flooding. The low lying areas are typically flooded up to 3 m every year during the monsoon with the influence of the rivers and tributaries of the Ganges Jamuna System. As the water recedes, the ground is exposed in November in the northern part and in January in the south. Agriculture is the main livelihood in the area with subsistence farming, typically with rice, pulses, mastered seeds and other vegetables. Some ponds near the homesteads are used for fish firming.

The requirements for systematic peat exploration in the country are necessary to determine the resource assessment and also to understand the suitability of peat resource use for power generation at a commercial scale including the assessments for options for mining pit. The granting of exploration licenses for peat within Baghia beels of Rajoir Upazila of Madaripur district and Kotalipara Upazila of Gopalganj district has created the opportunity to study the issues mentioned above.

The identified peat resource of 84 million tonne as per JORC code of resource assessment in 2010-2013 period in the Baghia beel area of Madaripur, Gopalganj district may be used for power generation on a commercial plant. But the quantitative and qualitative analysis of peat properties specially the moisture content of peat offers sufficient challenge for using them directly to the boilers. Also the mining of the required volume of peat for feeding the 100 MW size power plant, a reasonable commercial target, storing of the mined peat or alternatively keeping the extraction of peat and transport it to the power plant inevitably invite the assessment of the role of moisture content of peat as an significant contributor to the feasibility of the operations.

Some major issues of peat extraction from the area include among others the deposition concentration of peat and the peat to overburden ratio would play vital role in mining decisions. Also the peat from the study area will not suffice alone to feed a 100 MW power plant and therefore co-firing with imported hard coal could be suggested as an option. The 50 MW size power plant will presumably require 2.1 million tonne peat from this quality limits per annum. Mining of peat for meeting the requirement of a 100 MW size plant will be challenging. Therefore, it is suggested to plan a peat mine to support the power plant along with the co-firing with imported coal option for the power plant so as to maintain a sustainable mining interventions on the environment and social acceptability.

Also, it is assessed that the peat mining would offer significant social and environmental challenges as the major part of the concentrated peat bearing depressions remain

underwater for almost all the time of the year. And the seasonal flooding submerges the area under several meters of water.

In addition, the mining will cause volume deficit due to mining 1.5 m peat on average in lowering of the mined area by 1.5 m. This volume deficit area will be further depressed and would effectively become flooded area for major part of the year. As a result there is likely reduction of cultivation period in the area and a concern for depriving the population dependent on the agricultural income unless alternative livelihood is created and offered to the project affected people. Also the magnitude of earth moving for required volume of peat extraction has its impacts on socio-environmental aspects of the operations. Both climatic and physiographic environment of potential peat deposit area requires thorough assessment from these perspectives.

The peat resource mining and livelihood of the people living in and around the study area, mostly dependent on subsistence farming in the area that covers part of peat bearing depressions are inseparable issues. Therefore, mining peat involving massive earth moving will invite some social and environmental issues to resolve and such issues warrant further studies for working out appropriate strategies for post mining rehabilitation and livelihood improvement challenges for the people concerned. Such a study among others should address the challenges for the justifying commercial mining of peat with its social and environmental cost considerations.

Construction Rocks from Maddhyapara Underground Mine

Bangladesh has long been facing a scarcity of construction rock sources. The limited quantity of construction rocks collected locally comes mainly from the river streams in Sylhet, Sherpur, Chittagong Hill Tracts, Panchagarh and Lalmonirhat districts. Therefore, clay bricks have remained the major construction material in Bangladesh. However, Bangladesh needs good quality rocks for producing quality concrete that is required for road, bridge and embankment construction. Part of the requirement has so far been met through imports.

The presence of quality rocks in the sub-surface in the Maddhapara area was confirmed in the late 1960s. The follow-up exploration and feasibility studies in the 1970s were carried out by the Geological Survey of Bangladesh with external assistance. In 1979, the Maddhapara Hard Rock Mining Project formally started its journey. In 1994, the Petrobangla signed a turnkey Contract with the Korean (DPRK) NamNam Corporation on the build-train-transfer basis to develop the mine within 6.5 years with an annual production capacity of 1.65 million tonnes (5,500 tonnes per day). The construction works of the mine was completed in 2006 and the Petrobangla started limited commercial production of construction rocks (mainly granodiorite) from it.

As the Maddhapara Hard Rock Mining Company Ltd. (MGMCL) did not have adequate number of skilled miners for operating the mine independently it hired a number of technical staff from North Korea who helped the authority to produce approximately 800-1,000 tonnes of rocks per day from the mine. During the commercial production years (2006-2015), the mine could not secure further necessary development activities and continued limited production of rocks. So far the MGMCL could mine only approximately 3.2 million tonnes of rocks from its 174 million tonnes of resource within 1.2 sq. km area designed for mining. The mine had a planned production life of 48 years. The Maddhyapara

mine authority has assigned a production and management contractor (a consortium of Germania Corporation Ltd. Bangladesh and JSC Trest Shakhtospetsstroy, Belarus) to manage the development and production of the mine. The contractor has been working for further construction works underground to extend a number of mine stopes for continuing rock production. Until the new mine stopes are developed, Maddhyapara mine remains suspended temporarily (since September 2015) for commencing production. It is estimated that the country has approximately an annual demand for 10 million tonnes of good quality hard rocks suitable for construction works.

Interestingly, the hard rock reserve found at Maddhapara has the shallowest depth of 128 meters and the initial studies have confirmed availability of a sufficient minable reserve in the mining lease area. At the mine, rocks are extracted from the depth of 228-271 meters using the so-called 'sub-level stopping' method, a variation of the Room and Pillar method of mining. In this mining method, drilling and blasting are used for separating the rocks from the massif. Petrobangla took initiatives in early January 2013 to engage a production and management contractor to overcome the technical and management capacity limitation of the MGMCL and a contract was signed with the Germania –Trest Consortium for production and management of 9.2 million tonnes of rocks within next six years. The production and management contract signed with the Germania Corporation Limited would cost the Petrobangla approximately USD 171million.

The Petrobangla hopes the mine will be operated in three shifts a day with the help of the production and management contractor and its production rate will increase significantly. The contractor will develop the new underground production stopes (production faces) for enhancing the production area and for extension of the mine life.

