

A tool for Thailand's green industry enhancement: case study on sustainability indicators at national level for mining industry

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Abstract:

According to concept of sustainable development, the mining activities should be done to maximize the needs of current generation by supplying equitable distribution without decreasing the ability for future generations to achieve their own needs. In addition, adopting Green Industry concept is considered to be one alternative to strengthen the sustainability of mining industry in Thailand. However, to achieve that goal, the impact assessment tools for mining industries at national level in Thailand should be promoted. Hence, this study aims to provide a tool for sustainability indicators and link them with corporation among diverse stakeholders in the future. The sustainability indicators were grouped into 3 categories regarding key elements of sustainable development. For the linkage between indicator and corporation, the directions are divided into 2 major aspects by key elements and group of stakeholders. The results show that both indicator development and cooperation among organization should be commonly promoted to execute sustainable development in mining industry.

Keywords: Sustainable Development Indicators; Sustainability Assessment; Green Industry; Mining Industry

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1. Introduction

The challenge of environmentally-friendly manufacturing industries has created the new business opportunity which harmonizes the industrial growth while maintaining human well-being and sustaining ecosystem. The mining and minerals industry play a major role in our daily life, especially being an essential raw material for various industries such as ceramics, construction, infrastructure, etc. (Azepagic, 2004). The tendency of minerals demand tends to follow economic growth in order to satisfy rapidly increased demand of energy and materials. In Thailand, the gross value of mining industry is approximately 3.87% of GDP (National Statistical Office, 2012) with 663 mines. It covers more than 40 types of mineral such as gold, metal, tin, and coal. There are several processes in mineral production such as mining exploration, mining, ore dressing, smelting and mineral extraction which typically cause large numbers of impacts on environmental system. These issues including maximizing operational efficiency have provoked the mining and minerals industry to address their concerns in the sustainable development and establish strategies to encounter with this challenge. Furthermore, the Ministry of Industry of Thailand has launched the project of "Green Industry" since 2011 to strengthen environmentally-friendly business and better responsible industries (Ministry of Industry, 2014). The development of tool for sustainable mining assessment at national level will facilitate the management at operational or corporate level to be more effective. Hence, the objective of this study is to develop sustainability indicators at national level for mining industry in Thailand and to recommend how to link them with other sustainability indicators at corporate level in the future.

2. Material and methods

The development of sustainability indicators was done by literature analysis and interviews. Firstly, sustainability concept and sustainability development indicators of mining industry were reviewed under 3 key aspects of sustainable development; Economic, Environmental, and Social Performances. The first set of sustainability indicators were chosen from Azepagic (2004), Global Reporting Initiative (GRI, 2013) and Sakamornsnguan (2009, 2010). All the indicators should capture the

characteristics of each activity and relevant issues specifically for Thailand's mining practices. The indicators reflecting sustainability were selected and defined in suitable unit and linked them with the measurable standard. Moreover, the indicator should simplify the complex issue or strategy. The interviews with the experts of this field from the Department of Primary Industries and Mines (DPIM) were undertaken in order to identify and modify the final set of indicators presented in this paper and to obtain recommendations on future improvements on the tool development.

3. Results and discussion

The selected indicators of this research can be summarized in Table 1. Many of these indicators are measured or controlled by different government agencies such as Ministry of Natural Resources and Environment, Ministry of Public Health, Ministry of Labor, etc. In order to link the indicators at national level in corporate level, the cooperation between diverse government authorities is the most important key success factor as well as the inclusion of existing voluntary best practices in the mining industry.

Table 1 Sustainability indicators for mining industry in Thailand

Group	Indicator	Unit	Description	Main Responsible Organization
Environmental Aspect	Air Quality	Proportion of mineral company that complied with national standard (%)	To measure the number of mineral company that complied with national standard that is the Enhancement and Conservation of the National Environmental Quality Act B.E.2535 (NEQA).	<ul style="list-style-type: none"> ■ Ministry of Natural Resources and Environment (MNRE) ■ Department of Environmental Quality Promotion (DEQP)
	Wastewater			
	Solid Waste			
	Hazardous waste			
	Nuisance			
	Environmental report			
Energy Usage	kWh per ton of production	To measure the number of energy usage efficiency in kilowatt/hour per ton of production.		
Water Recycling	Proportion of recycling water and total amount of water use (%)	To measure the number of water recycling that are measured by proportion of recycling water and total amount of water use.		
Social Aspect	Wage rate	Thai Baht/Day	The average wage of highly educated level (accountant, engineer etc.), skilled labor, non-skilled labor.	<ul style="list-style-type: none"> ■ Ministry of Labor (MOL) ■ Ministry of Public Health (MOPH)
	Working hour	Hour/Day	The number of working hour.	
	Health and Safety system	Percentage (%) of mining company that complied with national standard	The amount of company that provide the health and safety system following the national regulation (Occupational Safety, Health and Environment ACT B.E. 2554)	

