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# EVALUATION OF ECONOMIC POTENTIAL OF INDUSTRIAL MINERALS OF PAKISTAN USING LORENZ MODEL

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Economic potential of industrial minerals and rocks of Pakistan have been evaluated by using Lorenz (1985) model. Based on the preconditions a list of priorities have been deduced. Top six industrial minerals have been discussed with reference to their reserves, production, present infrastructure, uses and export potential.

***Key words***: Lorenz model, Industrial mineral, Economic potential.

## Introduction

A large number of industrial rocks and minerals are distributed in Pakistan. Infrastructure for many mineral based industries such as ceramics, glass, fertilizers, refractories, cosmetics, abrasives, cement, chemicals and metallurgy are widely present in Pakistan. Ironically the mineral sector hardly accounts for a little over one percent of the Gross National Product (GNP), despite the variety of economic mineral occurrences. Proper evaluation is needed for better utilization of these mineral deposits, so that this sector may actively participate in the economic development of the country.

Lorenz [1] has proposed a model for estimating the economic potential for raw materials in terms of certain objective criteria (preconditions). A list has been prepared (based on Lorenz's model) of those deposits which are either already in production or require marginal development to render them marketable. Top priority minerals have been discussed considering important preconditions.

## Material and Methods

*Evaluation of economic minerals.* Important industrial mineral deposits are assessed according to Lorenz model [1]. As per his model each precondition, namely geological, macro-economic and industrial/technical carry equal number of five (5) points. For every mineral deposit the precondition listed under heads A - C are marked with a plus sign (+) if they are favourable (Table 1).

After all the individual mineral have been assessed the total number of points provide an initial overall indication of general favourable preconditions for development and exploitation. Sub-total of each of the three main preconditions (A - C) are listed in the column of code. A deposit obtaining 5-5-5 would be the code for a mineral with most favourable preconditions, while 0-0-0 code for one with worst possible preconditions. However raw materials with first code one or zero and second number zero are considered inexpendient or unworkable. Based on the total points obtained, a list of priorities have been deduced in the extreme right hand column. Summarized discussion of the top priority minerals have been given with some suggestions considering important preconditions for Pakistan.

## Discussion

*Rock salt.* Rock salt is one of the most important mineral commodities of Pakistan and the quantity of rock salt available in near surface deposits is probably the world's largest. The best known salt deposits are in Khewra (Punjab) of the Salt Range. The estimated reserves are in excess of 600 million tons, with a production about 600,000 tons a year [2]. Khewra deposits have been studied and in production for the last 100 years. Salt is used as raw material in many industries such as food preservative, tanning, as table salt etc. as well as in the manufacturing of acids, caustic soda, salt soda, soda ash, sodium bicarbonate and other sodium bearing chemicals. Indirectly rock salt finds application in metallurgy, ceramics, glass, medicines, soap, refrigeration, insecticides and bleaching industries [3]. On a limited scale the infrastructures of these industries is present in Pakistan. Proper planning may reduce the import of these items. By starting such industries or stepping up the production of the existing ones the necessary fillup to rock salt production is possible with the attendant beneficial effect to the national economy.

*Limestone*. Pakistan has practically inexhaustible reserves of limestone distributed all over the country. The estimated reserves above the ground level are at least 45 billion tons [2]. Annual production during the year 1989-90 was over 7 million tons [4]. Besides its principal use as a building stone and for lime production, cement industry is the main consumer of limestones. It is difficult to understand why a country like Pakistan which has adequate reserves of all indigenous raw materials, operative network of cement industries, locally cement manufacturing plants and cheap labour the local price

TABLE 1. LORENZ MODEL FOR ASSESSING THE ECONOMIC AND GEOLOGICAL POTENTIAL OF NON-METALLIC RAW MATERIAL TAKING ACCOUNT OF THE MOST ESSENTIAL GEOLOGICAL, ECONOMIC AND TECHNICAL PRECONDITIONS.