Construction Stone and Sand from other Sources of Supply

In Bangladesh major parts of stone and sand (course sand and sand) are mined from river beds or from the flood plain areas. The deposit areas comprise of stones and sand but the manual collection method usually concentrate on stone productions unless there are specific demands for supply of sands from the site/quarry. The collected stones then are transported to different parts of the country either by boat or by trucks. Also, stones are collected/mined directly from the river beds (manual collection from river beds and transporting them to wholesale market places by small boats). The produced stones are of different sizes and quality (granite, gneiss and quartzite). Usually the stones and sand are transported by river water from the upstream hills of Assam and Meghalaya of India (or from the Himalayas) and deposit them either on the surface of the river bed or at a depth up to 5 meters. The collection of stones is replenished naturally by river during the monsoon floods. Major parts of the stones are produced from the Sylhet, Sunamganj, Panchagarh and Bandarban districts.

Geological Survey of Bangladesh published reports estimates stone (Gravel) deposits in the country as shown in Table. 2:

Table 2. Gravel deposits in the country

Name of the reserve	Deposit Area	Volume	Unit	Remarks
Gravel (Construction Stone) deposit as per Geoogical Survey of Bangladesh	Bholaganj, Sunamganj Tetulia, Panchagarh Patgram, Lalmonirhat Chittagong Hill Tract,	4 2.5 2.5 1.00	Million m^3	Gravel deposits are being exploited from different places of the country mainly from small quarries

The major supply sources of stone and sand (the Table 3 represents cumulative area of the resource rich lands in different parts of the country) in Bangladesh as per Bureau of Mineral Development (BMD), Gazette dated 14 March 2013 are:

Table 3. Major supply sources of stone and coarse sand in Bangladesh

Name of the areas for stone mixed with sand	Area (hectares)	District
Jaflong, Goainghat	158.70	Sylhet
Bichanakandi, Goainghat	92.37	Sylhet
Shripur, Jayantapur	22.60	Sylhet
Bholaganj, Companyganj	311.80	Sylhet
Utma, Companyganj	123.84	Sylhet
Ratanpur, Companiganj	2.02	Sylhet
Shah Arefin Tilla, Companyganj	40.49	Sylhet
Lovachara, Kanaighat	163.11	Sylhet
Dhopazan, Sunamganj Sadar	44.56	Sunamganj
Dhopajan, Biswambhapur	137.26	Sunamganj
Fazilpur, Tahirpur	121.49	Sunamganj

Patgram	32.21	Lalmonirhat
Panchagarh Sadar	269.30	Panchagahr
Boda, Panchagahr	107.36	Panchagahr
Debiganj, Panchagahr	218.97	Panchagahr
Tetulia, Panchagahr	118.91	Panchagahr

It is difficult to estimate a total reserve and productions capacity from the list of the resource area for stone and sand as systematic resource assessment studies are absent. However, Geological Survey of Bangladesh (GSB) officials in a field visit made an estimate for stones available in situ in some of the resource areas. The unpublished GSB estimates suggest 30.10^6 tonne resource in Lovachara, 90.10^6 tonne in Bholaganj, 25.10^6 tonne in Utma, $1.7.10^6$ tonne in Jayantapur (Shripur and Asampara), 15.106 tonne in Jaflong, $5.8.10^6$ tonne in Bichanakandi, $9.2.10^6$ tonne in Fazilpur, $4.3.10^6$ tonne in Dhopajan area. GSB also estimates $8,523.10^6$ tonne resource in Panchagahr, Dinajpur, Nilfamari, Lalmonirhat, Rangpur areas. But only part of the resources could be mined from these areas as government so far did not list all of these areas as stone and sand fields and the lands are being used for agriculture or other purposes.

BMD records (unpublished) show that during 2013-2014 financial year revenue in the form of royalty (at a rate of BDT 1.96/cubic feet) was collected for production of stone as follows :

Table 4
Royalty (revenue) collected from different leased stone queries in 2013-2014 period

Name of the construction stone quarry	Collected royalty in Bangladesh Taka (BDT)	Royalty Rate	Volume of stone produced, cft.	Remarks
Shripur	BDT 4,323,227	1.96/cft	2,205,728	
Kanaighat	BDT 4,323,227	1.96/cft	2,205,728	Royalty is
Bholaganj	BDT 30,332,170	1.96/cft	15,475,597	Imposed on the
Utma	BDT 1,962,015	1.96/cft	1,001,028	basis of stone
Shah Arefin Tilla	BDT 320,678	1.96/cft	163,611	Truck loads and
Ratanpur	BDT 53,150	1.96/cft	27,117	Boats, hence
Jaflong	BDT 27,954,036	1.96/cft	14,262,263	extracted stone
Bichanakandi	BDT 8,574,003	1.96/cft	4,374,491	Volume is likely to be more than reported.

The quarry lease is allocated for two years (renewable) by the Bureau of Mineral Development (BMD), Ministry of Power, Energy and Mineral Resources, Government of Bangladesh. A quarry lease for stone is granted based on among others on the reports that the deposit contains more than 50% stone available in the lease area, balance may be sand. Also, the District Commissioners allocate permissions for extracting stone and sand from the government Khas lands (specially from the rivers and flood plains). Royalty on the extracted volume of stone (at a rate of BDT 1.98 per cubic feet) is collected at pit mouth or at a nearby road while transporting.

For extracting sand the land is leased by the District Commissioners through tendering and bidding process (value defined on the basis of market rates) for one year period. Bangladesh government has published the Gazette Notification (dated 14 March 2013) accommodating the list of lands having reserves of stones and sand in different parts of Bangladesh.

The stones are mined or collected and transported either as they are produced or crushed at a nearby site. Trucks may carry 7 to 40 tonne stone and the truck fair varies depending on distances to be covered. For large construction projects the contractors or proponent engage a number of suppliers for unhindered supply of construction materials including stone and sand from different sources.

A common stone and course sand extraction site is Rangpani river in Jaintapur, Sylhet. Stone and coarse sand are also extracted from the adjacent Piain river and Dauki river in Jaflong, Sylhet. The extensive stone extraction from these rivers during the dry months of the year have been threatening the flow of these rivers and the extractive activities are not carried out legally. Indiscriminate and unplanned stone extraction and its transportation activities from the river beds challenge the free flow of the rivers and its ecosystems, enhance erosion of land and scenic values of the area. Amazingly, the local administration (Office of the Upazila and Deputy Commissioner) lease out the 'stone quarries' for collecting revenues ignoring the Environmental Conservation Rules, 1997. The published reports (Box-1) and images demonstrate indifference of the regulatory authorities for conserving the rivers and their ecosystems. Unfortunately such practices of stone and sand lifting as it has been done in the Rangpani river is not uncommon in the other parts of the country. Jaflaong area has been considered as one of the tourist attractions for its scenic beauty and rich biodiversity. Unplanned and destructive stone collection, crashing and trading activities in the area has been challenging not only to the environment and biodiversity conservation but also threats the tourism businesses there.

