

Sustainable Mining and Environment

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I have great pleasure and feel privileged to be a part Prof. S.K. Bose memorial lecture organized by my alma mater, i.e. Indian School of Mines, Dhanbad. I am sure that I will be able to highlight various issues related to sustainable mining practices while preserving the ecology.

While we talk and use the word "sustainable" casually, its interpretation is as varied as that of "democracy". However, the World Commission on Environment and Development, popularly known as Brundtland Commission (constituted in 1983), in its report submitted to UN in 1987 defined sustainable development "to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs".

The alarmist attitude of certain house of thoughts is probably because of the fact that they are unmindful of phenomenal technological developments. Minerals are elements of nature and are therefore re-cycleable. Today metals are being re-cycled upto 80-90% (more than half of the metals used in Europe are from recycling) and there are also better and more efficient utilizations of these resources. Over the course of time, the efficiency of usage of metals has increased by a factor of four and subsequently to a factor of ten. New technological developments have since taken place, which has put the apprehension of depletion of resources way behind.

I believe that there cannot be any unbridled exploitation even if one wants to, because of limitation of market forces. One can exploit to the extent it is demanded and at an economic price. The myth that the present generation is exploiting resources unmindful of the future generation is not borne out by facts. Scientific and technological developments have made today's waste into tomorrow's resources. It may be possible that what we preserve today, the future generation may not require that at all. We cannot therefore envisage what the world will require, let us say, 100 years hence at that level of technological developments.

We are aware that minerals are the building blocks of our society and mining products have shaped human civilization from the Stone Age to the modern Information age. It is hard to conceive a world without mining, a world without buildings, roads, cars, trains, aero planes, ships, television, computers, etc. In this lecture hall, everything except wood/furniture is the product of mining activities.

India is endowed, with a wide variety of minerals resources. The country produces about 89 minerals. The total value of mineral production in the country has consistently increased from a level of Rs 58.438 crore in 1947. The total value of the mineral output in 2009-10 was estimated to be Rs 1,27,921 crore contributing about 2.87 % of the GDP. But this is the economic figure with which I personally do not agree as mining is involved directly or indirectly in every sphere of our life.

Our per capita value of mineral production and per capita mineral consumption are woefully low compared with industrially advanced countries. If one studies the economics of modern industrial nations, one sees a close relationship between per capita value of mineral production and national prosperity or economic growth. In general, increase in living standards will demand increase in per capita mineral consumption and hence increased mineral production. Maintaining the existing living standards with increasing population will naturally demand greater exploitation of mineral resources.

The economic growth in the country has been on an upturn supported by step-up in infrastructural investments and pick-up in demand for commodities. Large investment are proposed over the next several years in infrastructure (ports, airports, roads) and manufacturing sector has the potential to sustain the growing demand for minerals and metals. The vision statements for various core sectors of the economy show the increasing demand for minerals and for meeting these demands the mining sector of the country will have to expand greatly. Therefore, stage is set for mineral sector to grow.

Therefore, the expanding mineral sector has to be closely integrated with the overall strategy of development. The exploitation of minerals is to be guided by long-term national goals and perspectives. This would essentially require an effective mechanism and co-ordination for regulation of mineral sector both at Central and State level. This means that the regulatory systems such as Indian Bureau of Mines at the Central and State Directorate of Mines & Geology at

the State level would require to be strengthened suitably to gear up for effective regulation of the mineral sector.

The Three Circles of Sustainable Development

A widely held view of sustainable development is that it refers at once to economic, social and ecological needs. According to this view there must be no single focus (or object) of sustainability, but instead all economic, social and ecological systems must be simultaneously sustainable. Satisfying any one of these three sustainability circles without also satisfying the others is deemed insufficient. Each of the three circles is independently crucial, but they are interconnected. There is, therefore, a risk of unwittingly causing or worsening problems in one system while attempting to correct problems in another. The only sure way to avoid this is to integrate decisions such that effects in all three systems are considered before action is taken.