| Essential Preconditions | | | | | | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Geological 1st. no. of code | | | B. Macro-economic 2nd. no. of code | | | | C. Industrial/technical 3rd. no. of code | | | Total assessment | Code | |
| A1 | A2 | | B1 | B2 | B3 | | C1 | C2 | C3 | | | |
| Geologically favourable preconditions | Adequate geological data | | Immediate interest on the part of local industry and government | Possiblities for import substitution/ satisfaction of needs/stimulus for downstream industries/diversification | Potential for increasing exports | | Favourable infrastructure (transport, links, energy, water) | Extraction is technically/ economically favourable | Processing is technically/ economically favourable | Total points (A - C) | Sub-total of (A-B-C) | Priority |
| Assessment Factor | | | | | | | | | | | | |
| Minerals | | X4 | X1 | X2 | X2 | | X1 | X2 | X2 | X1 | | | |
| Abestos | | | + | + | + | | | | | | 05 | 1-4-0 | 19 |
| Barite | | | + | + | + | | + | + | + | | 10 | 1-5-4 | 08 |
| Bauxite | | | + | | + | | | | | | 03 | 1-2-0 | 20 |
| Celestite | | | + | + | | | + | + | | | 06 | 1-3-2 | 15 |
| China clay | | | + | + | + | | | + | | + | 08 | 1-4-3 | 11 |
| Coal | | + | + | + | + | | | + | | + | 12 | 5-4-3 | 05 |
| Dolomite | | + | | + | | | | + | + | + | 11 | 4-2-5 | 07 |
| Fire clay | | | + | | + | | | + | + | + | 08 | 1-2-5 | 10 |
| Fluorite | | | + | | + | | | + | | + | 06 | 1-2-3 | 16 |
| Fuller' earth | | | + | | + | | | + | | + | 06 | 1-2-3 | 17 |
| Graphite | | | + | | + | | | + | | + | 06 | 1-2-3 | 18 |
| Gypsum | | + | + | + | + | | + | + | | + | 12 | 5-4-3 | 04 |
| Limestone | | + | + | + | + | | | + | + | + | 14 | 5-4-5 | 02 |
| Magnesite | | + | | + | | | | + | | + | 09 | 4-2-3 | 09 |
| Marble | | + | + | + | + | | + | + | | + | 13 | 5-5-3 | 03 |
| Ochres | | | | | + | | | | | | 02 | 0-2-0 | 21 |
| Rock phosphate | | | + | + | + | | | + | | + | 08 | 1-4-3 | 12 |
| Rock salt | | + | + | + | + | | + | + | + | + | 15 | 5-5-5 | 01 |
| Silica sand | | + | + | | + | | | + | + | + | 12 | 5-2-5 | 06 |
| Soap stone | | | + | | + | | | + | + | + | 08 | 1-2-5 | 13 |
| Sulphur | | | + | + | + | | | + | | | 07 | 1-4-2 | 14 |

of cement is practically exorbitant. Even it is imported from other countries. This ironical situation can be solved by proper planning for the economic development of the country. This will not only earn valuable foreign exchange but help in finding jobs for thousands of jobless and thus it will be a right step in achieving the goal of self reliance.

*Marble*. Pakistan possesses very large reserves of marble deposits which have been classified into 3 main types (a) Crystalline calcitic/dolomitic rocks, (b) Partially crystallized compact limestone-commercial marbles and (c) Travertine deposits [2]. White, pink, grey, green, black and multi colour banded marble are being worked at various localities of NWFP, Pakistan [5]. Varieties of marble are also reported from eight different localities of Chagai district, Balochistan [6].

Locally these marble varieties are being used in marble tiles, marble chips and marble powder for mosaic flooring. Artifacts such as ash tray, flower vases, key chains, chess board, table tops, fancy facing tiles etc. produced by unorganized small scale cottage industries. Blocks of good quality marble is exported as a raw material at very low cost. It is therefore recommended that the government impose a ban on the export of these raw marbles or at least discourage their export. On the other hand promote and provide facilities for the

establishment of proper marble industries and allow only the finished products of marble to be exported to European and Middle East Market.

