

Indicators of Sustainability for the Mining Industry

The Economic Dimension in the Selection of Indicators

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Mining & Sustainable Development: The Economic Dimension in the Selection of Indicators

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1. Concept

Focusing on aggregate level and keeping apart the influence of different dimensions that permeate the conception of sustainable development, this article takes as reference a concept closer to the definition suggested by The *World Commission on Environment and Development* – WCED¹:

A pattern of development that fulfills the most urgent and general needs of the present generation without compromise the legacy options of the future generations in fulfilling their needs.

Unquestionably, the fundamental challenge to achieve a pattern of sustainable development is to find out a compromise solution between the interests of the present and future generations.

2. Is it Possible a Sustainable Development without Mining?

This question can be approached by means of three levels:

- **International** – taking into account the fundamental role of the minerals in industrial production and in higher standards of living the answer is certainly not. There is a consensus, the mining industry is an important vector for leveraging the global development process into a sustainable level;

- **National** – although facing a different scale and options comparing to international level, the sectoral status is similar in terms of importance. However, considering a diversity of interests and policies it is opportune making the following considerations:
 - Developed Countries;
 - Developed Countries with mineral vocation;
 - Developing Countries; e
 - Developing Countries with mineral vocation.

- **Local** – at local level the relative importance of the mining industry will be constrained by the availability of other opportunities of investment with special concern to mutually exclusive situations. On the other hand, probably the interests of community will be subordinated to national ones.

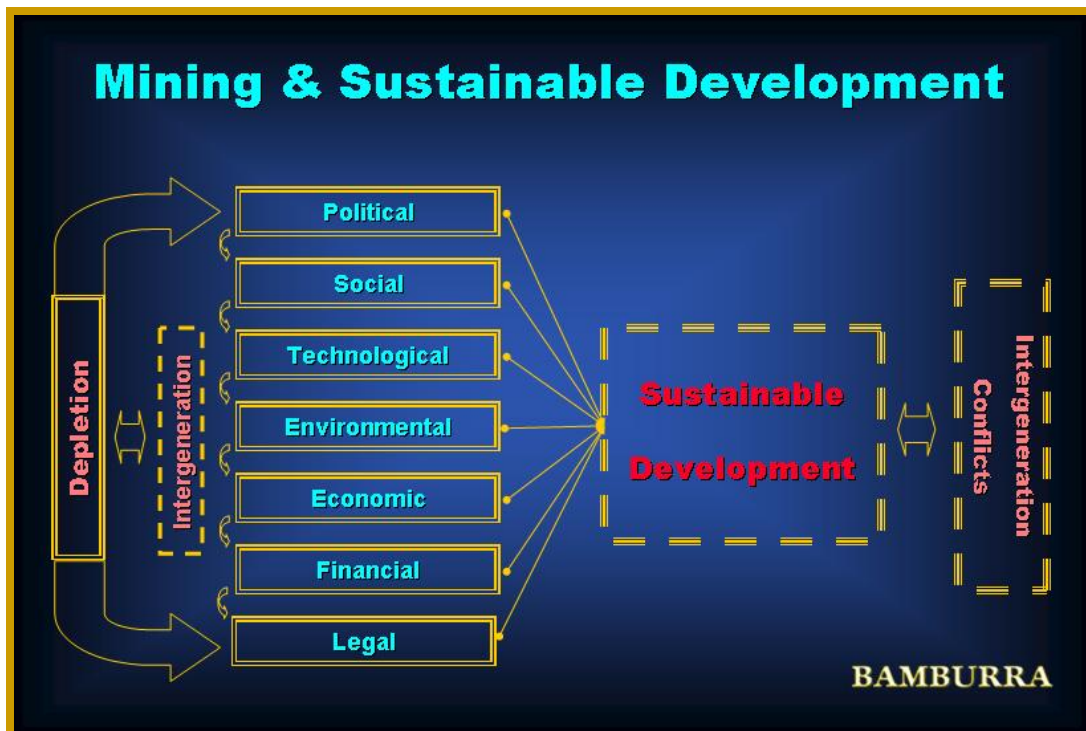
In fact, while some regions have at your disposal several conceptual routes for development, for others mining is quite the unique option. An extreme example is Mali

The interrelationship between spacial dimensions and the matrix of opportunities and challenges, at local and national levels, are going to be crucial in the formatting process of the opportunity costs associated with alternative development paths. . In this sense, incremental costs are going to reflect trade offs in the amount of net benefits susceptible to be generated by each policy.

3. Is Mining Sustainable?

4. Multidimensional View of the Concept

Figure 1 characterizes the usual dimensions referencing concepts of sustainable development and a specific factor - **depletion** - of the mining industry.



Obs: Cultural aspects are inserted in social dimension.

Since Malthus, depletion is recognized as a critical factor in the interface of intergeneration conflicts. In the last decades, with the maturation of the sustainable development concept this interface is embedding other relevant dimensions – economic, social and environmental - as well. Despite this evolving process, by means of irreversible impacts and the preservation of the ecosystem efforts in order to guarantee conditions to future generations, in essence the challenge is the same.

