Global Competitiveness, Sustainable Development and Economic Empowerment of India through Mineral Resources & Management of its Competitive edge.

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Introduction

Environment without development would be life without opportunities & development without adequate environmental protection would destroy delicate natural balance. There should be planned and systematic explorations of natural resources, so that the tranquility of eco- system is not disturbed. In the new knowledge based & technology driven global economy, this can be achieved only by concept of sustainable development & by integrating our economic, environmental & social goals & policies with various levels of government within our country and across the globe.

THE MINERAL RESOURCES:

The mineral resources of the earth are the backbone of all economic development activities. It comprises both fuel (energy resources) and non- fuel mineral resources. Extraction of mineral resources from earth crust often results into deforestation and biodiversity erosion land

subsidence, soil erosion, disruption of underground water circulation water pollution, acid drainage and tailings generation (when ores are washed and concentrated); air pollution and solid waste generation .The Planet's mineral wealth has been tapped since pre-history. Most metals are obtained from non-fuels minerals of earth. About 24 billion tones of non –fuel minerals are mined worldwide every year for processing in industries to get materials of mass consumption such as iron, aluminum, copper, lead, nickel, tin etc. Our developmental programs depend heavily on some 80 minerals of which iron and aluminum is in abundance in earth crust and they are materials of mass consumption.

Some Important Non fuel Mineral Resources Used in Development Activities

Minerals	Resources Base	Expected Years of Supply
Aluminum Ore (Bauxite)	**232,000**	**2,388**
Iron Ore	**216,408**	**236**
Manganese	**50000**	**186**
Tin	**42800**	**21**
Chromium	**3350**	**374**
Cadmium	**970**	**46**
Titanium	**660**	**138**
Copper	**560**	**66**
Zinc	**295**	**42**
Mercury	**241**	**42**

Lead	**125**	**37**
Nickel	**121**	**144**
Antimony	**4.5**	**70**
Cobalt	**3.1**	**116**
Uranium	**2.4**	**Large**
Platinum Group	**0.037**	**176**

Source: the GAIA Atlas of Planet Management (1994)

Mineral Resources – Indian Perspective

Today India produces as many as 90 minerals, which includes 4 fuel 10 metallic, 50 non- metallic 3 atomic 23 minor minerals (building and other materials.) The national thrust on mineral resource development indeed paid a rich dividend in post-Independent India, which is clearly demonstrated by the phenomenal growth in mineral production, raising the value of indigenous mineral products from Rs. 58 crores in 1947 to about Rs. 30675 crores (excluding Rs. 26132 crores foroile and natural gas) during 2000-01 .Total value of mineral products has been increased in 2004-04 to Rs 75,018 crores, accounting for about 2.8% of GDP.

A critical study reveals that the exploration success in India is not far behind those of many developed countries but the growth profile in this sector would have improved significantly if the global standards for economic exploitation could be attained. Here comes the role of judicious planning and management of the identified resources for sustainable development based on

modern concepts, keeping in view not only the present needs but also securing the perceivable interests of future generations. It is of paramount importance to realize that the mineral resources of all kinds are non- renewable assets and improper management of the same may inflict irreparable loss to the country and its citizens. The different categories of minerals are presented in the table below :

Sl. No	**Mineral Grouping**	**Abundant**	**Adequate**	**Deficit**	**Scarce**
1.	Fuel	Coal (Non-coking)	Lignite	Coal(Coking)	Petroleum Crude
2.	Metallic Minerals				
i.	Ferrous	*L*ron ore	Chromite (Metallurgical Grade) Managanese Ore	Chromite(Refractory grade)	Nickel Tungsten Cobalt Molybdenum, Vanadium
ii.	Non – ferrous	Bauxite (Metallurgical grade)	zinc	Bauxite (Chemical. & Refractory grade) copper, Lead	Antimony Gold Platinum Group metals, silver, Tin

3.	Industrial Minerals	Barites, Ballclay, bentonite, Dolomite (excluding low silica grade) felsper, fire clay, fuller's earth/Garnet, Gypsum, lelmenite & Rutile, Kaolin, Limestone, Magnesite, Mica pyrophyllite, pyrite, Ochre, Quartz & Silica sand, Quartzite, Beach. sand, sillimanite, zircon, steatite			
4.	Precious Stone				Diamond Emerald

Life indices of some important minerals

(In million tones unless otherwise stated)