Figure 5.
Stone and coarse sand mining threats the Rangpani river, (Sylhet) flow and the surrounding ecosystems (Photo : The Prothom Alo)

রাংপানি নদী। সিলেটের জৈন্তাপুর উপজেলার রাংপানি নদীর উৎসমুখে শুকিয়ে যাওয়া জায়গায় অসংখ্য গর্ত করে চলছে পাথর উত্তোলন। নিষিদ্ধ 'সেভ মেশিন' দিয়ে তোলা এ পাথর পরিবহনের জন্য নদীর বুক চিরে তৈরি করা হয়েছে ট্রাক চলাচলের রাস্তা। সম্প্রতি ছবিটি তুলেছেন আনিস মাহমুদ ▮ খবর : পৃষ্ঠা-৪

পাথর লুটেরাদের খপ্পরে পড়ে বিবর্ণ রাংপানি নদী

উজ্জ্বল মেহেদী, সিলেট ., জানুয়ারি ১৯, ২০১৬ , Prothom-Alo

সিলেটের জৈন্তাপুর উপজেলার রাংপানি নদীর উৎসমুখের ২০ একরের বেশি জায়গা দখল করে যন্ত্র বসিয়ে শুরু হয়েছে বেপরোয়া পাথর উত্তোলন। এমনকি উত্তোলিত পাথর পরিবহন করতে শুকিয়ে যাওয়া নদীর বুক চিরে ট্রাক চলাচলের রাস্তাও করা হয়েছে। অন্তত ১৯ জন প্রভাবশালী পাথর ব্যবসায়ী রাংপানির উৎসমুখ দখল ও পাথর লুটপাটে যুক্ত বলে স্থানীয় সূত্রগুলো জানায়। উপজেলা প্রশাসন 'এই তৎপরতা ঠেকাতে না পেরে' গত ২৩ ডিসেম্বর পাথর উত্তোলনে খাস কালেকশন (তাৎক্ষণিক খাজনা আদায়) প্রথা চালু করে। কিন্তু পরিবেশ সংরক্ষণ আইনে বলা হয়েছে, জলাভূমি হিসেবে চিহ্নিত কোনো ভূমি ভরাট ও শ্রেণি পরিবর্তন করা যাবে না। করলে দুই থেকে ১০ বছরের কারাদণ্ড এবং ১০ লাখ টাকার জরিমানা করা হবে। এভাবে নদীর উৎসমুখে পাথর উত্তোলন পরিবেশগত বিপর্যয় ডেকে আনবে বলে মনে করেন সিলেট শাহজালাল বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়ের পুর ও পরিবেশ কৌশল বিভাগের প্রধান মুশতাক আহমদ। তিনি প্রথম আলোকে বলেন, শুকিয়ে যাওয়া অংশে পাথর উত্তোলনের ফলে বর্ষা মৌসুমে নদীর দুই পাড়ে ব্যাপক ভাঙন দেখা দিতে পারে।

সম্প্রতি রাংপানি নদীর উৎসমুখ শ্রীপুর এলাকায় দুই দফায় সরেজমিনে দেখা গেছে রাংপানির উৎসমুখের উজানে একটি বাঁধ দিয়ে পানির প্রবেশ বন্ধ রাখা হয়েছে। বাঁধের ভাটির দিকে বিশাল জায়গায় পাথর উত্তোলন করতে শতাধিক গর্ত করা হয়েছে। এসব গর্ত থেকে 'সেভ মেশিন' (নিষিদ্ধ বোমা মেশিনের মতো পাথর উত্তোলনযন্ত্র) দিয়ে পাথর তোলা হয়। এ রকম ২৭টি গর্তে ৩৫টি যন্ত্র চলতে দেখা গেছে।

পাথরশ্রমিকদের সঙ্গে কথা বলে জানা গেছে, তাঁরা একেকটি গর্ত চুক্তিতে নিয়েছেন। পাথর তুলে ট্রাকে করে নিয়ে যাওয়ার সময় ফুট হিসাবে দাম এবং 'বাঁশকল' বসিয়ে প্রতি ট্রাক থেকে ২৫০ থেকে ৭০০ টাকা পর্যন্ত চাঁদা আদায় হয়। পাথরশ্রমিকসহ সংশ্লিষ্ট ব্যক্তিদের দেওয়া হিসাব অনুযায়ী, প্রতিদিন শুধু বাঁশকল থেকে দুই–আড়াই লাখ টাকা আদায় হয়। এ ছাড়া পাথর উত্তোলনযন্ত্র, যন্ত্র চালানো ও ট্রাক পরিবহনের জন্যও বিভিন্ন হারে টাকা ধার্য করা রয়েছে। পাথর উত্তোলনযন্ত্র পরিচালনায়ও আলাদাভাবে দৈনিক দুই থেকে সাত হাজার টাকা দেওয়া হয়।

রাংপানির পাথর অনেকটা লুটের মতো উত্তোলন হওয়ায় উপজেলা প্রশাসন খাস কালেকশন দিয়ে পরিস্থিতি নিয়ন্ত্রণের চেষ্টা করছে বলে জানান উপজেলা নির্বাহী কর্মকর্তা (ইউএনও) মোহাম্মদ খালেদুর রহমান। তিনি প্রথম আলোকে বলেন, ২৩ ডিসেম্বর থেকে বাঁশকলপ্রথা চালু করা হয়। এ পর্যন্ত ১০ লাখ টাকা সরকারি কোষাগারে জমা হওয়া র কথা। কিন্তু এখনো কোনো টাকা জমা পড়েনি।

The above information leads to the following conclusions :

- The reserves for stone and sand are scattered in Bangladesh;
- No single or a few quarry can not guarantee the supply for required volume of sand and stone for a huge construction project Major sources of supply for class I sand and stone are concentrated in Sylhet and Panchagahr areas;
- A single government own underground stone mine is operating in Maddhapara Dinajpur with daily production capacity of 2,500 tonne. The supply may increase to 4,000 tonne per day;
- Sand (Class II) are usually extracted from the river beds and flood plains from nearby locations of the construction sites; The requirement for identifying the suitable locations for sand extraction from the river beds and floodplains through BIWTA survey has been ignored. As a result sand extraction activities for various construction works remain unplanned, inviting erosion, loss of firm lands, damage to the infrastructure and natural river flows. This particular activity has country wide impact on environment and livelihood of the people. As the unplanned sand extraction activities have been carried out or encouraged by the locally powerful businessmen and political activists, Bangladesh Inland Water Transport Authority, local land administrators either pay no attention to the activities or help them continue their activities. There are resource constraints for land administration authority and BIWTA to enforce the existing regulations to prevent unplanned sand extractions as well.
- The supply chain for stone and sand involves several businessmen and supply contractors;

The stone and sand extraction from the river beds are not always carried out legally. Even if they have been producing valuable resources for construction and development activities of the country, they care less about environment and sustainable resource extraction. Thus the sand and stone lifting businesses have emerged in most of the cases as a major threat to existing water bodies, land and bio-diversity conservation.

