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A Verification of the Effectiveness of Alternatives Analysis and Public Involvement on the Quality of JICA Environmental and Social Consideration Reports

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A Verification of the Effectiveness of Alternatives Analysis and Public Involvement on the Quality of JICA Environmental and Social Consideration Reports

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Abstract

The Japan International Cooperation Agency (JICA) introduced guidelines for environmental and social considerations in April 2004. The guidelines could lead to an improvement in the quality of environmental and social consideration reports. The main reason for this may be the inclusion of alternatives analysis and public involvement. This study aimed to quantitatively verify the effectiveness of alternatives analysis and public involvement, and to propose concrete methods for improving the quality of reports based on the analytic result. The Lee-Colley review package was used to review the quality of the samples of 120 reports dating from 2001 to 2012. A path analysis with structural equation modeling was used to obtain a causal model. The rating scales from A to F (ordinal scales) were converted to rank scores and analyzed using a statistical technique. This paper acknowledges the effectiveness of alternatives analysis, public involvement, and the number of criteria for improving the quality of the reports. The effectiveness of those variables may be verified by the causal model. As a result of statistical analysis, the paper points out the effectiveness of alternatives analysis with a wide range of criteria and public involvement. Further research is needed to improve the causal model by attaining new knowledge, to find out what are the concrete benefits of public involvement to the quality of the reports, to verify the most suitable number of alternatives and criteria for alternatives analysis, and to prepare technical guidelines for the use of the quantitative technique of alternatives analysis in case studies.

Keywords: environmental and social considerations, alternatives analysis, public involvement, The Lee-Colley review package, path analysis

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Introduction

This study aimed to verify the effectiveness of alternatives analysis and public involvement for improving the quality of environmental and social consideration reports (ESCRs) prepared by the Japan International Cooperation Agency (JICA), both quantitatively and objectively. At the same time the study set out to propose concrete measures for improving the quality of the JICA ESCRs. As the executing agency of Japanese official development assistance (ODA), JICA assists and supports developing countries and is in charge of administering all ODA, such as technical cooperation, ODA loans, and grants in an integrated manner (JICA Profile, November 2014). The application of JICA guidelines for environmental and social considerations (ESC) started in April 2004. Institutionalized procedures for environmental assessment at the preparation phase of the project cycle included screening classifying projects into three categories, increasing the range of environmental and social impacts, an analysis of the alternatives including the zero option, the introduction of strategic environmental assessment (SEA), information disclosure, and public involvement. In 2010, JICA fully widened the range of the environmental assessment process to include the project cycle from preparation to the monitoring phase. The examination may conclude that the JICA ESC guidelines have improved the quality of the ESCRs, and that alternatives analysis and public involvement have led to a better quality of analysis (Kamijo 2014).

The US Council on Environmental Quality Regulations (CEQ 1978) highlights the importance of the assessment of alternatives by noting that this represents “the heart of the environmental impact statement (EIS).” A review of alternatives to a proposed action is the basis for environmental impact assessment (EIA) good practice. It is applied primarily to find better ways to avoid and minimize adverse impacts while still realizing project objectives. However, review of alternatives is inadequately carried out in many countries (Abaza, Bisset, and Sadler 2004, 51). A discussion of alternatives ensures that the developer has considered the

other approaches to the project and the means of preventing environmental damage. It can allow people who were not directly involved in the decision-making process to evaluate various aspects of a proposed project and to understand how the decisions were arrived at. It also provides a framework for the competent authority's decision, rather than merely a justification for a particular action. Finally, if unforeseen difficulties arise during the construction or operation of a project, a re-examination of these alternatives may help to provide rapid and cost-effective solutions (Glasson, Therivel, and Chadwick 2012, 90). Despite its importance, little progress on alternative considerations has been observed over the years. The poor consideration of alternatives is exacerbated by the separation of the impact assessment types. The better integration of types is necessary to ensure that impact assessment adds more value to the decision making (Geneletti 2014, 17). The insufficient alternatives analysis has long been pointed out.

Public involvement is an integral part of EIA. There is no doubt that public involvement and consultation is a vital component of successful EIA (Abaza, Bisset, and Sadler 2004, 66). The benefits of public participation are: the improved quality of decisions, the minimizing of cost and delay, consensus building, increased ease of implementation, avoiding worst-case confrontations, maintaining credibility and legitimacy, anticipating public consensus and attitudes, and developing civil society (Creighton 2005, 19). The most important justifications for public participation can be grouped into three categories: improving quality, enhancing legitimacy, and building capacity (National Research Council 2008, 50). Developers do not usually favor public participation as it carries the risk of giving a project a high profile, with the attendant costs of time and money. The decision may also represent the views of the most vocal interest groups rather than of the general public. Public participation has often evolved into a systematic attempt to put a stop to projects. Thus, many developers never see the positive side of public participation (Glasson, Therivel, and Chadwick 2012, 145).

