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Towards Sustainable Development – Indicators for the Minerals Industry

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Abstract

Indicators provide the minerals industry with a means of informing all stakeholders about their contribution to ensure socio-economic well-being and actions that have been taken to improve environmental performance. This paper describes indicator development initiatives for the minerals industry in Canada, Australia and Malaysia. The Canadians are in the process of developing a conceptual framework to identify sustainable development criteria and indicators for the mineral industry to fulfill institutional requirements. Indicator development in Australia and Malaysia is still at the research stage.

Ke Arah Pembangunan Mampan – Indikator Industri Mineral

Abstrak

Indikator boleh digunakan oleh industri mineral untuk menyebarkan maklumat kepada pihak-pihak yang berkepentingan mengenai sumbangan industri bagi memastikan kesejahteraan sosio-ekonomi dan langkah-langkah yang telah diambil untuk membaiki pengurusan alam sekitar. Kertas kerja ini menerangkan inisiatif pembangunan indikator untuk industri mineral di Kanada, Australia dan Malaysia. Pembangunan indikator di Kanada dilakukan untuk memenuhi tuntutan institusi dan kerangka konsep dan kriteria pembangunan mampan untuk industri mineral sedang dibangunkan. Pembangunan indikator di Australia dan Malaysia masih pada tahap penyelidikan.

INTRODUCTION

Many initiatives have been undertaken at the global, national and local levels to shift the development paradigm to one that is sustainable, taking into account the social and environmental imperatives in addition to that of economic growth. All such initiatives come under the umbrella of sustainable development. In order to measure the progress of such initiatives; some form of objective tool is required. The tool should have the capability of communicating information in a simplified manner to all relevant stakeholders regarding the progress toward sustainability and also enable knowledge-based policy and decision-making. Indicators have been purported as the most suitable tool to carry out precisely that function.

The minerals industry faces many challenges in the context of sustainable development. The public perception of the minerals industry is generally a negative one, which have been reinforced by the occasional environmental disaster and ecological cost. Health and safety factors in the mines have also been raised as an issue, in addition to the contribution of the industry to the marginalisation of indigenous peoples. The social and economic benefits that the mining industry provides are often overlooked in the misconceptions that have been propagated. This situation has inconvenienced the minerals industry to some extent when requesting access for exploration activities and contributed to the sterilization of resources.

The concept of sustainable development is useful to highlight the service that the minerals industry provides to society and national development. It also provides a useful approach to improve the environmental performance and enhance the competitive advantage of the minerals industry. The efforts of the minerals industry can then be communicated to the government and the public through the use of indicators. The aim of this paper is to introduce the concept of indicators and its potential application in the context of sustainable development for the minerals industry. A brief overview of indicators is provided before indicator development initiatives for the minerals industry in Canada and Australia and Malaysia are described.

INDICATORS AND THEIR APPLICATION

Indicators are parameters or values derived from parameters, which provide information and describe the state of a phenomenon or area, with a significance extending beyond that directly associated with the parameter value (OECD, 1993). There are basically two defining characteristics of indicators (SCOPE, 1995 cited in Peterson, 1997). The first is their ability to quantify information and make its significance more apparent. The second is their capacity to simplify information about a complex phenomena so that it can be communicated more easily to all the parties involved.

Indicators have many purposes depending on the objectives for which they have been developed, and the functions range from decision-making to public awareness. (Peterson, 1997). The government can use indicators to inform the public about the actions that have been taken to address environmental problems and promote sustainable development. Indicators can also be used by industry to inform the public and the government regarding their environmental performance and progress towards sustainability.

Indicator frameworks have been constructed for a variety of purposes to fulfill institutional requirements. For instance, Canada, Australia, Japan, China, USA and New Zealand have prepared indicator frameworks based on the State-of-the-Environment Report approach (Peterson 1997). Indicator frameworks have also been constructed for assessing renewable and non-renewable resources nationally, evaluating performance in addressing key issues, implementing national management policies, reporting regional and international scale status and trends, and monitoring progress towards sustainable development internationally.