SL. No	**Minerals**	**Total Recoverable Reserve as on 1.4.2000 (proved + probable**	**Domestic Production from 1.4.2000 to 1.4.2003 (3**	**Balance Reserve as on 1.4.03 (proved + probable**	**Life index after 1.4.2003 based on total/ proved + probable reserve (Yearly depletion**

		reserve in parenthesis	**yrs), actual & probable**	**reserve in parenthesis**	**rate in parenthesis)**
1.	Bauxite	2462 (1354)	24	2348 (1330)	300/166 yrs (8 m.t.)
2.	Chromite	97 (56.60)	5.90	91.10 (50.60)	45/25 yrs (2 m.t.)
3.	Copper ore	537 (332)	10.48	526.52 (321.52)	150/92 yrs 3.5 m.t.)
4.	Lead-zinc	176 (118)	8.00	166 (110)	60/40 yrs (2.7 m.t.)
5.	Iron ore (Hematite)	10,052 (7,475)	240	9812 (7235)	122/90 yrs 80 m.t.)
6.	Manganese ore	167 (86)	4.80	162.20 (84.20)	35/20 yrs (1.6 m.t.)
7.	Limestone	75,678 (28,766)	380	75,298 (28,386)	580/218 yrs (130 m.t.)
8.	Dolomite	4386 (1301)	9.00	4377 (1292)	1459/430 yrs (3 m.t.)
9.	Rock phosphate	145 (105.40)	3.75	141.25 (101.65)	112/80 yrs (3 m.t.)
10.	China clay	1042	2.40	1039.60	1298/430 yrs

		(347)		(344.60)	(0.8 m.t.)
11.	Gold ore	17.8 (14.17)	1.50	16.30 (12.67)	32/24 yrs (80.50 m.t.)
12.	Diamond (Carats)	981515 (851156)	17200	8,09,515 (6,76,156)	14/12yrs (57.000 carats)

The above table more comprehensively reflect the strength & weakness of the resource base though faster rate of depletion without the adequate replenishment might off set the projection.

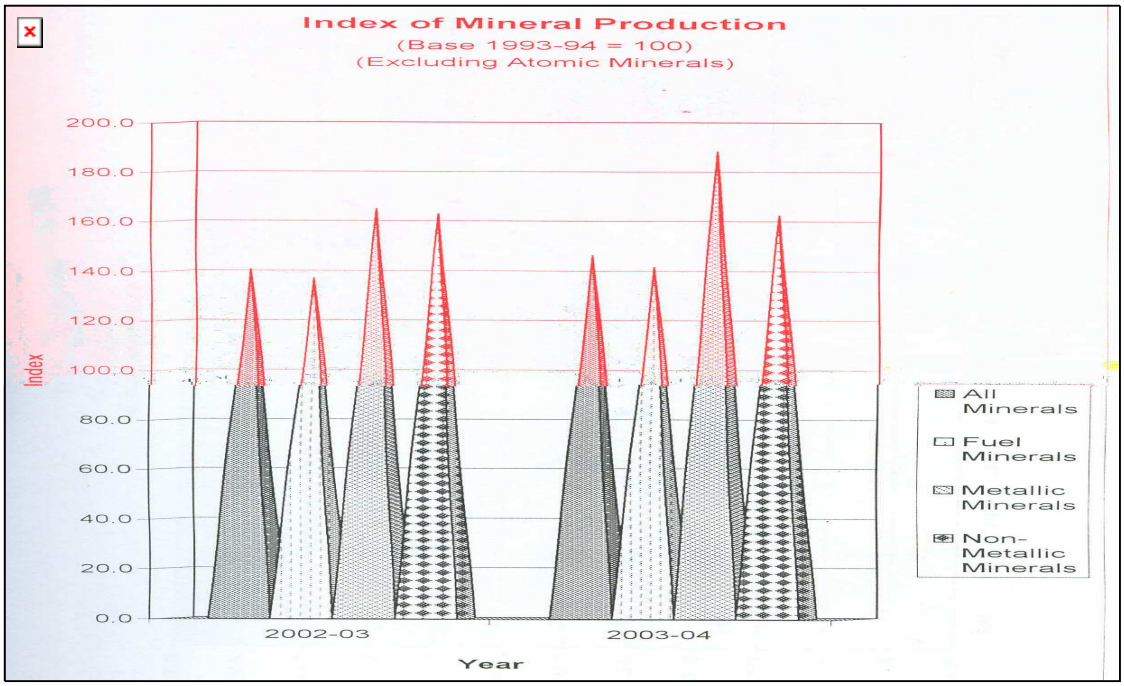
Growth of mineral production in the country (1948-2005)