Another specific factor deserving mention is the locational rigidity of mining operations in relation to conflicts with other natural resources, aboriginal areas, creation of enclaves etc. In this context, isolated regions in the hinterland, with low demographic density and rich biodiversity are the principal concern.

5. Matrix of Indicators of Sustainability

The process of identification and selection of indicators of sustainability although subordinated by macro-dimensions should focus on operational issues in order to quantify and qualify the level of conformance of the mining industry to sustainable development. The objective is to estimate quantitative and qualitative indicators and conduct absolute and relative evaluations and analysis at minesite, sector or cluster levels. With this reference we adopted the following scheme:

- **FUNDAMENTAL DIMENSIONS { Politic, Legal, Economic, Social, Environmental, Technology....}**
- **Parameters of Interest [rate of recovery, consumption of energy, consumption of water, recycling of water, disturbed land ...]**
 - **Metrics & Indicators (emissions per unit of product, etc)**

In sequence we present a summary of possible topics and references that can be used to select indicators of sustainability.

➤ ENVIRONMENTAL

➤ Energy

- Total Consumption
- Consumption Profile per Source
- Participation of Renewable Sources
- Self-generation
- Reuse
- Consumption per Unit of Product

➤ Water

- Total Consumption
- Treatment
- Recycling & Reuse
- Quality of Discharged Water
- Consumption per Unit of Product

➤ Land

- Total Area Occupied
- Profile of Occupied Area (%)
- Mining Operations
- Treatment Operations
- Townsite
- Dams & Waste Disposal
- Roads

- Disturbed Natural Areas (%)
- Protected Natural Areas (%)
- Reclaimed Natural Areas (%)

➤ **Inputs & Materials**

- Consumption per type
- Profile of Consumption per type
- Consumption of Risk & Hazardous Materials
- Recycling & Reuse
- Consumption per Type / Unit of Product

➤ **Effluents, Emissions & Waste**

➤ **Plan of Mine Closure**

➤ **SOCIAL**

➤ **Employment**

- Total Direct Employment
- Total Indirect Employment
- Generation of Employment per Unit of Product
- Minimum Wage
- Average Wage
- Subcontracting
- Work Conditions in Subcontracting Companies
- Female & Minorities Work Force
- Health & Safety Conditions
- Work Accidents Rate
- Strikes

- Penalties
- Training & Education (\$/worker)
- Health & Safety (\$/worker)
- Levels of Satisfaction of the Work Force
- Channels of Communication & Participation in Decision Process

➤ **Community Relations**

- Total Direct Employment
- Total Indirect Employment
- Total Employment per Unit of Product
- Total Expenses in the Community(%)
- Social Infra-structure of the Project
- Creation of Additional Infra-structure in the Region (\$)
- Levels of Integration with the Community
- Training & Education (%)
- Level of Integration with Public Health and Civil Defense Services
- Levels of Satisfaction of the Community
- Channels of Communication & Participation in Decision Process

➤ **Plan of Mine Closure**

➤ **ECONOMIC**

➤ **Selected Aggregates**

- Value of Production
- Income
- Gross Margin
- Acquisition of Inputs
- Direct and Indirect Rent

- Wages & Associated Costs
- Return of Capital
- Rent Distribution
- Direct and Indirect Taxation
- Net Currency Generation
- Prospection & Exploration
- Research & Development (R&D)
- Investments in Infra-structure
- Investments in Education & Health
- New and Expansion Investments
- Investments in Diversification
- Donations
- Sources of Funds

➤ **Plan of Mine Closure**

Considering the expressive interrelationship between dimensions, parameters and indicators there are many metrics that could be selected.

6. Expected Challenges & Impacts

➤ **International Issues**

➤ **National Issues**

➤ **Local Issues**

7. Some Questions of Concern

- **Quantitative & Qualitative Indicators**
- **Social Rate of Discount**
- **The Influence of Spatial Dimensions**
- **Confronting National & International Markets**
- **Opportunity Costs Dilemma**
- **Trade & Non Traded Goods**
- **Transferring Prices Issues**
- ***Sustainability Dumping?***
- **Who pays the Bill? Is the Polluter Pays Principle?**

Notes & References

1. “*Sustainable development: a guide to our common future*”. The Report of the World Commission on Environment and Development. Geneva, 1990.
2. BARRETO, M. Laura (Ed.). “Ensaio Sobre a Sustentabilidade da Mineração no Brasil”. Rio de Janeiro. CETEM/MCT, 2001. 130p.
3. “*Sustainability Reporting Guidelines*”. Global Reporting Initiative – GRI (<http://www.globalreporting.org>)
4. VALE, Eduardo. “*Mine Closure: selected highlights*” - Mine Closure: Iberoamerican Experiences - Module V - Economy and Finance - CYTED/IMAAC/UNIDO - 2001 - 581p. - pp. 219-223. Rio de Janeiro.
5. _____ “A Mineração e o Meio Ambiente: uma análise técnico-econômica” - Anais do I Encontro do Hemisfério Sul sobre Tecnologia Mineral - Vol. II - pp. 1.166-1.175 - dezembro/1982