Despite the establishment and refinement of EIA systems in developing countries, EIA

implementation still has many shortcomings, including: insufficient consideration of alternatives and weak public participation, a shortage of environmental information and expertise, a poor quality of EIS, and weak implementation of mitigation measures and monitoring. Ahammed and Harvey (2004) pointed out that in Bangladesh there was weak legislative control over the EIA processes including the development of alternatives, the disclosure of information, public participation, dispute settlement, and monitoring. Betey and Godfred (2013) revealed that in selected African countries, successful integration of EIA into planning and decision-making processes had not yet been realized. Briffett, Obbard, and Mackee (2004) described many practical constraints that needed to be overcome in Malaysia. Clausen, Vu, and Pedrono (2011) indicated an important gap between EIA theory and practice in Vietnam, and recommended improving the capacity of EIA practitioners rather than introducing further substantial legislative change. Khusnutdinova (2004) explained the shortcomings of the EIA system in Uzbekistan which included unclear screening provisions, lack of public participation, and limited consideration of alternatives. Looking at Pakistan and India, Nadeem and Hameed (2008) and Panigrahi and Amirapu (2012) revealed that in those countries EIA approval authorities have insufficient capacity, the quality of EIA is poor, there is inadequate public participation, and monitoring is weak. The authors reported that EIA was used as a project justification tool rather than a project planning tool. Wayakone and Inoue (2012) explained the major weakness in the EIA system in Lao PDR were a lack of trained and skilled personnel, inadequate public consultation, insufficient environmental data, and weak follow-up and monitoring. Wood (2003) evaluated EIA in developing countries using 14 evaluation criteria - few of which were met. He found that the consideration of alternatives was frequently weak and there was no tradition of consultation and participation. The notion of public participation in decision making was revolutionary in many developing countries.

The review results of EIS submitted to the Asian Development Bank (ADB) revealed that EIS was generally weak in: 1) assessment of ecological impacts; 2) analysis of

alternatives; 3) economic analysis of environmental impacts; and 4) public participation (Lohani et al. 1997, 2-31). Weak enforcement of EIA was a major problem in many developing countries in East and Southeast Asia, which was reflected through late implementation, insufficient consideration of alternatives, weak public consultation, and a lack of information disclosure. In order to make the system more effective, the requirements of early implementation, alternatives analysis, public consultation, and information disclosure should be stipulated as essential elements of EIS (World Bank 2006, 15).

Given the constraints on implementing EIA in developing countries, which includes a shortage of environmental and social expertise and information, it could be difficult for them to prepare EIS to a quality as high as that in developed countries. However, alternatives analysis and public involvement are actual options for improving EIS because detailed information or advanced technology is not required. The effectiveness and benefits of alternatives analysis and public involvement have been pointed out for years but their implementation is still weak. One reason could be that their effectiveness in improving the quality of EIS is not indicated with clear evidence, and in practice the alternatives analysis and public involvement are perfunctory processes. If we show their effectiveness and a causal relationship quantitatively, we would expect that their justifications and understandings would be enhanced, the methodologies of alternatives analysis and public involvement would be advanced, and the quality of EIS improved even under the constraints present in developing countries.

1. Literature review

Research on alternatives analysis has been conducted to show the merits of each technique and its importance to EIA. Solnes (2003) and Dey (2001), for example, suggested the application of an analytical hierarchy process (AHP), which was particularly convenient for comparing different alternatives and was a well-known tool for decision making in operational analysis. Geneletti (2005) indicated a methodology of weighted summation as simple multi-criteria

analysis (MCA). Janssen (2001) noted that the role of MCA was to make the decision-making process more transparent and the information manageable for all stakeholders. Hajkowicz (2007) compared MCA assisted decisions with unaided decisions and concluded that the majority of decision makers supported the adoption of MCA for making future investment decisions. Hajkowicz (2008) showed how relatively simple MCA could help stakeholders make group decisions, even when they have strongly conflicting preferences. Steinemann (2001) stated that more environmentally sound alternatives could be overlooked and inadequate alternatives could undermine the goals of EIA - to encourage more environmentally sound and publicly acceptable actions. Smith (2007) examined Federal Court of Appeal decisions on challenges to alternatives analyses that were contained in federal agency documents. The results showed that federal agencies had not included a full, reasonable range of alternatives and had improperly constructed the purpose of, and need for, their projects.