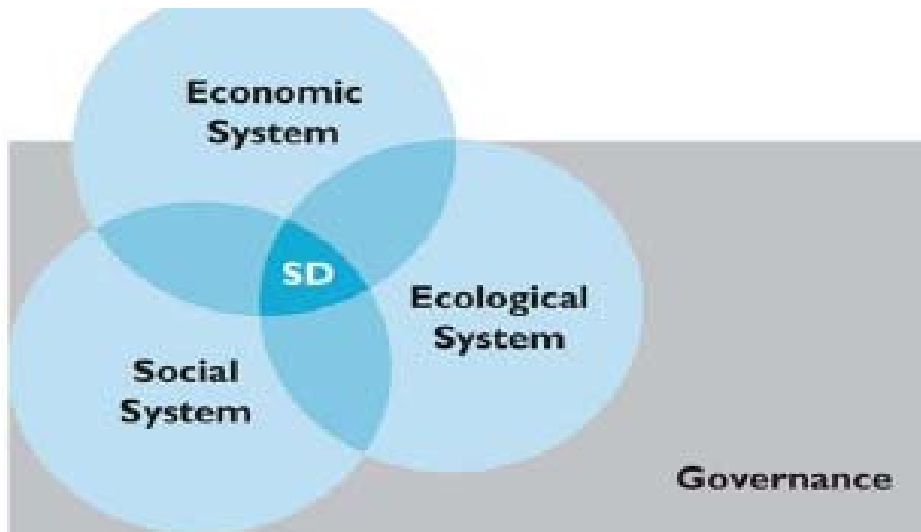


Figure 1. Three pillars for Sustainable Development

Economic Sustainability

The concept encompasses traditional theory on economic growth that is, determining optimal economic growth with a given capital. The premise is that future generations can only be better off if they have more capital per capita than we have today. It is immediately obvious that population growth is inimical to sustainable development since it 'dissipates' the capital stock. Technological change, on the other hand, enables a given capital stock to generate more well being per unit of the stock.

From the viewpoint of a mining company, sustainability means locating and developing mining projects to provide returns to shareholders, as well as funding for exploration to find or acquire replacement projects. Some companies, such as the Benguet Corporation of the Philippines, once a major producer of gold, copper and other minerals, have sustained themselves during downturns in the industry, by alternative revenue-generating activities such as real estate development. Profit is clearly the main requirement for sustainability of any commercial enterprise. Most companies aspire to be sustainable; however, many do not achieve this goal, whether due to poor management, lack of profitability, take-over, or inability to find replacement projects. The main disincentive for a company is the lack of security-of-tenure over its mineral resources, and it is unlikely that any Board of Directors would approve commitment of capital for a project that lacked such security.

Commonly during the planning stages of a project and continuing into the operating stage, a mining company is under pressure to contribute funds or efforts to a wide range of programs. The company may be reluctant or unable to make significant contributions until operations are underway and a positive cash-flow is established. As negotiations take place during the environmental permitting process, the company may commit to future contributions and it is important that these commitments be sufficiently conservative that they can be afforded under all reasonable financial scenarios.

Benchmarks for economic sustainability in Steel Industry

Indicator	Unit	Value
Investment in new processes and products	% of revenue	9.0
Economic value distributed	% of revenue	70.4

Source: World Steel Association

Social Sustainability

The social circle of sustainability addresses issues such as poverty, health, education, local empowerment and maintaining culture and heritage. Although social norms change over time, sustaining social and cultural systems is important. Social sustainability has obvious linkages with economic development in terms of addressing poverty and local input into economic decision-making. Linkages with environment development focus on the allocation and distribution of natural resources to future generations as well as local empowerment over natural resource management.

From the viewpoint of a community hosting a mining operation it is important that the mining operation itself is not perceived to be sustainable in the sense that it will continue forever. All mining projects have finite lives. Communities should be well informed so that their expectations are realistic. While there are examples of communities which have been supported by mining operations for more than 100 years, there are many more examples where mining has ceased after much shorter periods. In some cases the associated communities have declined substantially or disappeared totally, as in the case of 'ghost towns', the remnants of abandoned mining communities. This is not to suggest that there is anything intrinsically wrong with temporary communities. Many mines are developed in remote, unpopulated areas with no other potential source of employment and, in such cases, there is usually no reason for the community to be sustained, once mining ceases.

The mining industry itself, however, can be considered as sustainable, as there will always be ores to be mined. This follows because the elements which combine to form ores remain at or close to the earth's surface, even after they have been used. When the higher grade, readily accessible ores have been mined, lower grade and/or less accessible ores will be mined. And, in the future, particularly if production costs increase, it can be expected that more and more mineral and metal products will be produced by recycling.

