Thailand

Broadening Environmental Impact Evaluation Methods by Applying Environmental Accounting to Development Projects

External Evaluators: Yasutami Shimomura, Claude P. Siegenthaler (Faculty of Humanity and Environment, Hosei University), Atsuhi Inaba (Research into Artifacts, Center for Engineering, The University of Tokyo: RACE)
Field Survey: August 2006

Outline and Objectives

This thematic evaluation attempted to verify the overall impact of a development project on the environment by introducing the perspective of environmental accounting into the evaluation. Focusing on the reduction of greenhouse gas (GHG) emissions relating to an ex-post evaluation project, the Promotion of Electricity Energy Efficiency Project in Thailand (hereafter, "DSM project")*1, this study used Life Cycle Assessments (LCAs) *2 to explore the possibility of improving environmental impact evaluation methods while verifying the effectiveness of the LCA method itself.

Applying an environmental evaluation model centered on LCAs not only to environmental ODA projects but also to future infrastructure projects could broaden environmental impact evaluations for development projects.

*1. DSM (Demand-Side Management) project: A project for promoting energy conservation and reduction of air pollution by increasing the supply capacity of energy-saving products and services in the energy sector and related private businesses through assisting DSM for five years in Thailand.
*2. LCA (Life Cycle Assessment): A method of measuring the amount of energy and resources consumed and the volume of emissions (environmental burden) during three stages in the product life cycle: (1) manufacturing of the materials required for energy-saving products, (2) manufacturing of the products themselves, and (3) disposal of the products after use.

Evaluation Results

Evaluation Methodology

By introducing the environmental accounting method, this thematic evaluation attempted to determine the overall environmental impact of the development project and to verify improvement in the accuracy of the environmental impact evaluation by estimating the increase or decrease in the environmental burden. Using an LCA method, the study looked at the reduction in GHG emissions relating to the DSM project in Thailand, for which an ex-post evaluation was conducted in FY2006, and explored the possibility of improving environmental impact evaluations while verifying the validity of the method. The study also investigated and analyzed the possibility of expanding upon environmental impact evaluations in future development projects using an environmental evaluation model focused on LCAs.

1. Environmental impact evaluation and theoretical framework of the LCA

An LCA is a method for holistically measuring and evaluating the environmental impact of the life cycle of a certain project or product, and its principles and framework follow ISO-140140.

One of the main objectives of the DSM project is to control energy consumption through the introduction of energy-saving products such as refrigerators and fluorescent lights, and to control the emissions of substances that place a burden on the environment such as CO_2, which is considered a direct effect of the project. In addition to this, an LCA measures energy consumption, resource consumption, and the emission of substances that place a burden on the environment during the following three stages: i) manufacturing of the materials required for energy-saving products, ii) manufacturing of the products themselves, and iii) disposal of the products after use.

The emission of substances that place a burden on the environment over the entire life cycle was measured for two types of electrical equipment: equipment high in energy efficiency and existing equipment models low in energy efficiency. The difference in environmental impact of the two models can be determined through a comparison of the efficiency results. The difference obtained in this way can be considered as an indirect effect. The sum of the direct effect and indirect effect is the overall environmental impact of the project (in the case of the DSM project, the introduction of energy-saving products such as refrigerators and fluorescent lights).

This study undertook the LCAs narrowing the focus to GHG emissions reduction relating to the DSM project.

Environmental impact of the entire project = direct effect*3 + indirect effect*4

*3. Impact evaluation using the existing method
*4. Impact evaluation using LCA

2. Execution of the study

The study team visited Bangkok in August 2006 and collected information from the Electric Generating Authority of Thailand (EGAT), the executing agency of the project, and the three companies below, which manufactured the products that were the subject of the study.

The study was undertaken by a research team from Hosei University comprised of three members: an ODA evaluation specialist, an environmental accounting specialist, and an LCA specialist, in cooperation with National Metal and Materials Technology Center (MTEC), a research division under the jurisdiction of the Ministry of Science and Technology, which is currently engaged in activities to introduce LCA methods in the Thai government.