Heavy Mineral Send

Bangladesh has significant heavy mineral sand deposits in the coastal shore lines, offshore islands and in the 'char lands' of the river Brahmaputra and Padma. Exploration for heavy minerals in the country is limited but there are encouraging findings of commercial deposits of valuable heavy mineral sand. Bangladesh Atomic Energy Commission (BAEC) has been carrying out search for heavy mineral sands and has been operating a pilot project for separating valuable constituents from the sands collected from the Cox's Bazar sea shore deposits. BAEC has delineated a 17 commercially potential high grade heavy mineral sand deposits at the beaches of Coxes Bazar, Inani, Silkhali, Teknaf, Sabrang, Badarmokam and Kuakata along the main coast lines and in the offshore islands of Moheshkhali, Matarbari, Kutubdia, Nijhumdwip and in the south eastern coastal belt area. These deposits have on average 23% Total Heavy Mineral Sand minerals and the deposits range 152-3048 meters in length, 15-305 meters in width and 1-1.5 meters in thickness. These mineral sand deposits contain approximately 4.35 million tonnes of heavy minerals of which 1.76 million tonnes are economic deposits of ilmenite (10,25,000 tonnes), magnetite (81,000 tonnes), zircon (158,000 tonnes), garnet (223,000 tonnes) rutile 70,000 tonnes), leucoxene (97,000 tonnes), monazite (17,000 tonnes and kyanite (91,000 tonnes). Among the industrial heavy mineral sands available in the identified deposits zircon and monazite have radioactive properties.

People living in the deposit areas may have adverse impacts due to increased radioactive background. However the hotels, tourist facilities and other infrastructures being developed in the Cox's Bazar Inanai beach areas without considering such impacts. More than 1500 tonnes of heavy mineral sands of economic value have been produced by the Pilot Project of the Bangladesh Atomic Energy Commission and consumed by the local industries in Bangladesh. These minerals have high demands and presently they are met mainly by imports.

Mineral sands or 'heavy minerals' having high specific gravity include commercially important minerals content rich in titanium, zirconium and rare earth minerals. In Bangladesh these 'heavy mineral' sands deposits are located along the coastal shorelines and in the char areas of the Brahmaputra and Padma river. Concentration of heavy mineral rich sands is generally low and they are mainly transported rocks. The origin and concentration of these minerals depend on the characters of the disintegrating rocks and landforms from which the rock particles (sand) are transported and on which they are deposited. The process of heavy mineral sand deposition may include the erosion and washed out rocks by the sea waves or rain. The mineral rich sand carried back to the shore line and to the river banks. The sea waves wash back the lighter grains of the sand leaving behind the heavier grains on the beach or on the shore lines. Over the geologic time, the shoreline moves and some deposits of the heavy mineral sands form an accumulation of valuable heavy mineral sand. The wind may further carry lighter grains from such accumulations leading to the formation of higher concentration of heavy minerals deposits.

The deposits identified in Bangladesh costal shore lines are rich in heavy minerals of commercial interest including rutile, ilmenite, zircon, garnet, monazite, leucoxene and magnetite. Ilmenite and rutile are used for productions of white pigment, titanium metal and as flux for welding electrodes. Zircon mainly used in ceramic and refractory brick industries and for cladding of fuel rods in nuclear reactors. Thorium metal extracted from monazite has application in nuclear industry fuel assemblies. Garnet mainly is used as abrasive material.

A low concentration of Total Heavy Minerals (around 1%) in the bulk sand mass on the sea beach or on the river char lands can be considered as a commercial deposit. Depending on the concentrations the heavy mineral sand accumulations can attract attention. The higher the concentration of zircon in mineral sands the better its commercial value.

Bangladesh Atomic Energy Commission has been carrying out exploration activities on heavy mineral sands along the south-eastern coastal shoreline of Bangladesh for more than forty years. The exploration results and mineral grade and their technical characteristics and mining possibilities of the identified deposits have been reported. A few international companies also carried out exploration activities both in the coastal areas and in the Brahmaputra river Char areas within the scope of their exploration licenses obtained from the government. On the basis of exploration findings and Feasibility Study for mining, Primer Minerals Limited Bangladesh (PML,B), a Singapore based mineral development company applied for mining of heavy mineral sands from the prospective deposit blocks of Teknaf-Cox's Bazar area. The scheme of Development for extraction of heavy mineral sands of (PML,B) is awaiting government approval for several years. In the meantime, some of the potential heavy mineral sand concentration deposits in the Cox's Bazar area are damaged

due to unplanned development activities there. Another mineral development company, Carbon Mining Pty Ltd carried out exploration for heavy mineral sands in the char areas of the Brahmaputra river areas and applied for a few mining lease for extracting heavy mineral sands. Unfortunately the applications for mining leases for mineral sands are pending for several years.

The limited productions of commercially attractive mineral sands of BAEC found positive response from the local companies including the refractory brick and electrodes for welding manufacturers. Again the production enhancement initiatives could not be progressed for lack of initiatives and support despite the growing demands for mineral sands in the country. (Source : Recent Advances in Mineral Development and Environmental Issues, Edited by : Madhumita Das, P. P. Singh, H. K. Mohhapatra, B. M. Faruque).

Lime Stone

The major limestone deposit in Bangladesh was discovered in Joypurhat district at a depth of 410-541m below the surface in the early 1960s. As the limestone proved suitable for producing clinker for production of cement, German Fried Krupp Rohstafee was assigned to carry out feasibly study for mining lime stone in 1966. The study recommended for developing an underground mine for extracting limestone (with a production of one million tonne/annum) from the deposit of 270 million tonne within 6.47 km^2 are of Joypurhat and producing cement by establishing a mine mouth cement factory there. In 1974 a project was approved by the government of Bangladesh to develop an underground mine and a cement factory there. Some surface structures were built for the mine development and cement factory construction but the project could not proceed further mainly due to lack of financial supports.