Group	Indicator	Unit	Description	Main Responsible Organization
	Local worker recruitment	Percentage (%) of local workers per total workers	The proportion of amount of local workers to total workers	
	Worker gender	Proportion of male, female and non-adult worker from total worker (%)	To measure the proportion of male, female and non-adult workers	
	Occupational Accident	Man-hour of exposure	Measurement by Lost Time Injury Frequency Rate (LTIFR)	
	Number of Complaint	Amount of complaint per year	To measure the amount of complaint from local communities or other stakeholders	
Economic Aspect	Minerals produced, sold and export	Ton/year	This indicator represents the amounts of minerals that are produced, sold and export. The data of minerals produced, sold and export should classify by the type of mineral.	<ul style="list-style-type: none"> ■ National Economic and Social Development Board of Thailand (NESDB) ■ Department of Primary Industries and Mines (DPIM)
	Contribute to GDP	Percentage (%) of Mining sector value to GDP	This indicator represent the contribute values of mining sector to GDP.	
	Mineral security	Percentage (%) of Mineral production, imported by DPIM and imported by business owners to total minerals requirement	This indicator represents the amount of mineral that can be produced within country, import by DPIM and import by business owner itself.	

3.1 Roles and corporation among relevant parties in the future

As aforementioned, the corporation among relevant organizations especially government sector is very important. This cooperation is illustrated in Fig. 1. The authority and power of diverse organizations in Thailand are complicated and generally overlap on each other. The direction of future cooperation can be divided into 2 major aspects by key elements of sustainable development and by group of stakeholders.

3.2 Key elements of sustainable development

(1) *Economic Aspect*: The business owner should support sufficient raw materials to downstream

industries and relevant sectors. The process for raw material exploitation should be developed effectively in order to achieve best production. Besides, the process of value adding should be considered together with maximization of the uses recycled or additional materials.

- (2) *Environmental Aspect*: All relevant sectors should set up the tangible goal at which mining activities and operation should be done friendly to ecosystem and community. Moreover, many activities in mining industry consume a lot of energy. Therefore, the plan to minimize the environmental impacts and energy consumption should be considered.
- (3) *Social Aspect*: Mining activities and local communities should be mutually developed. All stakeholders deserve to be safe and healthy throughout the mining life cycle. Furthermore, the business owner shall perform CSR to encourage stakeholders to understand mining industries and participate in developing process.

3.3 Group of stakeholders

- (1) *Government sector*: Both of governments and local authorities should provide diverse impact assessment tools and applications to support decision making process, especially for national. As a result, the government can reduce budget and working-time of business investigation and monitoring. Moreover, the government should provide clear policy, direction, and plan which are practical and acceptable for business sector, communities and other stakeholders.
- (2) *Business sector*: The business owners should perform business effectively and transparently. They should be entrusted by all stakeholders. Besides, the mining industries should be mutually developed and promoted together with CSR activities. As a result, fairly benefit sharing will be achieved.
- (3) *Communities and other stakeholders*: The responsible sectors should provide variety channels for local communities and other stakeholders to express their idea, comment, question, and complaint. Additionally, all relevant parties should promote benefits sharing through CSR activities such as green mining week. The community members and stakeholders should involve in monitoring and developing processes in order to confirm that the activity will be executed successfully and sustainably.



Fig. 1 Cooperation among relevant sectors.

4. Conclusion

This study provides a set of 18 sustainability indicators at national level which can be used to strengthen and develop the Green Industries in Mining Sector in Thailand. The indicators shall be linked with other existing regulative and voluntary indicators at corporate level. The cooperation between diverse governmental authorities is the most important key success factor for effective tool development and implementation towards Green Industry in Thailand. The application and contribution of sustain development tools among relevant parties should be developed based on actual practice or feedback on policy issue. For future studies, implementation framework and declaration of responsible authorities are needed to be explored. The benchmark values for setting standards of indicators should be set by considering national and international standards, policies

and practices. The database regarding mining and mineral productions should be developed and shared to stakeholders. In addition, other qualitative indicators should be considered such as acceptability from social, corporate governance among organizations, trend of production and consumption.

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