In constructing the indicator framework, many countries have modified the OECD Pressure-State-Response (PSR) model (Peterson, 1997). This model provides a useful approach for organising a menu of indicators and attempts to explain why environmental changes are occurring in relation to temporal and spatial associations, and the management responses to these changes. Pressure is exerted by human activities and these result in changes to the state or condition of the environment. Society responds to changes in pressure or state by enacting policies to prevent the pressures and mitigate environmental damage. The pressure-state-response model of the OECD presents a problem to the minerals industry because it portrays the sector as a pressure on the environment and society (Hancock, 1998). This negative portrayal does not do justice to the role of the minerals industry in sustaining the quality of life and promoting economic growth.

CURRENT INDICATOR DEVELOPMENT INITIATIVES

The Canadian Initiative

The Canadian Government leads the international scene in initiating efforts to make the minerals industry more sustainable. This effort is spearheaded by Natural Resources Canada, the government agency responsible for policy making on natural resources at the federal level (Natural Resources Canada, 1998). The concept of sustainable development within the minerals industry is institutionalised within the comprehensive Minerals and Metals Policy of the Government of Canada formulated in, 1996. The policy incorporates a requirement to develop sustainable development indicators for minerals and metals in partnership with all the relevant stakeholders. The stakeholders include government, industry, labour, aboriginal organisations and the environmental community. The implementation of policy has been assisted by the Canadian mining industry, which took the lead to develop a common vision based on sustainable development, in partnership with all relevant stakeholders (McCann, 1998).

Natural Resources Canada is currently in the process of developing a conceptual framework to identify sustainable development criteria and indicators for minerals and metals (Pasho, 1998). Very little has been done previously on the development of criteria and indicators for non-renewable resources in Canada. The development of indicators will allow Canadians to focus on priority issues and enable knowledge based decision-making. It will also provide a means of assessing progress towards sustainable development. In the Canadian context, issues of priority include wildlife and endangered species, water quality, aboriginal concerns and the manner in which these concerns are addressed i.e. by regulatory control or voluntary initiatives.

The conceptual framework proposed is national in approach and encompasses two cycles, the mining cycle and the product cycle. The mining cycle covers aspects related to prospecting, exploration, development, mining, closure and monitoring. The product cycle includes raw materials, processing, use, disposal and recycling. Environmental, social and economic components and their linkages are implicit within the cycles. The types of indicators within the framework include indicators of pressure, state and response. Pressure indicators measure human activities that effect change. State indicators measure the condition of the parameter related to the issue in the social, economic and environmental context. Response indicators measure the actions taken and may cover education, regulation, voluntary non-regulatory measures or economic instruments. This approach appears to be sufficiently generic in that it allows for indicators to be developed for both the total and individual commodities.

It has been proposed that the development of indicators be conducted in five stages (Pasho, 1998). The first stage involves the selection of key issues, focusing on areas where decisions are required. This is followed by the second stage, where statements of objectives are formulated for each key issue. The third stage involves selection of appropriate pressure, state and response indicators for each statement of objectives. In the fourth stage, the indicators are populated with data and validated to ensure that the information provided is relevant for decision-making. The final stage involves the communication of the results of this exercise to the public. The indicators selected by Natural Resources Canada have yet to be reported.

The Australian Initiative

Australia is increasingly emphasizing non-regulatory measures over regulatory control of the minerals industry. The country is pursuing best practices in mining where general conditions are set for mining through the

environmental impact assessment process but companies are given the flexibility of meeting these conditions. Generally, the companies must ensure that the conditions conform to best practicable technology and environmental management plans. Otherwise, they risk facing severe penalties and even closure. Another aspect that is regulated within the mining industry, in combination with the usage of performance bonds, is land rehabilitation. Guidelines are being implemented on rehabilitation security deposit systems to ensure the rehabilitation of mines.