In many cases, the communities that have developed in association with mining have continued long after mining has finished, albeit on a reduced scale. Examples in Australia include many of the larger inland cities, such as Ballarat and Bendigo, which continue to exist and ultimately to thrive following conclusion of mining. What is important to a community considering becoming host to a new mining project, is that the community itself is sustained during and after mining. This usually means that the pre-existing livelihoods and economic bases are maintained and that additional means of income generation

are developed to replace mining, once operations cease. An excellent example is hunter valley of Australia which was historically a coal mining area, later on rehabilitated as horse & cattle breeding, fruit farming, tourism etc.



Figure 2. Hunter valley of Australia

The disastrous condition of **Jharia Coalfield** is the living example of poor vision towards sustainable mining. More than 400,000 people resides are living on land in danger of subsidence due to the fires. It will not be an exaggeration to say that Jharia township is on the brink of an ecological and human disaster. The government has been criticized for a perceived conniving attitude towards the safety of the people of Jharia.

The subsidence, which causes loss of agricultural land and damage to surface structures, is severe in the Jharia coalfields. The magnitude of mine fire problems is very large in the Jharia coalfield which is dotted with several fires. The fires have pockmarked the coalfield and threaten main railroads and highways in many places. Heavy fumes emitted by the fires lead to severe health problems such as breathing disorders and skin diseases among the local population. These environmental problems, which are already critical, are being magnified because of the increasing quantum of output, increasing mine size and concentrated production in Jharia. These issues needs a quick redressal otherwise mining industry will be blamed of overlooking safety, health and environment.

Benchmarks for Social sustainability in Steel Industry

Indicator	Unit	Value
Lost time-injury frequency rate	Injuries/million hrs worked	3.6
Employees' training	Training days/employee/year	5.1

Source: World Steel Association

Corporate Social Responsibility

Corporate social responsibility is basically a concept whereby companies decide voluntarily to contribute to a better society and a cleaner environment. Corporate social responsibility is represented by the contributions undertaken by companies to society through its business activities and its social investment. This is also to connect the Concept of sustainable development to the company's level.

Over the last few years an increasing number of companies worldwide started promoting their Corporate Social Responsibility strategies because the customers, the public and the investors expect them to act sustainable as well as responsible. In most cases CSR is a result of a variety of social, environmental and economic pressures which is not desirable and can deter the objective of its successful implementation.

As per the new MMDR Act, 2010, Union government of India is going to make it mandatory for all mining companies to spend a part of their net profit on the welfare of local people affected by the activities. Coal miners have to shed about 24% of the retained earnings towards the stakeholders (original land

owners). Other sectors also have to contribute towards the same cause by way of depositing double the royalty amount in the Govt. exchequer. However, the Govt. decision faced a lot of criticism from various corners of the mining industry of India.

Ecological Sustainability

The ecological circle of sustainability is concerned with maintaining the physical/chemical and biological environment to preserve resilience and the ability of natural systems to adapt to change, protecting from degradation the ecological processes, functions and cycles that are fundamental to life on Earth.

An obvious linkage with economic development is through the supply of raw materials for production and the use of the environment as the final waste sink. One linkage with social sustainability is through the level of local participation in natural resource management.

All mine developments intrinsically involve 'trade-offs' between potentially conflicting goals, such as mineral exploitation and respecting traditional land rights, or economic growth and environmental conservation. The challenge is to optimize trade-offs between and across the three spheres basic to sustainable development.

According to IPCC the steel industry accounts for 3-4% of global greenhouse gas emissions and over 90% of steel-industry emissions come from 9 countries/regions: Brazil, China, EU-27, India, Japan, Korea, Russia, Ukraine and USA.

Bench marks on Ecological Sustainability of Steel Industry

Indicator	Unit	Value
Greenhouse gas emission	Tonnes CO ₂ /tonnes of steel cast	1.7
Energy intensity	Gcal/tonne steel cast	4.28
Material efficiency	% of by-products re-used	98.1
Environment Management System (EMS)	% of employees in EMS registered production facilities	86.6

Source: World Steel Association

Between 1990 and 2010, the North American steel industry reduced the CO_2 intensity per ton of steel produced by 33 percent and energy intensity 27 percent as a result of industry's voluntary investments in R&D and resulting new technology.