A separate limestone deposit of 14 million tonne at a comparatively shallow depth was discovered in 1951 at Takerghat-Bagalibazar area of Sunamganj. Since 1961 small scale mining activities started there and from 1965 East Pakistan Industrial Development Corporation started producing limestone from an open pit mine for supplying them at Chatak Cement factory, Sunamganj. During 1972-1995 approximately 741,000 tonne of limestone was produced from the mine at a rate of approximately 60,000 tonne per annum. The mine seized its production.

White Clay

In 1957 surface deposit of China Clay or white clay was discovered in Bijoypur area of Netrokona district. Later a few more white clay deposit were discovered in Sherpur and Chittagong areas. During 1964-65 some exploration wells drilling were carried out for determining geological characteristics and economic resource estimation of the china clay in Bijoypur area. The exploration results revealed that approximately 619,500 tonne medium quality China Clay deposit was available on the surface and within 15m depths. The deposit is extended to a depth range of 60m and a probable resource might extend upto 2.48 million tonne. Since 1960 China Clay has been produced from the deposit areas of Netrokona district and the produced resource have been used by the ceramic factories of the country. The mining has been carried out following no standards norms and practices of environmental conservation and the concerned authorities care less as the remote deposit areas are sparsely populated and comparatively remote. There are deep underground deposits of China Clay in the western parts of the country and they were confirmed while

drilling and mine building in Barapukuria and Madhapara mines. No economic assessment was made for these China Clay deposits. Small scale mining without any care for planned mining scheme, environmental health has been continuing for white clay extraction in different parts of the country. A typical report in the Box-2 states the affairs.

The Daily Star

No care for resources

White day being plundered, authorities 'take no action'

Aminul Islam

The sorry state of a hillock after loads of white clay had been extracted from it in Bhedikura area of Dhobaura in Mymensingh. The photo was taken last year. Photo: File

Indiscriminate extraction of white clay, also known as Sada Mati, has continued unabated for long in hilly areas of Mymensingh's Dhobaura upazila and the authorities concerned have apparently been looking away. Locals said the plundering began years ago and hundreds of Sal trees had also been cut down to collect the clay from five hillocks in Bhedikura area, causing immense damage to the local environment and ecology. White clay is used as a raw material for making ceramics products which have huge demand at home and abroad. Currently, Bangladesh Agro-ceramics Company is taking white clay from one of the hillocks at Bhedikura. The firm has been working in the area for several years. Quoting workers and officials at the company, Gaziur Rahman, chairman of Dakshin Maizpara Union Parishad, said, the quantity of white clay being extracted by the company was much higher than it was mentioned in the Demand Order (DO) letter.

The DO, issued in December last year, permitted the company to collect 16,000 sacks, each containing 50kgs of white clay, but it took approximately 60,000 sacks, he claimed. The company refuted the allegation. Its local representative Mohammad Ainuddin said they were working following the DO issued by the ministry concerned (Ministry of Power, Energy and Mineral Resources). He, however, admitted that they had not yet collected the clearance from the Department of Environment (DoE) in the district. Contacted, Jamir Uddin, senior chemist at the DoE, said the company did not even contact them for the clearance certificate. The union chairman said he had informed the authorities concerned about the alleged plundering many times in the past but to no avail. Also, he said some 200 indigenous people in the area were in constant fear of landslides during the rainy season due to the indiscriminate cutting of hillocks. Officials from the authorities concerned were supposed to monitor the clay extraction which they never did, he alleged. Anisuzzaman Khan, Dhubaura Upazila Nirbahi Officer, alleged that the company had violated four out of the five terms and conditions mentioned in a previous DO letter. "I had looked into the matter and submitted a letter to the authorities concerned last year." Later on, the company had to suspend their work for a few months, he claimed. The Daily Star could not verify the claim. "Legal action should be taken against the company immediately, if it is still involved in plundering," the UNO said. Gazi Mohammad Golam Kibria Tapon, proprietor of the company, could not be reached despite repeated attempts. Recently, the Bangladesh Environmental Lawyers Association (Bela) filed a writ petition with the High Court, seeking to stop clay extraction without DoE clearance, and destruction of hills and hillocks at Mejpara, Arapara and Pacakahania mouzas in Durgapur upazila in Netrokona. On March 14 this year, the court issued a ruling asking to know why indiscriminate and unplanned cutting of hills and extraction of clay without the environment clearance should not be declared illegal.

3 ISSUES

In the backdrop of worldwide access to electricity for one in five people Bangladesh has improved significantly in the Sixth Five Year Plan period for securing access to electric energy and overall commercial energy use. Per capita electricity consumption now stands at 321 Kwh and 66% population has access to electric energy in Bangladesh. Still a large part of population lacks access to power grid. Government of Bangladesh has been steadily improving the commercial energy supply including the supply of grid electricity so that within the premises of the Vision 2021 all citizens get access to electricity for improving their life and livelihood. Increased fossil fuel use so far is the means to increase electric energy as the renewable sources are limited and cannot at this stage substitute fossil fuel based primary commercial energy and electricity supply.

Extraction and mining projects affect environment and ecology at multiple levels. For mining projects the option for alternative is not applicable (unless 'no mining option' is considered). Hence the impacts on terrestrial eco-systems, impacts on environment and bio-diversity are inevitable. Mining activities specially large scale coal mining requires to build major infrastructures, may relocate existing infrastructure and sometimes demands rearranging natural land and water use patters. Large scale mining projects demands large tracts of land acquisitions resulting in socio-economic and political impacts. These mining activities not only affect the environmental settings but also impact on existing socio-cultural and livelihood activities. Unless carefully planned and implemented mining may destroy forest, pollute water bodies and air heavily. Coal mining may release methane, a major greenhouse gas in the air (major share comes from underground coal mines) contributing to global warming. Also, burning coal and other fossil fuels contribute to global warming by carbon and greenhouse gas emissions. As the mining of mineral resources are site specific activities, environmental and social impacts need to be addressed and mitigation measures to be implemented considering the ground realities and site conditions.

Quality supply of electric energy and making available commercial energy can positively impact on attaining SDG 7 goals. On the other hand, production of electric energy using fossil fuel remains as one of the major contributors to climate change. SDG 7 targets to improved efficiency in primary and secondary energy consumption at an affordable cost and to encourage the share of renewable energy use.