Companies interviewed:
- Toshiba (Thai Toshiba Lighting): fluorescent lights, stabilizers
- Sharp (Sharp Appliances (Thailand)): refrigerators
- Philips (Philips Electronics (Thailand)): fluorescent lights

3. Environmental improvement effects of the DSM project indicated by the LCA analysis (case studies)

An inventory analysis[1] to calculate reduction in GHG emissions was initially undertaken. During the inventory analysis, it is necessary to collect data directly related to the manufacture, use, and disposal of the products. Two products, a refrigerator and a fluorescent light, were selected as the subjects for this study. The results of the LCA analysis conducted to determine the effects of the introduction of energy-saving (high-efficiency) equipment under the DSM project are summarized below.

1. An analysis where data regarding inputted resources and energy (input) and manufactured or disposed products and emissions (output) of the products and services that are the subject of the LCA are collected and, based on this data, a detailed input/output table of items with an environmental burden is prepared.

Table 1: Breakdown of Total Greenhouse Gas (GHG) Reduction Effects (each product /per unit) (Unit: kg)

Product		Stage of use (direct effect)	(ratio: %)	Other stages (indirect effect) (manufacture, disposal)	(ratio: %)	Total
Refrigerator	Improvement in efficiency of refrigerator	640		6		646
	Reduction of basic unit of electricity CO_2	500		4		504
	(Subtotal)	1,140		10		1,150
	Reduction of CFC emissions*5	1,276.5				1,276.5
	Total	2,416.5	99.59%	10	0.40%	2,426.5
Fluorescent light		8.16	98.79%	0.1	1.21%	8.26
Overall total		2,424.7	99.59%	10.1	0.41%	2,434.8

*5. Indicates the CO_2 equivalent

The above Table 1 suggests the following points:

1) The introduction of high efficiency equipment with low energy consumption and its use followed by disposal 10 years after its manufacture resulted in GHG reduction effects equivalent to 2,426.5 CO_2 equivalent kg for one refrigerator, and 8.26 CO_2 equivalent kg for one fluorescent light.
2) With regards to both products, GHG reduction during the usage stage accounted for the overwhelming proportion of the reduction. This means that there was no significant negative impact at either the manufacturing or disposal stages which may have offset the positive effect of the introduction of high-efficiency equipment.
3) As shown in Table 2 below, during the period from 1993 to 2005, the basic unit of CO_2 emissions arising from electric power generation in Thailand improved by about 10%. Of this, 504 kg, which was equivalent to 44% of the CO_2 emission reduction in refrigerators (1,150 kg), was due to the improvement of the basic unit of CO_2 emissions for electricity in Thailand. The combined improvement of the equipment itself and improvement in electric power infrastructure resulted in total reduction effects of 2,426.5 kg per refrigerator.
4) In the case of refrigerators, 1,276.5 kg, which was the equivalent of about 53% of the total effects of GHG reduction, was due to a change in the cooling medium following the changeover of the model. This suggests that the improvement in the cooling medium (controlling the emission of CFCs / CFC substitutes) is very important in terms of global warming prevention.

Table 2: CO_2 Emissions Due to Electric Power Generation in Thailand

Substance	Unit	Electric 1993	Electric 1995	Electric 2003	Electric 2004	Electric 2005
CO_2	kg/kWh	0.660	0.627	0.527	0.590	0.592
Comparison with Japan (2003)		1.59	1.51	1.27	1.42	1.42

Source: MTEC (National Metal and Materials Technology Center)

In summary, the concept of the DSM project aspiring to switch to energy-saving equipment may be considered essentially relevant even on the basis of inferences from the reduction effects during the overall life cycle. It also became clear that the LCA evaluation method functioned effectively, and it is believed that there was a scope for broadening the environmental impact evaluation method for future project evaluations.

New model (energy-saving) fluorescent light

4. Conclusion and recommendations regarding the environmental impact evaluation method

The most significant obstacle in introducing the LCA method in development countries is the data limitation. However, in this study, coordination with Thailand worked effectively, and a system of cooperation was smoothly established. Nevertheless, efforts required for the long-term development of data infrastructures through cooperation between developing and donor countries remain a future challenge. While tackling these issues, applying environmental accounting theory from the perspective of ascertaining the impact of specific development projects on the environment in a more systematic and comprehensive way is desirable. At the same time, disseminating information about Japan's unique environmental evaluation model centered on the application of LCAs in enhancing the accuracy of environmental evaluation methods widely available to the international aid society continues to be a valuable topic.