Thailand

Environmental Impact Assessment for the MRTA Initial System Project (Blue Line)

Study period: from August 2007 to March 2008

Summary of the Evaluation

This thematic evaluation study proposed a method to quantitatively estimate the environmental load and environmental benefit of an infrastructure development project, based on the idea of life cycle assessment (LCA). The evaluation study then employed this method to evaluate the MRTA Initial System Project (Blue Line) which was designed to mitigate environmental problems including air pollution in the area. The study also introduced the idea of environmental accounting which converts the environmental impact into a monetary value in order to assess the environmental impact.

This evaluation study is proposing a new framework for analyzing the relationship between transportation problems in metropolitan areas and their environmental impact, and shows one possible direction for environmental impact assessments (EIAs) on large-scale infrastructure development projects.

Evaluation Results

Background and Objectives of the Evaluation

In developing countries, environmental regulations are not keeping up with rapid economic development and so environmental problems such as air pollution are becoming more severe. The MRTA Initial System Project (Blue Line) which is subject to the evaluation is a subway construction project in central Bangkok as part of the development of a mass transit railway network. The project was designed to mitigate environmental problems such as air pollution and to mitigate traffic congestion in Bangkok which is continually worsening, as well as realizing the smooth and efficient movement of people.

The idea of life cycle assessment (LCA) is increasingly utilized in EIAs for air pollutants. However, LCA is originally designed to comprehensively assess the environmental impact of industrial products at all stages of their lifecycle (i.e. the manufacturing, the utilization and the disposal stages). Therefore, in order to conduct an EIA for the development of infrastructure (which has different characteristics from industrial products) based on LCA, a different method needs to be developed.

The evaluation study developed a quantitative method which can comprehensively assess both the environmental impact and the environmental benefits of an infrastructure development project, based on the LCA concept. The study then carried out the EIA for the MRTA Initial System Project (Blue Line), using the developed method.

The Framework and the Policy for Evaluation

Figure 1 summarizes the evaluation method for the environmental load and benefit of infrastructure developments, which was used in the evaluation. This evaluation method takes into consideration the life cycle of an infrastructure, and considers the construction stage and the operation stage as the period subject to the EIA. Regarding the environmental impact evaluation, the method is divided into the "local impact assessment method" focusing on the direct environmental impact caused by an infrastructure development project, and the "global impact assessment method" focusing on the environmental impact considering the whole effect caused by all industrial activity that is related to an infrastructure development project. The assessment for the "global impact category" therefore estimates the amount of each substance which has an environmental impact that is emitted by all the project-related elements at their production, distribution and consumption stages. On the other hand, the assessment for the "local impact category" estimates the amount of each substance which has an environmental impact that is emitted by the project-related elements at their consumption stage only (such as CO_2 emitted by construction machinery or cars).

In addition to the environmental load, the evaluation method takes into consideration the environmental benefits (positive effects on the environment) of an infrastructure development project. Therefore, the evaluation method examines both the environmental load and the benefits of an infrastructure development project. In this evaluation method, the estimated emission of each substance which has an environmental impact is converted into a monetary value (environmental cost) using the damage cost* per unit.

In this thematic evaluation, the study limited its evaluation scope to the following elements. Regarding the environmental load, the study estimated the emission of each substance that has an environmental impact (CO_2, SO_2 and NO_2) which is derived from the utilization of materials, fuel and electric power in the construction stage and in the operation stage of the MRTA Initial System Project (Blue Line). Regarding environmental benefits, the study estimated the reduced emission of each substance which has an environmental impact, which is derived from the reduced vehicle traffic around the relevant area due to the operation of the subways in Bangkok.

* Paying compensation for the emission of substances which have an environmental impact has become more widespread in recent years, as can be seen with the CO_2 emission trading. This compensation is called the damage cost.

Evaluation Results, Lesson Learned and Recommendations

Tables 1 and 2 show the CO_2, SO_2 and NO_2 emissions estimated for the global and local impact categories in the construction and the operation stages of the Bangkok subways. In infrastructure development projects such as subway construction, the environmental load at the construction stage is often emphasized, but the environmental load at the operation stage is actually bigger because it has a long-term impact. Therefore, it is important to evaluate the overall impact including the construction and the operation stages.

Table 1 Estimated Environmental Load at the Construction Stage

	Amount used	Global impact category			Local impact category		
		CO_2 emission	SO_2 emission	NO_2 emission	CO_2 emission	SO_2 emission	NO_2 emission
Concrete	2,230	457	221	1,028	0	0	0
	($\times 10^3$ t)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
Reinforcing bars	180	170	270	608	0	0	0
	($\times 10^3$ t)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
Fuel (diesel oil)	36.6	110	161	728	97.3	95.9	644
	($\times 10^3$ t)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
Electric power	41.2	23.2	19	25.3	5.77	8.53	14.4
	($\times 10^6$ kWh)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
Total missions		760.2	671	2,389.30	103.1	104.4	658.4
		($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)

Table 2 Estimated Environmental Load at the Operation Stage

FY	Electric power used	Global impact category			Local impact category		
		CO_2 emission	SO_2 emission	NO_2 emission	CO_2 emission	SO_2 emission	NO_2 emission
2004	119	67.1	54.9	73.1	16.7	24.6	41.6
2005	120	67.7	55.3	73.8	16.8	24.8	42.0
(Omitted)							
2033	201	113.3	92.7	123.6	28.1	41.6	70.4
	($\times 10^6$ kWh)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
Total		2,782.40	2,274.30	3,034.10	690.7	1,021.20	1,726.70

Table 3 shows the reduced CO_2, SO_2 and NO_2 emissions (environmental benefit) derived from less vehicle traffic in the relevant area due to the operation of the Bangkok subways, for the global and local impact categories. There is only a small difference between the environmental benefit and the environmental load (shown in Table 2) for the global impact category. Therefore, the operation of the Bangkok subways does not have a negative impact on the environment at the global level.