(In million tones unless otherwise spectied)

Mineral/Ore	Decade-wise growth (1948-1988/89)					Growth during (1991/92-2005)						
	1948	1958	1968	1978	88-89	91-92	95-96	99-2000	2000-01	2000-02	2003-04	2004-05
Coal	30.33	46.03	70.61	101.34	194.37	229.35	273.41	304.10	309.62	327.64	361.15	382.13
Lignite	0.07	0.02	0.13	3.61	12.59	15.18	22.14	22.12	23.55	24.80	27.92	30.34
Natural Gas (mil. C.u.m)	-	-	0.60	1.72	9.25	14.44	20.93	26.88	27.86	27.86	30.90	30.82
Petroleum	0.25	0.44	5.85	11.27	32.04	30.34	34.52	31.95	32.43	32.04	33.37	34.01
Bauxite	0.023	0.17	2.13	1.66	4.39	5.01	5.56	7.05	7.89	8.58	10.92	11.70
Chromite	0.023	0.064	0.213	0.77	0.93	1.08	1.70	1.74	1.95	1.81	2.92	3.64
Copper Ore	0.327	0.111	0.484	2.13	5.13	5.21	4.74	3.08	3.48	3.49	2.90	2.93
Dolomite	0.083	0.177	1.28	2.00	2.26	2.95	3.72	2.87	2.96	3.09	4.05	4.30
Gold (kg)	5612	3291	3588	2774	2011	2041	2036	2586	7554	2810	3049	NA
Iron Ore	2.329	9.055	27.05	39.29	49.91	58.53	67.42	74.94	79.21	86.22	122.83	142.71
Lead conc.(t)	1346	3341	3365	16834	40485	53255	61583	62899	54487	52386	59132	NA

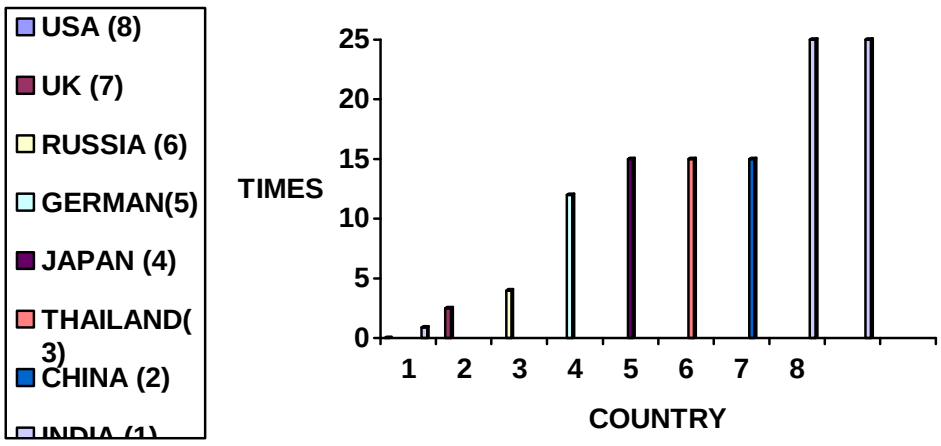
Limestone	**4.05**	**10.53**	**21.03**	**31.06**	**65.31**	**77.18**	**96.83**	**128.79**	**126.07**	**129.77**	**153.39**	**161.46**
Manganese Ore	**0.54**	**1.38**	**1.61**	**1.62**	**1.39**	**1.64**	**1.84**	**1.58**	**1.56**	**1.55**	**1.77**	**2.37**
Silver (kg)	**398**	**3416**	**2026**	**12138**	**38928**	**35556**	**35531**	**53641**	**64684**	**57672**	**NA**	**N A**
Zine conc.(t)	**-**	**7391**	**12839**	**66026**	**121993**	**252540**	**289072**	**360138**	**365164**	**399105**	**485,976**	**590,000**
Tin Cone. (Kg)	**-**	**-**	**-**	**570**	**25137**	**115085**	**54991**	**22812**	**12979**	**13887**	**10630**	**NA**
Tungsten Conc. (kg)	**-**	**-**	**39103**	**10749**	**33808**	**7755**	**6451**					

The above table indicates the growth profile of the country during post inde pendent era. It testifies the phenomenal growth in the initial decades, a much lower rate of growth in the later period (except a few) & recent upturn for some minerals during the last few years.