Mining of primary energy commodities like coal, limestone, clay, stone, sand and other minerals are energy-intensive activity. Although at a nascent stage, the mining industry in Bangladesh can improve energy use by accelerating energy efficient technology and waste reduction measures. Side by side, mining (including oil and gas exploitation activities) have been carried out in the comparatively remote areas; hence renewable energy consumption (like solar energy harnessing activities) can meet fully or partially mine and mineral processing (for example crushing stone boulders, separating ilmenite, monazite, rutile, magnetite, zircon separation from heavy mineral sand) power supplies.

SDG 12 goal for sustainable consumption and production patterns in mineral industry can be attained by reducing waste and by securing reduced input use and ensuring reuse and recycling of minerals and energy. Exploration and mining of minerals generate waste, both solid and liquid. As the high grade minerals exhausted in production process (miners try to recover high grade resources as much earlier possible to investment at a faster pace) mining switches to low grade mineral extraction which increases waste volumes. Mining companies in our country can adopt advanced technology and better management for mineral extraction and processing to enable waste reduction, reuse and recycling of resource for its sustainable consumption. Sustainable mining practices can help attaining minimum input use for production process using less water, energy, land, chemicals and materials. Less input use for mining operations automatically lead to generation of minimum waste generation, effluent discharge and emission.

SDG goal 13 takes urgent action to combat climate change and its impacts. In energy and mineral resource industries can contribute towards this goal by reducing their carbon footprint (in coal industry by adopting carbon capture and storage (CCS) technology and with engaging in dialogue with stakeholders to help reduce carbon emission and enhance adaptive capacities and integrate climate change by engaging in dialogue with stakeholders to enhance adaptive capacities and integrate climate change measures into policies and strategies. Strengthening adaptive capacity to climate related hazards and natural disasters can improve significantly through improved education, awareness and installing early warning systems.

4 STRATEGIES/POLICY/INTERVENTIONS

Energy and mineral sector development involve and have impact on the biophysical environment, water supply and agriculture, transport, infrastructure, occupational and community health and multiple functions of the government. Therefore it is expected that several laws, regulations and policies of the government will apply. Many laws prevailing in our country are age old and not always understood or are not enforced currently as functional authority. Also there exists several laws and regulations having environmental implications. Similarly there are different organizations and government agencies directly or indirectly involved in land, environment, water resources management.

The Constitution of Bangladesh came into force on 16th December 1972, Part X1, Miscellaneous, Section 143-Property of the Republic stipulates that 'all minerals and other things of value underlying any land of Bangladesh' are lawfully vested in the People's Republic of Bangladesh. Thus the minerals extraction rights in Bangladesh is owned by the government of Bangladesh. By the Order of the President of the Republic Bureau of Mineral Development (BMD) has been authorized to grant mineral exploration license and mining lease permits (except for oil and gas resources). On the other hand much of the exploration and mining related legislation does not cover mine rehabilitation, overburden placement, mine site water management. Briefly mining related legislations are listed below :

- Mining Settlement Act 1912- covers mainly control and sanitation of mining settlements;
- Mines Act 1923-provides regulation and inspection of mines, mine condition, health and safety of employees;
- Coal Mines (Fixation of rates of wages) Ordinance 1960, provides all the coal mine workers wages issues;
- Mines and Mineral Resources (control and development) Act 1992;
- Mines and Minerals Rules 1968.
- *Balumohal o Mati Babjsthapona Ain, 2010* (Sand Fields and Soil Management Act, 2010, Government of Bangladesh

On the other hand environment conservation and improvement are primarily governed in our country by the Environment Conservation Act 1995 (ECA), Environment Conservation Rules 1997 (ECR). These regulations are supposed to control majority of environment impacts mitigation of environment pollution issues. Apart from the ECA and ECR, a wide range of sectoral acts and policies have relation to environment and bio-diversity conservation.

In addition to principal laws and regulations for mineral exploration and excavation and environment conservation there are a number of relevant policies of the government that have relations to environment conservations, for exploration and mining of minerals, they are : National Conservation Policy 1991; Industrial Policy 1991; National Environment Policy 1992; National Energy Policy 1996; National Policy for safe water supply and sanitation 1998; National Agricultural Policy 1999 National Biodiversity Strategy and Action Plan 2004 etc.

The mineral resource extraction industries has an important interacting relations with water resources use and its conservation. Therefore, the relevant acts like:

- Groundwater Management Ordinance 1985;
- Canal Act 1864:
- Embankment and Drainage Act 1952;
- Bangladesh Water Development Board Act 2000;
- Irrigation Water rate Ordinance 1983 and Irrigation Water Rate (amendment) Act 1990;
- Irrigation Act 1876;
- The National Water Policy 1999 and National Water Management Plan 2001.

It is required to be considered while assessing the mineral exploration and extraction planning and production activities.

The mining and mineral resource extraction activities sometimes involve leasing, purchase and acquisition of lands owned by individuals, government agencies and autonomous bodies. Therefore the following legislations are relevant for conservation of land and addressing the livelihood of affected people:

- Registration Act 1908;
- Acquisition and Requisition of Immovable Property Act 1994;
- Displaced Persons (Compensation and Rehabilitation) Act 1958;
- Bengal Mining Settlement Act 1912;
- Mines Act 1923;
- Bangladesh forest Act 1927.

For sustainable development, energy and mineral resource sector require to carry out activities within the guidance of the National Conservation Strategy 1992 which offers various recommendations including:

-to use minimum area of land in exploration sites;
-to rehabilitate sites when the mineral exploration and extraction activities are abandons;
-to take precautionary measures against environmental pollution from liquid effluent;
-reforestation of hills forming catchments of rivers; and for
- assessment for selection of appropriate technology.

The National Energy Policy 2004 provides for utilization of energy for sustainable economic growth, supply of energy to the different zones of the country, development of indigenous energy sources and environmentally sound sustainable energy development programs. The specific recommendations relates to :

- To ensure reliable supply of energy to the people at reasonable & affordable price;
- To ensure rational use of total energy sources;
- To ensure environmentally sound sustainable energy development programs causing minimum damage to environment.
- Use of economically viable environment friendly technology;
- Use of fuel wood to be discouraged and replacement fuels are to be made at an affordable price;

- To bring entire country under electrification by the year 2020;
- Popular awareness to be promoted regarding environmental conservation;

The National Energy Policy 2004 stresses the need for energy conservation. In the section titled 'Energy Conservation' the policy statement includes that in Bangladesh efficiency of energy use is quite low and there are good potential to reduce energy demand through conservation measures (introduction of efficient technologies and better management practices) in all the end-use sectors; domestic, industrial, commercial, transport and agriculture. The government has started implementing some concrete initiatives and programs to implement energy conservation projects in industrial sector and domestic sector. The Policy rightly suggests for implementation of energy conservation measures effectively.