Table 3 The Estimated Environmental Benefit at the Operation Stage

FY	Fuel reduction	Global impact category			Local impact category		
		CO_2 emission	SO_2 emission	NO_2 emission	CO_2 emission	SO_2 emission	NO_2 emission
2004	9.9	28.6	27.3	60.5	23.1	0.35	25.6
	($\times 10^3$ kL)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
2005	11.2	32.2	30.7	68	26	0.394	28.8
	($\times 10^3$ kL)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
(Omitted)							
2033	25.9	74.7	71.1	158	60.2	0.913	66.6
	($\times 10^3$ kL)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)
Total		1,736	1,680	3,727	1,422	21.6	1,575
		($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)	($\times 10^3$ t-CO_2)	(t-SO_2)	(t-NO_2)

Figure 2 shows the estimated reductions and the estimated emission of each substance which has an environmental impact (CO_2, NO_2 and SO_2) derived from the MRTA Initial System Project (Blue Line), for the global and local impact categories. The results of the estimation of the environmental benefit / load derived from the MRTA Initial System Project (Blue Line) change depending on whether one looks at the global impact category or the local impact category.

Figure 1 Summary of the Evaluation Method for Environmental Load and Benefit

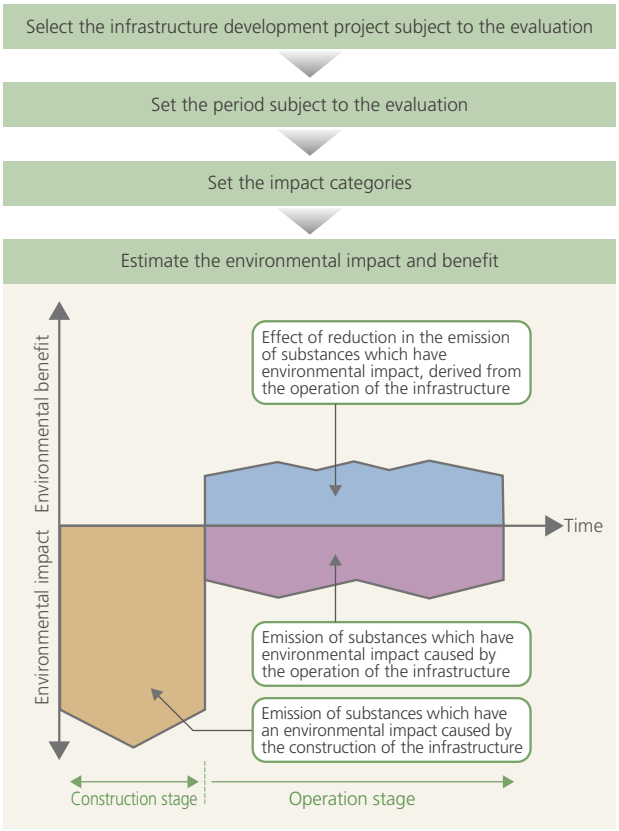
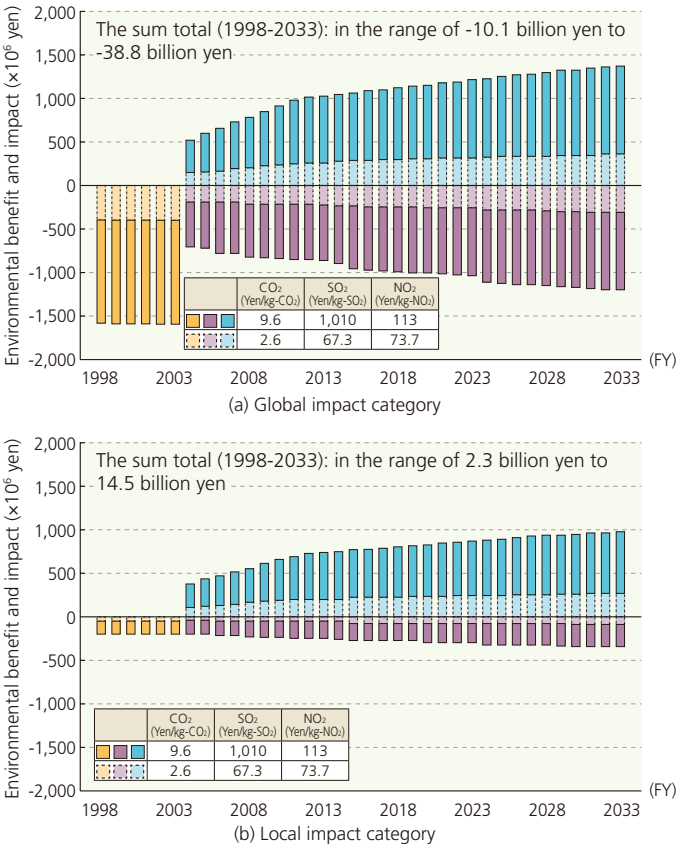


Figure 2 Changes in the Estimated Environmental Benefit and Load Derived from the MRTA Initial System Project (Blue Line)



Note: Since there is no standard damage cost per unit, the dotted lines show the minimum values and the solid lines show the maximum values on the graphs.