MEASURING SOCIAL CAPACITY INDICATORS FOR URBAN AIR POLLUTION FROM TRANSPORTATION IN JAKARTA CITY BASED ON AN ATTITUDINAL SURVEY

S.B, NUGROHO **, J.ZHANG***, A. FUJIWARA***, M. SENBIL ****

1. Introduction

Successful environmental management usually needs to involve various actors which play differing roles and their interaction each others. Public interest and their contribution in the environment are building as we gain information about the urban city services performances which influence to urban ambient air quality. Stakeholders opinion, whether founded on fact or driven by an ideology about future expectation, has harnessed a powerful base of influence in the ability of urban air pollution management. Social capacity for environmental management (SCEM) was proposed as a new concept to help effective policy decisions (Matsuoka and Kuchiki, 2003; Matsuoka *et al*, 2004).

Based on extensive reviews about previous research, Zhang *at al* (2004) re-defined SCEM as the relative and dynamic capacity to manage environmental problems toward their sustainable states in a social system composed of three social actors: government, firms and civil society, and their interactions. The three actors cover all the stakeholders involved in environmental management. Such definition is different from the original definition of SCEM by Matsuoka and Kuchiki (2003). This new definition not only describes the social capacity in a systematic manner, but also describes how to measure the social capacity. Concretely speaking, it suggests to measure social capacity based on the linkages with environmental states.

To overcome the above-mentioned problems, this paper attempts to propose a new method of developing social capacity indicators based on an attitudinal survey data with respect to government, firms and civil society. The objective of this paper is to determine and measure the respondent attitudes concerning social capacity and their cause-effects relationship to urban city service performance and its impacts to air quality in case of Jakarta which is representative of developing cities.

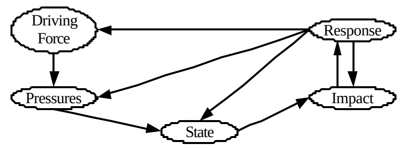
2. Research Methodology

The concept of "good governance" has become a fashionable term in development discussions over the past decade. The United Nations Development Programme (UNDP) has defined governance as the exercise of political, economic and administrative authority in the management of a country's affairs at all levels. TUGI (2003) argues that four aspects of the above definition are important to underline with respect to good urban governance. First, governance is conceptually broader than government. Second, governance is broader than management, which tends to focus on the implementation and administration functions of government. The third point emphasizes governance process. This recognizes that decisions are made based on complex relationships between many actors with different priorities. Finally, governance is a neutral concept. The core characteristics of the TUGI framework are participation, rule of law, transparency, responsiveness, consensus orientation, equity, effectiveness and efficiency, accountability, and strategic vision.

On the other hand, it is not an easy task to capture the genuine features of capacity because of its intangibility. Consequently, the measurement of such capacity has to reply on some feedbacks from various actors involved in environmental management, for example, their opinions, attitudes and evaluations. According to (OECD, 1999) and VRDC (2001), in the DPSIR (Driving forces, Pressure, State, Impact and Response) framework (see Figure 1), social and economic developments exert *pressure* (*P*) on the environment and, as a consequence, the *state* (*S*) of the environment changes, such as the provision of adequate conditions for health, resources availability and biodiversity. Finally, this leads to *impacts* (I) on human health, ecosystems and materials that may elicit a societal *response* (R) that feedback on the *driving* force (D), or on the *state* (S) or *Impact* (I) directly through adaptation or curative action.

Based on this DPSIR framework, many international organizations have developed various indicators for the purpose of environmental management. In order to meet this information needed for environmental management, indicators should reflect all elements of the causal chain that links human activities to their ultimate environmental impacts and the societal responses to these impacts.

* : keyword : Urban Air Pollution Problem
** : Graduate Student, Transportation Engineering Laboratory, Graduate School for International Development and Cooperation Hiroshima University
*** : Associate Professor and Professor, Transportation Engineering, Hiroshima University,
**** : COE Researcher, Graduate School for International Development and Cooperation
Kagamiyama 1-5-1 Higashi Hiroshima, Japan. Tel : 082-424-6921, fax : 082-424-6921, totoksbn@hiroshima-u.ac.jp



Source: OECD (1999) and VRDC (2001)

Figure 1 The DPSIR Framework for Reporting on Environmental Issues

This paper proposes to apply a structural equation modeling approach to capture the complex cause-effect relationships in the DPSIR framework. Methodologically, the models play many roles, including simultaneous equation systems, linear causal analysis, path analysis, structural equation models, dependence analysis, and cross-legged panel correlation technique (Jöreskog and Sörbom, 1989). Structural equation model is used to specify the phenomenon under study in terms of putative cause-effect variables and their indicators. Following the descriptions by Jöreskog and Sörbom (1989), the full model structure can be summarized by the following three equations.