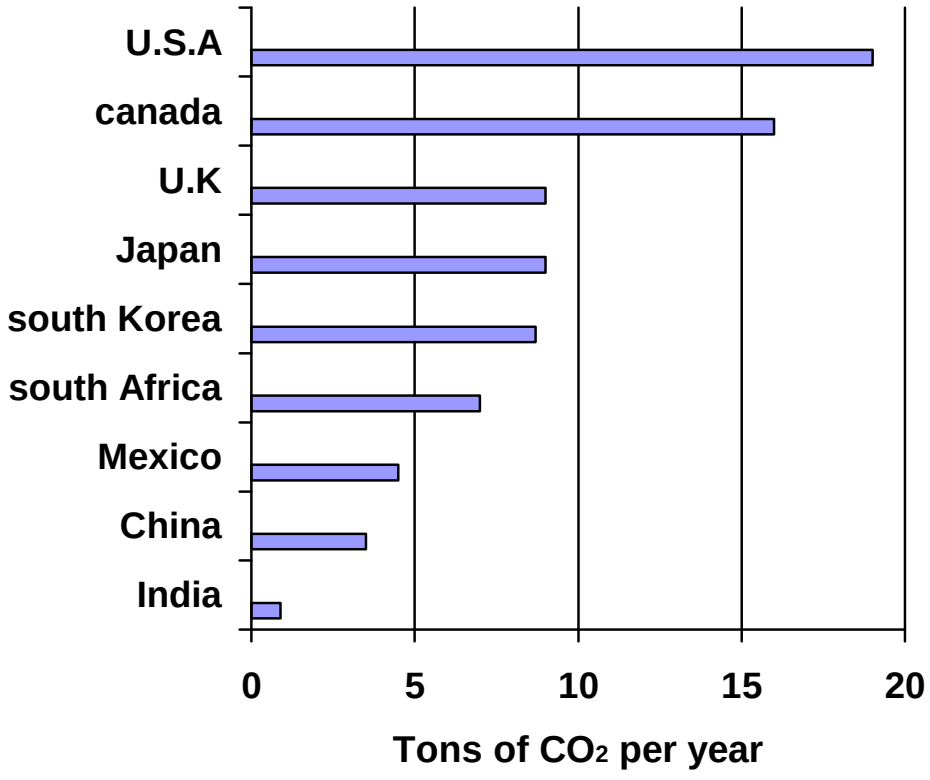
Politics of Climate change

It is a paradox that America which is not a signatory to the Kyoto Protocol announced on 31st May 2007, that it would exercise pressure on India & china for a long term global goal & for minimizing the emission of green house gases. But it is a fact, that India is consuming least energy in comparison to America which is consuming maximum. Presently Indian is emitting 1.5 tons/ capital year in contrast to USA 18 ton/ capital year. Taking into consideration the above fact, America should not pressurize India to reduce carbon dioxide which would be at the cost of industrial growth.



Energy Consumption Unit Per Capita in Different Countries

However, it is a matter of pleasure that USA for the first time at Bali Conference on 15th Dec. 2007 admitted that Pollution causes global warming will have to be cut drastically by 50% by 2050. At the Bali conference, the important concept emerged that the developed nations accepted ‘’deep cuts would be needed in their pollution while developing countries agreed to undertake, measurable defined & verifiable mitigation of these. They also agreed for the transfer of technology.



Per Capita Co2 Emission in 1995

Mineral Resources:- Competitiveness

Minerals are important raw materials for many industries and a major input in industrial development. The management of mineral resources has to be integrated with the overall strategy of development keeping in view the present and future demand of its competitiveness in global market. National Mineral Policy should be framed taking into consideration reforms in exploration and exploitation, conservation, foreign investment and participation and recent technology. Besides, care should be given on fiscal regime, trade tax etc, because mineral industry is highly risk prone with regard to time price and capital. With the onset of globalization and liberalization, the mineral industry has now to gear up, not only to domestic competition but also to global competition in terms of productivity, quality and prices. The trade liberalization has slashed down the price of products and made them available to large number of consumers. The prices of minerals have been declining in recent years.