In the section titled 'Mining inside the forest areas' the National Energy Policy 2004 stipulates that 'there should not be any commercial mining and quarrying inside the forest area (as
legally defined in the Forest Act) and within 3 (three) km from the forest boundary. However between 3 to 10 Km of forest boundary mining and quarrying may be allowed only where EIA shows that there is no negative impact on forest. Transportation of mining and quarrying materials should be controlled under the coverage of Forest Transit Rules'.

Despite the facts that there are a number of laws and regulations for mineral resource extractions and their environment management but Bangladesh does not have legislation and policy that could provide guidance to rehabilitation and resettlement of project affected people due to mining and mineral resource extractions. The environmental clearance for mining or mineral extraction activities now a days have included a requirement for including a rehabilitation plan for the affected people. Also, the rehabilitation requirement has been briefly included in the Acquisition and Requisition of Immovable Property Ordinance 1982 allowing to government for acquire land, but large footprint projects often involve conflicts with the project affected people while such initiatives are taken. In line with the SDG guidance and for securing sustainable development of primary energy the issue of rehabilitation of the project affected people demands policy reforms.

Government of Bangladesh has adopted Petroleum Policy 1993 with the objective of promoting , monitoring and regulating all activities in the oil and gas sector in relation to exploration, development, refining, marketing and export. The Petroleum Policy stresses the requirement for private companies in consultation with the Energy and Mineral resource Division/Petrobangla are to contribute towards improving the state of the environment in their areas of operations. The Petroleum Policy is now an integral part of the National Energy Policy.

The development approach of the Seventh Five Year Plan (2016-2020) coincides with the lunch of Sustainable Development Goals (SDGs) of the United Nations. The 7th Five Year Plan of the government of Bangladesh announced that the plan will place three themes :'acceleration of GDP growth, employment and rapid poverty reduction: a broad based strategy of inclusiveness and a sustainable development pathway that is resilient to disaster and climate change, entails sustainable use of resources and successfully managing inevitable urbanization transition'. The government has identified in its previous plan that

the power supply constraints serve as a major impediment to GDP growth. Development of primary energy sources and electricity generation are interlinked issues. Therefore, in the 7th Five Year Plan (sub-section Energy and Infrastructure) government puts goals to enhance installed electric energy generation capacity to 23,000 MW by 2020; ensure energy mix for ascertaining energy security and to enhance electricity coverage to 96% with uninterrupted supply of electricity to industries and reduction of system loss from 13% to 9%, improve efficiency of energy use and conservation. In the environmental sustainability part, the 7th Five Year Plan within its period targets for 'completion of land zoning for sustainable land/water use; risk reductions for environmental, climate change and disaster, integrated project design and budgetary allocations in implementation process'.

The 7th Five Year Plan in the section titled 'Strategy for Primary Energy Sector': takes into considerations the fact that the major primary energy source, the domestic gas supply will decline from the existing gas fields. Therefore during the 7th Plan the shortfall in domestic gas to be met with coal, particularly imported coal and LNG. At the same time Bangladesh needs to move ahead with accelerated exploration for new oil and gas fields discovery in the shallow offshore and in the deep sea areas. Government will have to put considerable emphasis on coal, use of nuclear energy for power generation and electricity imports from the neighbouring countries. At the same time the 7th Plan considers important that efficiency of gas use in industries and for captive power generations require to be improved by introducing technological advancements including through using cogeneration/tri-generation. The 7th Plan delineates its focus further for environment protection on:

- 'Natural conservation with increased forest coverage with appropriate tree density;
- Conservation of water bodies and protected areas;
- Maintenance of natural resource quality and wildlife at a desired level;
- Creation of alternative livelihoods and building resilience for community to lessen anthropogenic pressure on resources;
- Stresses on relevant programs for environmental and climate change capacity building at local and national level;
- Offer greater attention in research for knowledge generation concerning environment and climate change'.

The strategies for primary energy section it observes that Bangladesh continues to follow the path to increase its reliance on imported primary energy and this trend would increase the cost of power generation and add pressure to the national budget. The 7th Plan therefore considers that a judicious combination of choices (including domestic supply options and import options) to ensure the efficient and cost-effective supply of primary energy.

In line with the above, the Plan suggests that the government should 'urgently finalize and adopt the long-pending develop an Energy Master Plan. Such a Master Plan should delineate among others the following items i) Gas Allocation Policy, ii) Domestic gas exploration policy, (iii) Domestic coal utilization; iv) Energy import) Demand side management and energy conservation, vi) Improved Cooking Stove (ICS); and vii) Energy subsidy and pricing'. To address the long pending issues of primary energy there are needs for certain institutional reforms and investment mobilizations. Special attentions required for policy reforms and their implementation for domestic coal extraction and utilization. For the changed realities the institutional management reforms are needed for technical skill development for primary energy sector project negotiations, implementation and for sustainable resource utilization with a minimum environmental impacts.

The objectives of the 7th Plan in the Chapter 8 (Sustainable development: Environment and Climate Change) include :

- Ensure appropriate environment management system for sustainable development ;
- Enhance enforcement for pollution control ;
- Enhance, preserve, conservation of natural resources.

The Plan also includes low carbon development strategies for meeting the energy demands including with:

- Conserve non-renewable resources and sustaining auto and eco-generation of renewable resources
- Mass initiative to be taken under Clean Development Mechanism and REDD (Reducing Emission from Deforestation and Forest Degradation).