Structural Equation Model:

$$h = Bh + Gx + z \qquad (1)$$

Measurement Model for y:

$$\boldsymbol{y} = L_y h + e \qquad (2)$$

Measurement Model for x:

$$\boldsymbol{x} = L_x x + d \qquad (3)$$

Here, $\boldsymbol{?}' = (h_1, h_2, \ldots, h_m)$ and $\boldsymbol{?}' = (x_1, x_2, \ldots, x_m)$ are latent dependent and independent variables, respectively. Vectors *?* and *?* are not observed, but instead $\boldsymbol{y}' = (y_1, y_2, \ldots, y_p)$ and $\boldsymbol{x}' = (x_1, x_2, \ldots, x_q)$ are observed dependent and independent variables. ***?, e, d*** are the vectors of error terms, and B, G, L_x, L_y are the unknown parameters.

Concretely speaking, the cause-effect relationships shown in Figure 1 will be quantitatively represented using equations (1)~(3).

4. SUMMARY OF DATA

A questionnaire survey about urban air quality management in Jakarta was conducted with respect to the citizens and government officers in Jakarta in February 2005. The questionnaire items includes : 1) personal attributes such as age, gender, occupation, academic background, and commuting behavior ; 2) respondents' acquisition about knowledge of environment ; 3) expectations about, perceived performance of and perceived change in transportation systems and ecosystems during the last 5 years; 4) perceived impact of air pollution and its countermeasures on people's health, livability, ecosystems and economic growth; 5) respondents' evaluations on current situations and future expectations related to capacity of civil society, perceived capacities of city and central governments, and logistic firms. In the question items 3), 4), and 5), respondents were asked to give their answers using 5-scale measure (e.g., 1: very bad, 2: bad, 3: neutral, 4: good, and 5: very good).

Data was collected via a face to face home interviews (for citizen) and via a face to face office interviews (for government officers). Total samples are 619 (citizen: 394 and government officers: 225). Questionnaire for citizen were distributed to all over cities and districts around Jakarta which consists of Bekasi (48 samples); Tangerang (67 samples); Depok (37 samples); Bogor (81 samples); Jakarta city (145 samples) and via internet 16 samples. Questionnaire for government officers were covered national level institutions/agency (47 samples), provincial level (35 samples) and city level (143 samples). Sex composition for citizen respondents are 62,2% male and 37,8% female, for government officers respondents consist of 66,2 % male and 33,8% female. The respondent's attributes data are shown in figure 2 & 3.

Table 5 shows the citizens' and government's expectations about, perceived performance of and perceived change in transportation systems and ecosystems in Jakarta during the last 5 years. Table 6 shows perceived current impacts of air pollution on people's health, livability, and ecosystems, as well as citizens' and government officers' preferences about the relieving policies in the future.

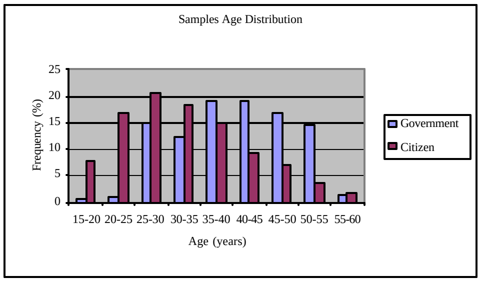


Figure 2 Samples Age Distribution

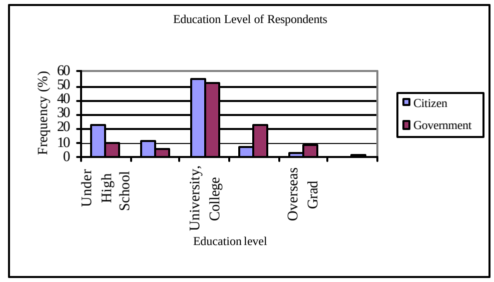


Figure 3 Education Level

Table 5 Perceived Expectation, Performance and Change urban city services by respondents

Descriptions	Government						Citizen					
	Expectation		Performance		Change		Expectation		Performance		Change	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Urban Public Transport System	4.68	0.57	2.22	0.86	3.12	0.93	4.65	0.53	2.24	0.85	3.05	0.9396
Traffic Congestion	4.71	0.58	2.21	0.87	2.95	1.01	4.71	0.51	1.99	0.84	2.74	1.0302
Traffic Safety and Accident	4.5	0.72	2.52	0.79	2.99	0.85	4.49	0.65	2.59	0.75	3.11	0.8822
Air Pollution from Traffic	4.72	0.57	2.16	0.82	2.72	0.98	4.7	0.52	2.03	0.86	2.63	1.0191
Air Pollution from Industry	4.57	0.62	2.31	0.82	2.81	0.91	4.53	0.60	2.25	0.88	2.83	0.9477
Preserving Forest and Farmland	4.31	0.71	2.48	0.80	2.8	0.97	4.23	0.75	2.5	0.81	2.76	0.9431
Development of Parks and Green Spaces	4.44	0.68	2.54	0.83	2.97	1.00	4.44	0.66	2.59	0.89	2.96	1.0706

Change during 5 years	1:much worse	2:worse	3:neutral	4:better	5:much better
Perceived Performance	1:very bad	2:bad	3:neutral	4:good	5:very good
Expectation (importance)	1:much less	2:less	3:neutral	4:more	5:much more