The Government encourages voluntary activities by mining companies to avoid environmental damage, to demonstrate stewardship and to benefit from incentives such as lower levels of regulation for demonstrated good practices. One example of a non-regulatory approach is the Minerals Industry Code of Practice for Environmental Management coordinated by the Minerals Council of Australia, to which most large and medium sized companies have signed up to (Lambert, 1998). This voluntary code commits its signatory to excellence in environmental management through continual improvement, application of risk management techniques, rehabilitation, setting of environmental targets, and reporting to governments and the community. In addition, Environment Australia has collaborated with industry and conservation groups to prepare a series of booklets on Best Practice Environmental Management in Mining. The purpose of this booklet series is to provide guidance that is easy to understand and practice on a voluntary basis. Many mineral companies have also volunteered to reduce the intensity of their greenhouse gas emissions under the Greenhouse Challenge Programme of Australia.

Many measures have been taken by the Australian government and the mining industry to ensure a high standard of environmental performance. Unfortunately, no coherent system has been institutionalised for assessing the success of the measures taken to move the mining industry towards sustainable development. The issue of sustainability indicators for the minerals sector has not yet become a priority for policy-makers in the Bureau of Resources Science, Australia (Lambert, 1998).

The lack of government initiated systematic effort for developing and implementing sustainable development indicators for mineral resources has not hampered research in this area. Thirteen mineral companies, under the auspices of the Australian Mineral Industries Research Association, funded a study on the development of sustainability indicators for mineral resource development. The study, conducted by the Centre for Resource and Environmental Studies at the Australian National University, reviewed indicator development initiatives in several industry sectors and proposed a systematic programme for establishing indicators based on a holistic model for mineral resources development.

In order to evaluate the progress of the mineral industry towards sustainability, a framework based on four categories of key sustainable development objectives has been proposed. Each category contains a menu of indicators. The categories are resource levels, economic benefits, management effectiveness in government and industry, and environmental and socio-cultural performance (Table 1). The next step in the indicator development process involves the evaluation of these proposed indicators and engagement of stakeholders in the selection process of these indicators to give a wide ownership to the message that these indicators convey (Hancock, 1998). The Australian minerals industry perceives sustainable development as a leverage for enhancing competitive advantage through improving quality, adding value, minimising environmental impacts and serving stakeholders.

The Malaysian Initiative

Malaysia, through the Economic Planning Unit of the Prime Minister's Department is in the process of developing a Sustainable Development Indicators (SDI) framework for national reporting. The framework that is being planned will utilize the pressure-state-response approach (Mohd Nordin, 1998). Sectoral initiatives on indicators in the country include the Malaysian Urban Indicators Programme (MURNINET) lead by the Town and Country Planning Department of Peninsular Malaysia and the Healthy Cities Programme established of the Ministry of Health Malaysia (Zainuddin, 1998). Both these initiatives will eventually contribute to the overall framework of the SDI.

However, the emphasis of the sectoral initiatives is only on aspects that are relevant to the human habitat, where the cities are defined in political and geographical terms. The ecological reality is that cities are mere nodes of consumption in a much larger ecosystem. The use and availability of non-renewable resources required to support the urban population and economy for the present and future generations are not taken into account in these sectoral initiatives. In fact, one of the most significant impacts of land development in certain parts of Malaysia is restriction on the availability of minerals to sustain the economic growth therein, due to lack of proper planning. The expansion of urban and industrial areas that encroach upon existing mines and quarries prevent the exploitation of and access to undeveloped mineral resources. If such resources become sterilized, minerals have to be transported into the area concerned, resulting in increased costs to the community.

Preliminary work on the development of indicators for the minerals industry in Malaysia is led by the Institute for Environment and Development (LESTARI). The framework for the minerals industry is based on the ecosystem health approach, using the Langat Basin as a case study (Pereira and Komoo, 1999). This approach requires the separation of the mineral resource based on whether it is a basic necessity or meant for wealth creation.

In order to fill in the gaps and establish a holistic approach to the national indicator programme, the Institute for Environment and Development (LESTARI) and the Minerals and Geoscience Department of Malaysia, have

Table 1: Potential indicators proposed for the minerals industry in Australia. Source: Lambert, 1998.