5 ACTION PLAN

(Within the framework of relevant SDGs)

Issues	Actions	Implementing agency
1. Mining of minerals (coal, sand, stone, white clay) have been carried out without effective control for rational resource use and environment conservations but mainly for revenue collection objectives only. As a result resources are depleting fast leaving environment and the people having livelihood dependency in the locality in sorry state. Unless land, water and environment are conserved and livelihood of the mine induced/affected people are rehabilitated/resettled properly long term environment degradation will badly affect life of the people and economic welfare of the community.	What needs to be done directly to address this problem 'a. prevent negative impacts to soil, water and air resources in and near mined areas; b. restore the quality of soils to their pre-mining level; c. maintain or improve landscape visual and functional quality.' d. establish office of the mine safety and resettlement for mining project affected people; e. Feasibility and Environment and Social Impact Assessment report and impact management programs should be a precondition set for approval of mining project scheme (irrespective of public of private sector mining initiatives); f. Mining project cycle exploration, assessment of economic resource and ESIA study , project approval, opening of resources and mining, transportation, reclamation and restoration of land for after use, rehabilitation of project affected people; environmental and social impact for mining shall be adequately managed and systematically monitored to minimize adverse impacts and to sustainable resource extraction; g. ensure establishment of an special authority to oversee the recommendations of ESIA for each of the mining and resource	Ministry of Power, Energy and Mineral Resources, Ministry of Land, Ministry of Environment and Forests, Bureau of Mineral Development, Petrobangla, Department of Environment.

	extraction projects and their mitigation measures; h. Environmental audits required to be introduced and maintained on a regular basis to ensure environmentally sound practices in mining operations.	
2. Absence of adequate legal instruments and institutions including 'the mines inspector's office' for securing safe mining practices, conservation and rational utilization of resources and for securing mine resettlement and rehabilitation of mine affected activities;	Update Mines and Minerals Rules, 2012, Environmental Conservation Rules, 1997; Adopt and apply land use/zoning map for the country; Adopt appropriate legal instruments to address the resettlement and rehabilitation of project affected people due to mining of minerals in particular and for large footprint project in general; Establish effective coordination among the departments like Department of Environment, Bangladesh Water Development Board, Bureau of Mineral Development, Department of Forrest, Land offices (Deputy Commissioner's office)	Ministry of Law; Ministry of Power, Energy and Mineral Resources; Bureau of Mineral Development; Ministry of Land
3. Conflicts of interest among the businesses for extracting minerals (stone, sand, clay etc.,) and conservation of land, water, bio-diversity, scenic value have been increasing . Sand and stone extraction activities from riverbeds and floodplains follow limited or ignore the prior BIWTA survey resulting erosion of river, loss of firm land, livelihood and damage to environment and bio-diversity.	Interdepartmental coordination among the land administration, law enforcement, mining and quarry lease authority, water, environment management and conservation/ protection authorities; Legal compliance irrespective of socio-political belongings; Make compulsory prior survey by BIWTA, Geological Survey of Bangladesh to identify suitable sites for sand extraction from riverbeds and floodplains; Ensure no harm to natural flow of water courses by sand and other mineral activities; Maintain applicable distances for sand and stone extraction activities from the roads, bridges,	Ministry of Land; Ministry of Home Affairs; Ministry of Shipping; Ministry of Power, Energy and Mineral Resources; Bangladesh Inland Water Transport Authority; Bureau of Mineral Development; Department of Environment;

	rails, communication towers and other important installations strictly to avoid threats; Also the quarry lease authority (Bureau of Mineral Development, District land administration need to ensure that the sand and quarry lease and permission for class II sand cause no harm to adjacent firm land, water bodies and environment;	
	Review the existing quarry lease regulations for two years with prior payment of royalty for extracted stone and sand and its monitoring systems to facilitate resource conservation, protection of land and water courses and avoid threats to livelihood of the people;	Ministry of Power, Energy and Mineral Resources; Ministry of Law; Ministry of Finance; Petrobangla: Bureau of Mineral development; Sustainable and Renewable Energy Development Authority (SREDA);
4. Secure domestic coal extraction for rational use mineral resource and balancing primary energy mix; increase baseload power generation plants with coal fuel for reducing pressures on import bills and for energy security;	Intensify the monitoring at local level to prevent unauthorized and unplanned sand extraction from riverbeds and floodplain. Adopt an Energy sector Master Plan. Such a Master Plan should delineate among others the following items : i) Gas Allocation Policy, ii) Domestic gas exploration policy, iii) Domestic coal utilization; iv) Energy import (demand side management and energy conservation), v) Strategies for energy use for domestic consumers including for cooking (such as Improved Cooking Stove); and vi) Energy subsidy and pricing'.	Mining authority (public and private); Bureau of Mineral Development; Bangladesh Power Development Board, SREDA Department of Environment;
5. In the process of exploration and resource extraction generated wastes are usually discharged to environment causing adverse impacts to land, water and eco-systems;		Ministry of Power Energy and Mineral Resources; Ministry of Law; Ministry of Land; Ministry of Forest and Environment; Ministry of Shipping; Department of Environment;
6. Many of the mineral resource extraction and environment	Adopt advanced technology and better management for mineral extraction and processing to enable waste reduction, reuse and recycling	

conservation related legislation and policies are age old and inappropriate for implementation;	of resource for its sustainable consumption; Use advance coal power generation technology; Effective environmental monitoring and control can reduce waste control and their handling and disposal;	Ministry of Power, Energy and Mineral Resources; Ministry of Forest and Environment; Ministry of Finance; Department of Environment.
7. Conservation of primary energy	Necessary reforms are to be done in the legislations and for their implementation; Careful assessment is required for	Ministry of Power, Energy and Mineral Resources; Ministry of Finance; Ministry of Forest and Environment; SREDA
8. Encourage renewable energy use in mining and resource industries; Conservation of resource and improvement of environment.	interlinked regulations and policies having relations to resource extraction, specially for primary energy resource extraction and use; Institutional reforms and capacity building are required to reflect new technology use, resource conservation and effective use of resources.	Ministry of Power, Energy and Mineral Resources; Ministry of Forest and Environment; Department of Environment; Local Administration of concerned areas; Departments having relations to implement energy and mineral resource sector;
9. Securing quality of environmental impact assessment and monitoring.	Use advance technology for power generation, Urea fertilizer and other industries; Introduce incentive instruments (financial and others) for energy conservation and effective operational indicators for environment conservations; Development of skilled manpower; improvement of training and target based operational practices with rewards; Allocate funds and improve fund management.	Ministry of Education; Ministry of Information: Department of Environment; Television networks; Community radio services;
10. Lack of awareness in the community on natural resource inadequacy,	Improve quality of Feasibility Study and Environment and Social Impact Assessment Studies for energy and mineral resources sector projects; Make necessary fund and logistics facilities available for environmental performance quality monitoring for energy	

sustainable energy and resource use;	and mineral sector projects. Improve inter departmental coordination for rational use of resource and for effective assessment and monitoring of environment, resource conservation and development works. Education syllabus should include sustainable resource use, conservation of resources; media can play important role in community awareness building for efficient and sustainable energy and resource conservation ; SDG targets and their importance for social development and community welfare.	

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