Table 6 Perceived Impacts of Air Pollution and its Relieving Policies

Evaluation Items		Evaluation Results			
		Government		Citizen	
		Mean	SD	Mean	SD
Impact of Air Pollution*	Health	4.49	0.71	4.30	0.76
	Livability	4.43	0.67	4.38	0.67
	Ecosystems at other areas (city)	4.19	0.76	4.19	0.86
Impact of Environmental Preservation Policies**	Unemployment	1.98	1.04	2.42	1.13
	Production Cost	2.82	1.14	2.60	1.18
	Car use and Ownership	3.65	1.12	3.62	1.08
	Taxation	2.72	1.04	2.61	1.20
	Economic Growth (reduce)	1.91	1.00	2.23	1.08
	Simultaneously Economic Growth&Reduce Air Pollution	3.64	1.06	2.60	1.17

*Current impact level: 5.very high; 4.high; 3.neutral; 2.low; 1.very low

** Preservation Policies: 5. Strongly Agree; 4. Agree; 3. Neutral; 2. Disagree; 3. Strongly Disagree

5. MODEL ESTIMATION AND EVALUATION OF SOCIAL CAPACITY

To quantitatively represent the cause-effect relationships in the DPSIR framework, the following five latent variables are introduced: "capacity of citizen", "capacity of government" and "capacity of firms", "urban city service performance", and "impact".

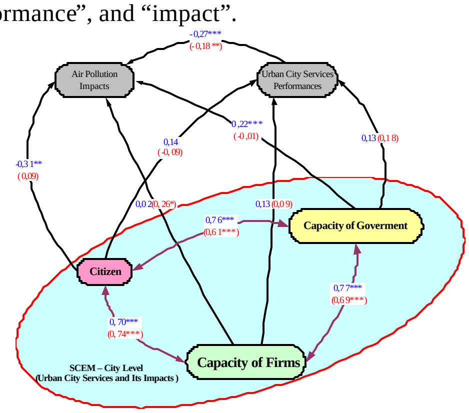


Figure 4 DPSIR Framework in the context of air pollution from transportation in Jakarta City

The standardized total effects obtained from the established structural equation model are shown in Table 7 & 8

Table 7 Standardized Total Effects (citizen respondent)

Evaluation Items		Respondent : Citizen				
		goverment Capacity	Firm Capacity	Citizen Capacity	Urban Services Performance	Air Pollution Impact
Impact of Air Pollution	Health	0.116	-0.012	-0.218	-0.169	0.615
	Livability	0.122	-0.013	-0.230	-0.179	0.650
	Ecosystems at other areas (city)	0.125	-0.013	-0.236	-0.183	0.667
Urban City Service Performance (State or Pressure)	Urban Public Transport System	0.083	0.08	0.09	0.619	-
	Traffic Congestion	0.085	0.082	0.092	0.633	-
	Traffic Safety and Accident	0.076	0.074	0.083	0.571	-
	Air Pollution from Traffic	0.093	0.09	0.101	0.694	-
	Air Pollution from Industry	0.089	0.087	0.097	0.668	-
	Preserving Forest and Farmland	0.084	0.082	0.091	0.629	-
	Development of Parks and Green Spaces	0.083	0.081	0.09	0.622	-

Table 8 Standardized Total Effects (Government respondent)

Evaluation Items		Respondent : Government				
		goverment Capacity	Firm Capacity	Citizen Capacity	Urban Services Performance	Air Pollution Impact
Impact of Air Pollution	Health	-0.026	0.155	-0.047	-0.112	0.640
	Livability	-0.035	0.211	-0.065	-0.153	0.873
	Ecosystems at other areas (city)	-0.020	0.121	-0.037	-0.088	0.500
Urban City Service Performance (State or Pressure)	Urban Public Transport System	0.123	0.063	-0.062	0.695	-
	Traffic Congestion	0.125	0.064	-0.063	0.709	-
	Traffic Safety and Accident	0.111	0.057	-0.056	0.632	-
	Air Pollution from Traffic	0.114	0.058	-0.058	0.647	-
	Air Pollution from Industry	0.13	0.066	-0.066	0.739	-
	Preserving Forest and Farmland	0.106	0.054	-0.054	0.602	-
	Development of Parks and Green Spaces	0.118	0.06	-0.06	0.669	-

Observing the total effects shown in Table 7 and 8, it is found that,

1) It is found that all the introduced explanatory variables related to each capacity not only have expected signs, but also have statistically significant estimated parameters. This result supports the proposed design concepts about the questionnaire surveys measuring the social capacity.
2) Increasing "Urban city service performance" will reduce "impact", because the relevant parameter is statistically significant.

From the viewpoint of residents concerning the effects on "impact", "capacity of citizen" and "capacity of firm" have a negative direct effect on "impact". From the viewpoint of government officers about the effects on "impact", "capacity of government" and "capacity of citizen" have negative effect on "impact".

6. CONCLUSION

Using data collected from Citizen and Government Officers in Jabodetabek areas, we confirmed the effectiveness of the proposed analysis framework in measuring social capacity for urban air pollution management in transportation sector. By the model, we found that there are several correlations among three actors' social capacities and increasing urban city services performance will reduce air pollution impacts.

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