The world mining industry has promptly responded to the decline in prices and taken the following measures:

1. Identifying and developing quality mineral deposits.
2. Increasing mining operation.
3. Replacing labour with capital.
4. Improved labour laws and industrial policy.
5. Increased environment management.
6. Caring for all (consumers, workers, people, etc.) by efficient governance.

Out of a total global world product of 30 trillion dollars, the share of mineral industry is 6%. By the end of 2004, 35 billion tones of mineral were produced globally and they provided 5 tonnes per capita. About 90% of world's primary energy production is based on mineral fuels. Due to rapid economic development of some of the Asian countries like China, Malaysia, Philippines, Indonesia and Thailand etc. consumption of minerals has increased in recent years. The demand is likely to increase in coming years because of expected higher quality of life.

The Indian economy is the fourth largest in the world and second largest among developing countries. The country has vast mineral deposits with over 2000 known mineral deposits comprising mineral fuels, metallic and industrial minerals.

India's competitiveness depends on its share in world market. The export of minerals is less than 1% of the total trade of minerals in the world. Important minerals exported are: Iron ore, Granites, Mica, Alumina, cut and polished diamonds etc. India is not self sufficient in resources in petroleum, coking coal, copper, lead, Zinc, Nickel, Tungsten etc.

It is clear from the above figure that India has lagged far behind in the International trade. Although development over regulation has been emphasised in new "Mines and Mineral Act", we have lagged behind in the following sector:

1. Progress of privatization.
2. Infrastructure development.
3. Sufficient investment in exploration.

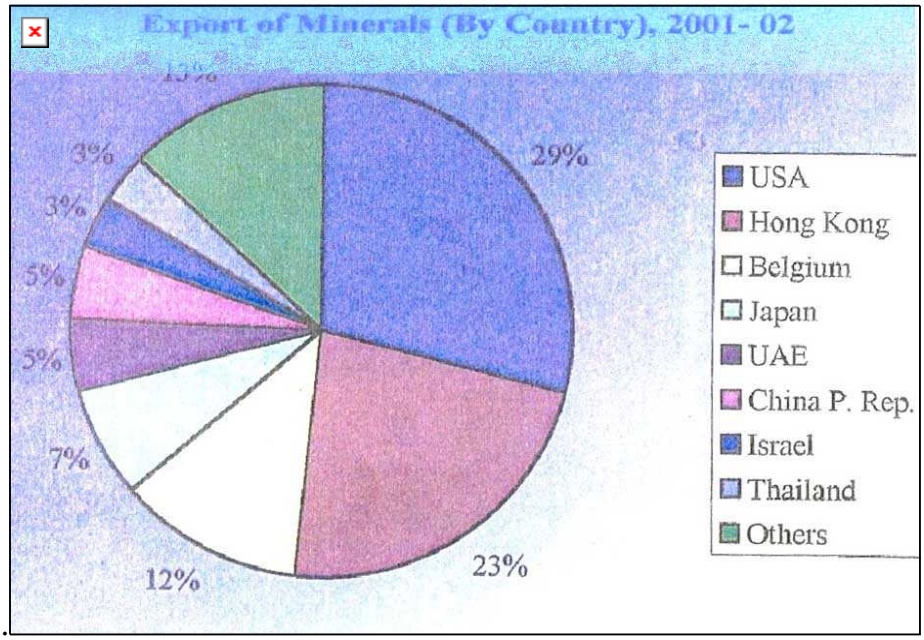
4. Beneficiation of low grade ore.
5. Organizational reforms etc.
6. Use of integrated recent technologies viz, Remote sensing, GIS and GPS and ICT technology.
7 Data Base Management.