The Steel Industry Improved its Energy Efficiency by 27% Since 1990

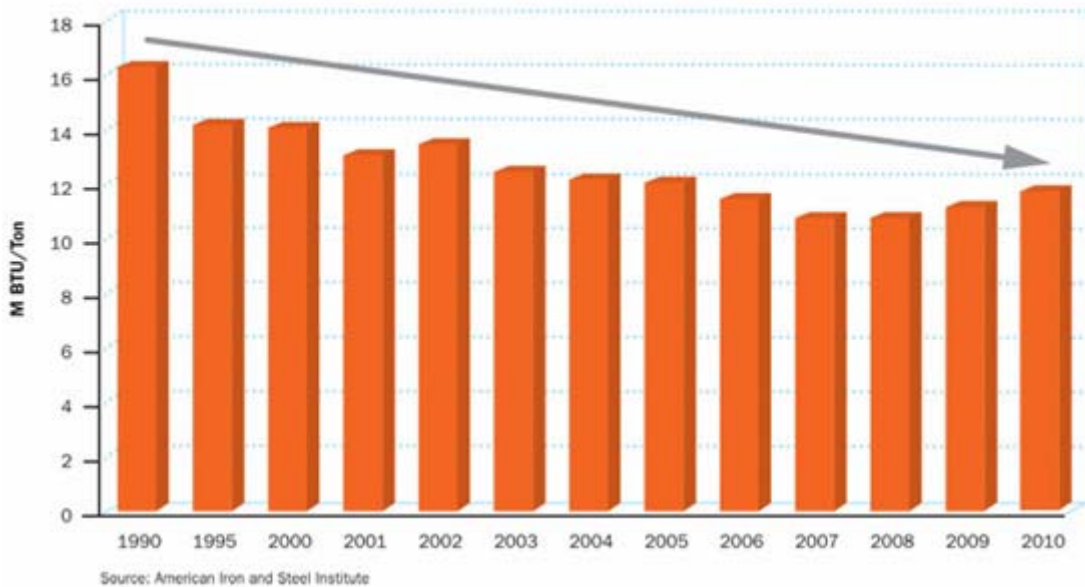


Figure 3. Energy consumption per ton of steel

Today, the American steel industry operates with the lowest energy consumption per ton of steel produced in the world. Efforts to achieve incremental improvements in energy use and CO_2 emission reductions will continue, however, in order to make major reductions in future energy/ CO_2 reductions, new methods of making steel will require completely fresh and innovative thinking.

Coal used primarily for the generation of electricity, now accounts for roughly 20 % of global GHG emissions and rising energy demand will continue to drive up coal consumption, particularly in countries with large reserves such as the United States, China and India.

- One 500-MW coal-fired power plant produces approximately 3 million tons/year of carbon dioxide (CO_2).
- The United States produces close to 2 billion tons of CO_2 per year from coal-burning power plants.
- GHG emissions from coal-fired electricity, now 27 percent of total U.S. emissions, are projected to grow by a third by 2025.

However, [Coal Industry](#) is committed to minimizing its GHG emissions and action is being taken in a number of areas. Research from the International Energy Agency (IEA) has found that replacing older coal-fired power stations with larger more efficient plants could reduce global GHG emissions by 5.5%.



Figure 4. GHG emission from a power plant

[Carbon capture and storage \(CCS\)](#) offers the opportunity to further reduce CO_2 emissions to the atmosphere from coal-fired power stations. Capturing the CO_2 emitted by the use of coal and other fossil fuels and injecting it for storage in deep geological formations is the only currently available technological solution that will enable deep cuts in greenhouse gas emissions whilst maintaining the energy infrastructure needed for growth.

Another important area where the coal industry is working to reduce GHG emissions is through the recovery of methane released during coal mining which has got global warming potential (GWP) 23 times greater than that of CO_2 .

Government role in sustainable development of mining

Sustainability of a mining operation generally requires that the mining organisation should be guided and closely watched by the regulatory authorities for:-

- Observe all applicable laws and regulations;
- Adhere strictly to terms and conditions associated with project approval, including environmental management and monitoring programs;
- Implement and maintain community consultations and community involvement programs;
- Implement programs to manage public risks associated with the project
- Provide regular reports presenting up-to-date information about key project issues and monitoring of environmental parameters;
- Ensure that sufficient funds are accrued or otherwise arranged so that the project site can be rehabilitated once mining has ceased.
- Assist government in providing services such as health and education, and the upgrading of local infrastructure.