Issue	Indicator/Parameters
Resource Stocks	Economic demonstrated resources Economic demonstrated resources to annual production ratios Exploration activity Levels of recycling Levels of substitution
Economic Development	Contribution to GDP Exports Tax or royalty income Commodity prices Employment Industry profits Self sufficiency Returns to the community Cost of inputs Resource demand
Management Effectiveness: (i) Performance of Industry	Aggregate balance sheet, profit and loss, cash flows etc. Accident levels Productivity Management responsibility Company profitability, rates of return Number of significant violations set in operating licences International standards met Skills base Ethical standards, reporting resources, valuing prospects Environmental reports
Management Effectiveness: (ii) Performance of Government	Provision for remediation Institutional arrangements Data storage and retrieval Compensation claims Investment ranking trends Number of projects approved and awaiting approval Extent of regional planning initiatives Availability of geoscientific data Extent of input to pertinent international forums
Environmental and Socio-Cultural Performance	Expenditure on environmental problems Land accessibility to minerals industry Area of land disturbance Rehabilitated area Efficiency of inputs (energy and water) Proportion of mines with emissions to the environment Number of mines with unresolved environmental and social impacts Number, location and status of abandoned mines Environmental benefits of mining Community attitude surveys

recently embarked on a project to establish a menu of geoindicators to assess abiotic landscape changes that are significant for urban planning and management. Development of indicators for the mineral industry is also a component of this project. It is anticipated that the results of this project will benefit planners, policy and decision-makers by providing information that illustrate the trends and status of environmental sustainability, and evaluate the success of existing policies in ensuring urban sustainability, particularly with regard to building material resources.

POTENTIAL INDICATORS FOR THE MALAYSIAN MINERALS INDUSTRY

The potential indicators for the minerals industry in Malaysia have been identified based on the concept of ecosystem health, using the Langat Basin as a case study. A healthy ecosystem requires conditions that are sustainable. In the context of minerals in the Langat Basin, a healthy ecosystem would have sufficiently accessible basic resource stocks to support economic growth and societal well being in an effective and equitable manner; and experiences minimal adverse environmental impacts from its extraction (Pereira and Komoo, 1998).

In the case of the Langat Basin, aggregate and other building materials such as sand and gravel as well as clay and earth materials, are considered basic minerals. They are essential to support physical development within the basin, to meet the needs of society. The lack of these minerals may threaten future infrastructure development or make it more costly if these minerals have to be imported into the Langat Basin. Minerals such as kaolin and tin are also important, but more so for the creation of wealth.

Indicators that are useful for the assessment of ecosystem health in the context of minerals can be divided into three major categories. These are availability and consumption of minerals, extraction of minerals and management of minerals.

Availability and consumption of minerals

Indicators that are useful to gauge the availability of minerals in the Langat Basin are the amount of reserves. Currently, this data is not available for all the minerals extracted in the Langat Basin. The availability of such data will facilitate long-term planning, with respect to the economic sustainability of the Langat Basin.

Another useful indicator related to the availability of mineral resources is the rates of mineral sterilization. The problem of mineral sterilization is not being seriously addressed in the Langat Basin, particularly for aggregates and other building materials. The high potential aggregate areas in the basin are threatened by the expansion of urban development. As a result, the high potential areas for aggregate, which are presently locked under forest reserves, may be exploited to meet the future demand for aggregates. The removal of forest reserves, which are mainly in the

highlands, will have a negative implication on the overall ecosystem health of the Langat Basin.

There are other indicators useful to relate to ecosystem health but these have not been examined in detail. Examples include recycling and substitution rates. It is difficult to estimate the quantity of the minerals that are recycled or extrapolated at the ecosystem level. But these can be easily extrapolated at the national level.

Extraction of minerals

Indicators related to extraction of minerals serve to assess environmental impacts that are associated with the extraction of minerals and its direct effect on the health of the ecosystem. The indicators identified from this study are the amount of hidden flows associated with the overburden and gangue during the extraction and processing of the minerals. Other hidden flows not considered in this study include loss of biodiversity, emissions into the air, discharge into waterways and accidental spillage during transfer of substances such as explosives and diesel during mineral extraction. Indicators directly related to the well being of humans include the number of quarry related occupational accidents, the number of and types of complaints related to quarrying activities such as flyrock and subsidence from residents, and the number of violations of conditions set in operating licenses as well as environmental infractions.