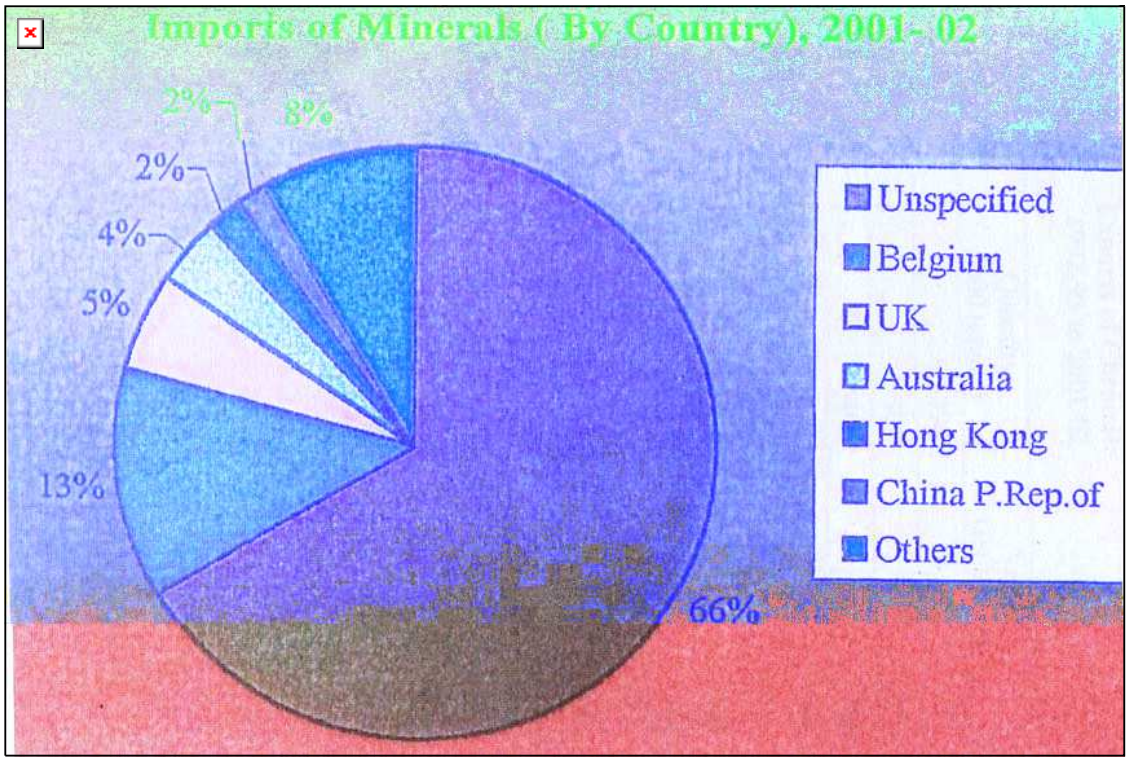
Therefore special attention should be given on the following factors for global competitiveness.

1. Domestic economic strength.
2. Internationalisation of trade.
3. Quality of human resource.
4. Quality of management cadre.
5. Development of Infrastructure.
6. Reforms in National Policies.

Status of Export / Import of Minerals

The value of export went up gradually from Rs. 11,700 crores in 1992'93 to Rs.35,136 crores in 2001-2002. Diamond (cut) accounted for 80% of the total value followed by iron ore 6% and ranites 5%. The value of import also went up from 20,289 crores (1992-93) to Rs. 92,797 crores (2001-2002)


Export of Minerals (By Country), 2001- 02
29%
23%
12%
7%
5%
5%
3%
3%
USA
Hong Kong
Belgium
Japan
UAE
China P. Rep.
Israel
Thailand
Others


Imports of Minerals (By Country), 2001- 02
66%
13%
5%
4%
2%
2%
8%
Unspecified
Belgium
UK
Australia
Hong Kong
China P.Rep.of
Others

Sustainable Development

In 1987 the world commission on Environment and Development to the United Nations (UNCED) was established. This commission published famous Burndtland Report which defined sustainable development as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’. This has been interpreted as meaning that each generation must rely on the use of renewable resources, and to reuse and recycle waste materials before considering taking ‘virgin’ resources from the earth which cannot be replaced. In this way we must adopt a way of life which passes on the earth’s resources undiminished to the next generation. This encompasses the concepts of ‘stewardship’ of the earth, and living within its’ carrying capacity’.

The key objectives of sustainability include:

1. Reviving economic growth so that it has a reduced impact on the environment by using less materials and energy;
2. Meeting essential needs for jobs, food, energy, water and sanitation;
3. Ensuring a sustainable level of population;
4. Conserving and enhancing our natural resource base;
5. Reorienting technology and managing risk;
6. Merging ecological and economic considerations in decision- making.

The key to growing sustainably is not to produce less but to produce differently in a way which is environmentally friendly and compatible i.e. by embracing the philosophy of 'Cleaner Production; not to consume less but to consume judiciously and efficiently within the regenerative capacity of Earth ecosystem and with minimum waste generation.