*Gypsum.* Huge deposits of gypsum and anhydrite are present in all four provinces of Pakistan. One of the largest deposits occur in Dera Ghazi Khan hills. Other important sites are Kohat, Sibi, Loralai salt range, Daudkhel and Hyderabad. Estimated reserves are over 350 million tons. Production during the year 1989 - 90 was 490,677 tons [4]. Gypsum is mainly used as building plasters, portland cement, plaster of Paris and as fertilizer [3]. Besides the present use of gypsum other new channels may be open for the better utilization of gypsum. Few years back a new low cost product "gypsum plaster" was introduced in the market in place of costly portland cement, but for unknown reasons it is now totally out of market. Similarly high alkali soil may also be treated with gypsum to reduced water logging and saline soils.

*Coal.* Pakistan has over nine billion tons of lignitous to sub-bituminous coal reserves with an annual production of over 2 million tons [4]. Among important coal deposits of Pakistan Lakhra, Sonda, Meting, Badin and Tharparkar in Sindh region; Duki, Khost Harnai, Pir Ismail Ziarat, Sor-Range-Degari, Mach in Balochistan province and salt range and Makerwal in Punjab [7].

Its demand during 1988-89 was for household 14.6, power 50.6 and brick kilns 2,586 thousand metric tons respectively. In the year 1989-90 37,998 million kilo watt hour electricity was generated, out of which thermal energy share was 20,238 million kwh. Coal can be considered as one of the future energy sources for the increasing demand of electricity, because the future of other two supplies in Pakistan i.e. hydroelectric and nuclear are questionable. One of the biggest hydroelectric project the Kala Bagh Dam has recently became a political issue and the nuclear programme is being opposed tooth and nail by the western world. Paracha[8] concluded that Pakistani coal is suitable for thermal power plants. The utilization of coal as the conventional inexhaustible and cheaper source of energy. The only technical objection is that of pollution. Perhaps with advancing technology the use of coal is bound to increase astronomically once we are able to overcome this problem.

*Silica sand.* Pakistan has very large deposits of silica sand with production during 1989 - 90 was 136,000 tons [4]. It finds application in the manufacturing of glass, abrasives and refractories. At present only glass and glass products is the main consumer of silica sand. This industry show progress during the past years. During the year 1986-87 its production was Rs. 904 million [4]. Sheet glass and glass kitchen wares has considerable potential as an export commodity especially in the Middle East. Sheet glass may also find use as a possible substitute for metal etc. With necessary research some of the glass sand could be beneficated to the production of optical glass.

## Conclusions

Important industrial minerals have been evaluated by using Lorenz model [1] and a list of priorities have been deduced.

The top six minerals are discussed with reference to their reserves, production, present infrastructure, uses and export potential.

Suggestions have been made for better utilization, future demand and stimulus for export for the achievement of goal of self reliance through minerals.

Government sector has to extend financial assistance, establishment of technical education centres, proper amendments in labour and taxation laws, tax free import of relevant items etc. Also by minimizing political constraints we hope this sector would contribute its share in future development of the industrial economy.

## References

1. W. Lorenz, *Natural Resources and Development* (Institute of Scientific Co., Tubingen, W. Germany, 1985), Vol. XXI, pp. 7-16.
2. W. Ahmed, Report of Geological Survey of Japan, No. 261 (1981), pp 47-76.
3. A.M. Bateman, *Economic Mineral Deposits* (John Wiley & Sons Inc., New York, 1967), 2nd edn., pp. 916.
4. I.A. Malik, Seminar on: Self Reliance Through Minerals, National Geological Society of Pakistan, Islamabad, (1991), pp.59.
5. Z. Ahmed, *Directory of Mineral Deposits of Pakistan* (Records, Geological Survey of Pakistan, Quetta,1969), Vol. XV, pp. 220.
6. Z. Ahmed, *Geology of Mineral Deposits of Balochistan, Pakistan* (Records, Geological Survey of Pakistan, Quetta, 1975), Vol. XXXVI, pp. 178.
7. A.M. Khan, A. Mumtaz and G.R. Athar, *Significance of Coal Resources of Pakistan*, A.H. Kazmi and R.A. Siddiqui (eds.) (Geological Survey of Pakistan & U.S., Geological Survey, Karachi,1990), pp. 173-188.
8. S. K. Paracha, *Significance of the Coal Resources of Pakistan*, A. H. Kazmi and R. A. Siddiqui, (eds.) (Geological Survey of Pakistan and U. S. Geological Survey , Karachi 1990), pp. 227-237.