Management of minerals

The maintenance of ecosystem health requires effective management of minerals with respect to their availability, consumption and extraction. The indicators required for this purpose should measure the effectiveness of actions taken rather than the number of or type of action that is taken. For instance, reduced frequency of encroachment of housing and industrial development onto areas adjacent to quarries would indicate the effectiveness of the planning process within the basin. Other indicators of increased effectiveness in the planning process would be mineral sterilization rates, increased area for mineral landbanks and buffer zones, and reduced number and amount of ex-mining areas. Examples of indicators showing improved management on the part of the industry would include reduced number of violations of conditions set in operating licenses as well as environmental infractions, reduced consumption of energy and water, reduced emissions, occupational accidents and land used for waste disposal, and increased tendency to self regulate through certification to ISO 14000 and other standards.

Challenges in Development of Indicators

Indicators differ both in scale and purpose. Some are site specific but applicable to regional, national and international levels. In the case of the minerals industry in Malaysia, it is important to focus on sustainability issues from the perspective of both the internal and external stakeholder. Issues that are of concern for the country, which is still developing, are mainly at the local and national levels. Notwithstanding this, issues related to the regional and global levels should not be ignored.

Table 2: Potential indicators proposed for the minerals industry in Malaysia, based on the ecosystem health concept. Source: Pereira and Komoo, 1999.

Issue	Indicator/Parameters
Mineral availability and consumption	amount of reserves rates of sterilization recycling rates substitution rates total material flow
Extraction of minerals	amount of hidden flow loss of biodiversity emissions into the air discharge into waterways accidental spillage during transfer accidental spillage during extraction. occupational accidents number of and types of complaints number of violations of conditions set in operating licenses number of environmental infractions
Management of minerals	reduced frequency of encroachment mineral sterilization rates increased area for mineral landbanks increased area for buffer zones reduced number and amount of ex-mining areas reduced number of environmental violations reduced consumption of energy reduced consumption of water reduced emissions reduced occupational accidents reduced land used for waste disposal increased tendency to self regulate

There are many challenges facing efforts to develop indicators for the minerals industry in Malaysia. Among these are constraints in the availability of data that provides a comprehensive picture of mineral development with respect to mineral availability and consumption, mineral extraction and management of the minerals industry. Information on the linkages of the minerals industry to socio-economic imperatives is also lacking. This is in part due to the limited funding that the government has in the collection of such data.

At the moment, there is no institutional requirement for development of indicators for the minerals industry. However, given the current trend at the national level, it will only be a matter of time before this aspect becomes incorporated for reporting the progress of the nation towards sustainability. The fundamental questions to ask when developing indicators for the minerals industry in Malaysia are who the indicators are meant for, are they for sectoral or cross sectoral purposes, and what interpretation of sustainable development is to be used, and who will choose the indicators. These are the questions being addressed in the ongoing collaborative work between the Institute for

Environment and Development (LESTARI) and the Minerals and Geoscience Department of Malaysia.

CONCLUSIONS

Indicators provide the minerals industry a means of communicating to all stakeholders regarding their contribution to ensure socio-economic well-being and actions that have been taken to improve environmental performance. Indicator development initiatives for the minerals industry in Canada, Australia and Malaysia show different stages of progress. The Canadians are in the process of developing a conceptual framework to identify sustainable development criteria and indicators for the mineral industry. This work is aimed to fulfill institutional requirements. The results of this exercise are communicated to the public in the final stage. The indicators selected by Natural Resources Canada have yet to be reported. Indicator development in Australia and Malaysia is still at the research stage. Indicator frameworks have been proposed in both these countries but many of the indicators have yet to be tested for its suitability. In addition, there is no coherent system institutionalised to assess the progress of the mining industry towards sustainable development. The issue of sustainability indicators for the minerals sector has not yet become a priority for policy-makers in these countries.

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