The Agenda 21 (agenda for the 21st Century) was adopted at UNCED. It was the blueprint for global sustainable development. In the opening lines of Agenda 21, the nations of the world pronounced that – 'Humanity stands at defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, ill health and our well-being. However integration of environment and development concerns and greater attention to them will lead to the fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer more prosperous future. No nation can achieve this on its own, but together we can-in a global partnership for sustainable development'.

The new paradigm of development is not the game of economics alone. All issues-economic, ecological, social (health) cultural (educational), legal (legislative), political and technology have to be merged into a collective decision making for sustainable development. They are mutually reinforcing. Technology plays greater role as they drive development.

Earlier economy was at the center of decision- making. This assumed that all environmental problems could be solved if economy was sound. This has become an obsolete theory, Now ecology has to be at the center. We have to Integrate ecological thinking into social and economic planning. The developmental activities have to be 'economically viable', 'ecologically compatible', 'socially equitable', 'culturally acceptable' and politically justifiable'. Then only it can be environmentally sustainable. This will require giving up the culture of consumerism', 'producing less consumers' that the earth can sustain and also achieving 'equity in resource use

and consumption' across the world. Over- consumerism and too much of prosperity in one part of the world, or overpopulation and poverty in other part, would thwart the spirit of sustainable development.

Negligence in protection of environment in mining and mineral processing industries had severe adverse effects on forest cover, land use potential, water and air quality and so on leading to vastly degraded conditions in the areas of activity. With the growth of general awareness and enunciation of adequate legislation and statutes, the maintenance of environmental balance is largely ensured today while striding for any economic development and the mining and mineral industries are no exception. The other positive factors are the voluntary organistions working for environmental protection and the vigilant media as well as proactive judiciary. The corporate sector is also voluntarily obtaining ISO 14001 certification after meeting all the stipulations of environmental management. Besides environmental aspects, the sustainable development in this sector also means preventing the squandering of the deposits by winning the cream portion only and leaving the leaner parts in unexploitable state for the future generations. Non – extraction of associated minor elements from the ore (wherever economically feasible) by avoiding adoption of upgraded technology is also against the principle of sustainable development.

Biomining: New Approach towards Sustainable Mining

Microbes are now being used in the mineral processing industries to leach 'sulfide ores'to recover copper, nickel, zinc, molybdenum and cobalt, and to pre – treat ores prior to extraction of gold, Bacterial processing has been part of copper mining industry for over 40 Years.

In recent years it has been recognized as an economically viable and environmentally sustainable technology for the mining and processing of precious metal ores and concentrates containing high

levels of ‘sulfide minerals’. Rod shaped bacteria called. Thiobacillus and Leptospirillum, eat forms of sulfur and iron instead of the normal organic carbon- based diet. Biomining by bio-oxidation of mineral ores can reduce capital costs by 12 to 20%, operating costs by 10% and construction time by 25%. Recovery rates are higher, and in the case of gold can lead to increase in production ranging from 2 to 13%. Under controlled conditions, such as in agitated and aerated tanks and in specially constructed heap leach pads gold’s bio-oxidation is rapied and highly effective. In 4 to 5 days, a sulphidic gold concentrate is bio-oxidised to achieve greater than 90 % gold recovery. New class of ‘hyperthermophile microbes’ has been discovered in the Bismark Sea, north of papua New Guinea.They are endowed with the natural ability to extract and process minerals from their ores at high temperatures .They grow fastest between 80 and 100oC. About 60 spices of hyperthermophiles have been discovered .These deep sea microbes can survive at surface and also be grown under laboratory conditions .They are all anaerobic , and gain their energy by using sulfur or nitrate to oxidize the reductive gases such as hydrogen ,Biominig have significantly less impact on the environment

These microbes are also finding uses in treatment of toxic tailing resulting from mining activities. When bacterial leaching is used with a solvent extraction electrowinnng (SX-EW) plant, base metal operations are capable of producing metallic products without smelting and refining

Some of the remedial measures for the control of the quality of the environment proposed by various authorities has been present below:

1) Improve the existing mining condition and operations.2) Removal or minimization of pollution in the environment.3) Installation of some air pollution control instruments in working environment.4) Industries should follow environmental pollution control laws and their effluent

standards. 5) Waste management, protection of biodiversity, land scape, air water, climate and ecosystems.6) Regular monitoring work for assessment of quality of environment. 7) Industrial effluents should be treated in effluent treatment plant (ETP) before their discharge into any water bodies.8) Development of green belt in mining and mineral industry complexes.9) Development of environmental awareness among people for protection of the environment.10)Solid and hazardous wastes should be disposed at proper land fill sites.11) There should be land reclamation plan12) Plantation in and around the mining and industrial complexes.13) Polluters must pay for it.14)Mineral industries should follow minerals industry code.15)Environmentally sound mining practices should be followed.16) Quality of life (QOL) based development planning for mitigation of societal impacts.17)Training of environmental personnel. Environmental education and pollution control through engineering interventions.