Reclamation and Rehabilitation (R&R) policy

A suitable R&R policy must be framed by the Mining companies and got it approved by the Government responsible for the area. While preparing, it is pertinent to address following typical requirements:

- Just compensation for landholders affected directly or indirectly by project development;
- Training to equip local people for direct employment;
- Opportunities for existing local businesses to supply goods and services to the mining project;
- Continuation of pre-existing land uses and livelihoods in the areas surrounding the project;
- Preservation of indigenous cultures and community values;
- Input to community development planning;
- Close involvement in formulation and implementation of closure plans.

Difficulties in implementing sustainable development

The concept and idea of sustainable development is widely accepted, and good progress has been made on sustainable development metrics; yet the implementation of sustainable development has been largely unsuccessful. The world has made little progress in implementing programs and policies to improve the lives of the poor and the integration of the three pillars of economic development, social development and environmental improvements remains a challenge.

Sustainable development is not easy and will take considerable time and effort. Efforts to implement sustainable development have taken place in an environment of mainstream economic planning and market-based investment, in a manner that will not disrupt overall growth. As such, implementation has not moved beyond slow incremental steps to transformative action.

Major bottlenecks are:

- Lack of leadership and each sector waits on the others, limiting real progress toward sustainable development.
- Lack of financial and technological resources,
- Lacking the resources, infrastructure, quality of governance, and business environment

Moving ahead

Making a paradigm shift will be difficult and will require that we show that following actions can make a difference.

Taking sustainable development out of the environment box.

We have to acknowledge that sustainability is not related with only environment but addresses wider social, economic and geopolitical agendas. Many of the needed decisions and actions will take place outside the environment community in the fields of energy, security, trade and investment, and development cooperation.

Moving to actual implementation, with real accountability.

We need to go beyond the present view of sustainable development as a framework or concept, to concrete action that includes bottom-up measurable activities. This includes a shift from "reaching agreement" to "implementation."

Using partnerships between government, business and civil society

We have to identify and test new approaches, and to scale up promising approaches. Public funding can be used to leverage sustainable private investments, but there needs to be recognition that the private sector will be more inclined to increase and sustain their investments in sustainable development financing the more they feel their voice is being heard and the more they are involved in the policy-making process.

In this regard, ERM India Pvt. Ltd has been appointed by the Ministry of Mines, Government of India, to prepare a *Sustainable Development Framework (SDF)* for the mining sector in India which is a set of guiding principles and aims at achieving resource efficiency, business viability and environment stewardship around development of affected communities.

The Sustainable Development Framework (SDF) will be developed with the following clear objectives:

- Ensuring social safeguards w.r.t affected communities, land losers, tenants, tribals, children and women;
- Ensuring Environmental Stewardship;
- Sustainability of mining business not to be overtly compromised;
- Benefits of mining to be shared in a more open and fair manner; and
- Transparency and good governance

Effectively communicating sustainable development successes, policies, and learning.

A communications vehicle that has effective access points will help kickstart and maintain implementation of sustainable development. Buy-in from political leaders and a coherent cross-government approach are needed elements to implement sustainable development. Strong political leadership is required to address the difficult challenges; but that alone is not sufficient. It is also incumbent that sustainable development permeates bureaucratic and corporate cultures and systems.

Applying Technological changes

This move will require radical technology change, which could act as huge stimulus for economic activity, e.g Carbon capture and storage (CCS) by coal industry. There is urgent need of huge capital to be invested in the research

on new technology. We have to prioritize the targets and targets and promote incentives to spread best-practice worldwide

CONCLUSION

Geological processes in operation dictate occurrence of minerals long before the human species surfaced on the earth. Therefore, mining has to be carried out at locations where minerals occur and there is no other alternative. For a mining project to be sustainable means that it meets the requirements of its major stakeholders including shareholders, employees, governments, local communities, financial institutions and the environment. The best outcomes occur when the needs and aspirations of these stakeholders are aligned. Then, all are working for the same objectives and all share in the benefits. However, if one of these stakeholder groups is too greedy and succeeds in obtaining a disproportionate share of benefits, then the sustainability of the entire project will be jeopardized.

However, I see bright future of Mining Industry for many more decades but the related issues connected with productivity, safety, health & environment would be the deciding factor in sustainable development of the industry.

With these few words I would like to thank you all for bestowing me the opportunity to share my opinion in this august forum, in the memory of a great teacher, Prof S.K.Bose.

Thank You.