Management of mineral resources has to be an integrated national effort for development and there fore the mineral resource build-up and exploitation are to be guided by long-term national goal and perspective. This is not going to converge entirely with the short-term profit motivated activities guided by the market economy. As such joint participation and assumption of respective responsibilities by both the private and government agencies are of paramount importance. Minerals and mineral products are essential for our sustenance and development. There is no alternative to locating more and more of mineral resources in country and their judicious utilization. Therefore, mining and mineral industry is to be protected and proliferated, keeping a balanced view of the need for environment and other protection measures in vogue.

Lackadaisical attitude towards the environmental protection issues by the miners insensitivity towards societal responsibility, lack of infrastructure and upgraded technology compounded the deterrent effects on the growth of the mineral sector.

In the mineral industry the issues involved are:

- Non renewability of mineral resources,
- Resource conservation and management,
- Preservation of biological diversity,
- Degradation of land,
- Solid waste disposal,
- Mining in ecologically fragile areas,
- Finding new materials to substitute minerals
- Transferring funding of environmental research to commercial practice.
- Minimizing or absorbing cost of environment management.

The approaches to environ management can be as follow:

Environment Management Approaches

a) preventiue Approach

- Study of situation.
- Pre-plan for environment protection as integral part of the project.
- EIP, EM.P. Keep in mind carrying capacity.
- Chose production process eco- friendly.
- Prepare mind set of people.
- Monitor at each stage.

b) problem soling Approach- (Curative)

- Repair damages to environment.

c) command and Control Approach-

- Policeman's approach. Catch law breakers and punish, close industry etc.

d) productivity approach-

- Waste converted to resource e.g. garbage used for energy, emissions of cokeplant products.

- Fly ash used for making bricks e.t.c

e) Enlightened self interest, with value based ethical (Dharmic) approach.

f) Eschew- fundamentalist approach, ''sage on stage''- approach –mining needed for

i) Sustenance of human race

ii) Pollution control.

There has been legislative provisions through forest conservation Act, the Environment protection Act, the Forest Conversation Rules, the Water Prevention and control of Pollution Rules, the Air Prevention and control of Pollution Rules, Hazardous waste management Rules, the manufacture storage and import of Hazardous chemicals Rules notifications for coastal Regulation Zone and submission of Environment Audit statement etc.

Methodologies for Environment impact assessment and preparing Environment management plans, procedure for clearances are now practiced. Environment protection and maintenance of ecological balance are thus ensured for new projects.

At the same time guide- lines have been laid for closure of pits, dealing with exhausted mining areas and development of the neighbour Iood. There are some international guidelines on mining and mine environment. These are:

1) UND. P's Environment Management Guidelines,
2) Berlin's Guide lines on mining and Environment 1991
3) UNDP- UNRFNRE Guide lines.
4) UN EP Technical guide lines on Environmental aspects of Mining–
5) UNDCD Draft Environmental Principles and Guide lines on mining in Development Countries

Suggestions:

Some salient suggestions for minimizing the impact of mining on environment are:

-Substituting minerals, metals by new man – made materials,

-In – situ mining through chemical or biological process,

-use of integrated G.P.S and GIS systems for surface mining

-Development of intelligent mine and tele- robotic mining for remote places like ocean bed or mountain top.

-Use of new tools of information Technology and micro electronics

Conclusion:

The Indian concepts of environment protection are unparalleled. Nature is raised to the level of God and invoked to remain in peace and harmony with the animate and inanimate ‘’Dharma’’ (moral duties and obligations) includes worship of ‘’Panch Mahabhoot’’ viz, earth, water air, ether and fire. It teaches us that the whole creation belongs to God. One should enjoy the fruits of creation but never be tempted to take any one else’s share. In effect it means keeping the development within the “carrying capacity” of the environment which equals assimilative capacity plus supportive capacity. Mankind will perish if the protection of the environment does not become an integral part of all technology development, planning and management.

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