Until recently, the benefits of public involvement in EIA had been indicated empirically and the empirical research had been limited (Creighton 2005, 19). Diduck et al. (2007) showed that public participation in project planning and implementation did not exemplify the characteristics of meaningful involvement. Glucker et al. (2013) concluded that there was a broad consensus that public participation was a key to effective EIA, but there was no consensus concerning the meaning, objectives and adequate breadth of public participation in EIA. Nadeem and Fischer (2011) evaluated the performance of public participation in EIA in Pakistan and revealed that overall the influence of public participation on the substantive quality of EIA and on the final decision was weak. Okello et al. (2009) indicated that despite the presence of good regulations regarding public participation in Kenya, in practice public participation was poor. This was particularly so during the scoping, report review, and follow-up stages, and draws attention to possible solutions, including the potential for SEA to act as a bridge to better public participation. Palerm (2000) developed the theoretical model for

public participation and proposed best-practice guidelines for the phases of scoping, EIS preparation, and EIS review. Monnikhof and Edelenbos (2001) looked at the result of stakeholder input on the final policy proposal. One overall finding was that many stakeholder inputs (ideas, values, wishes, and interests) were explored, but most of them were lost in the fogginess of the participatory process, and did not find a place in the Council proposal. Ward (2001) evaluated the involvement of diverse stakeholders in the planning of an urban transport system and concluded that an increase in the diversity of stakeholders led to an increase in the diversity of problem definitions and innovations in the planning process. He also found that attempts to include a greater diversity of stakeholders in transport planning would be obstructed by existing concentrated power structures. Mwenda et al. (2012) documented trends in public participation in EIA in Kenya, using a consultation and public participation index (CPPI) developed for the analysis of EIS. The results of the study indicated that public participation was relatively low. The CPPI was the first index to analyze public participation and it serves as a good starting point for the evaluation of public participation within EIA. Cuppen, Broekhans, and Enserink (2012) addressed the complex relationship between participating in EIA studies and accepting policies. They showed that four possible project attitudes arose among stakeholders (support, rejection, ambivalence, and acceptance). The authors then analyzed four factors that contributed to the development of these different attitudes, which were: 1) the influence the EIA had on the whole project; 2) the fact that the EIA had become a platform for a political debate; 3) the emergence of a win-all/lose-all situation; and 4) the non-use of the expertise of the experts. The legitimacy of policy-making and policy-makers themselves became challenged when attitudes of ambivalence and rejection developed within the project; this was, especially so where the negative attitudes were propagated to a wider public.

The role of causal networks in EIA had been assigned predominantly to impact identification, prediction, and assessment (Canter 1996, 81). This was particularly so with

regards to cumulative impacts, indirect impacts, and impact interactions, but not to evaluation or further phases of the EIA process (European Commission 1999, 39). Perdicoulis (2006) encouraged the future development of causal networks and more involvement by the networks in EIA practices, either by fortifying their present contribution to EIA or extending their contribution through applications in impact mitigation and impact monitoring.

The Lee-Colley review package (Lee et al. 1999) consists of a series of questions grouped hierarchically into four tiers. By allocating grades to the questions at each level, an overall grade for the quality of the EIS is determined. This package has been widely used in developed and developing countries. Findings from these types of studies indicate that the description of the project and the environment and the communication of results tend to be the better performing areas, whereas impact identification, assessment of significance, alternatives, and mitigation tend to be the more under-performing areas (Lee 2000, 140-142). Sandham and Pretorius (2008) reviewed the quality of 28 EISs in the North West province of South Africa using the Lee-Colley review package. The results showed better performance in the descriptive and presentational areas and poorer performance in the analytical areas. The authors discussed the way forward and proposed more quality review research as a means of broadening the EIS baseline quality, but they did not discuss key factors and methods for improving the quality of EIS. Tzoumis (2007) compared four agencies in the United States for their achievement of draft EIS ratings. Ratings could be used to help agencies monitor their own performance and improve their quality. Both the people who prepare EIA and the public would be better served if ratings were based on more detailed and uniform content standards of acceptable analyses. This would allow some standardization of preparation and understanding of the EIA methods.

Murayama (2004) recommended the consideration of the maximum ranges of alternatives when JICA implemented SEA but setting criteria and the overall evaluation of alternatives analysis were tasks set for the future. In the two years from July 2010, the JICA advisory committee for ESC, a permanent third-party institution comprised of external experts

who advise JICA, provided 1,123 advices in a total for 40 projects. The number of advice about alternatives and public involvement was 75 and 131 respectively. The alternatives analysis and public involvement were enhanced and the quality of JICA ESCRs was improved as a result of input from the committee (Murayama et al. 2012). Masumoto, Takahashi, and Ueda (2013) reported that alternatives analysis and stakeholder meetings were common issues in relation to JICA's SEA and further efforts were needed to improve both of them. Kamijo (2014) reviewed the quality of 120 JICA ESCRs which dated from 2001 to 2012 and analyzed the key factors for improving the quality of ESCRs. The results concluded that the 2004 JICA ESC guidelines improved the quality of ESCRs and the alternatives analysis and public involvement may be practical options for leading to a better quality of analysis. However, further research was required in order to verify the effectiveness of alternatives analysis and public involvement for improving the quality of ESCRs.

As shown in the literature, alternatives analysis and public involvement were studied individually, their effectiveness analyzed qualitatively, and technical issues were proposed within that limited scope. The alternatives analysis may be relevant to public involvement but there were no studies which focused on this relevance. The use of causal networks was limited based on subjective judgments. The quality review studies showed both improved and worsened performance in this area but did not analyze rating data quantitatively to examine explanatory variables for improving the quality of EIS. However, one recent piece of research pointed out that alternatives analysis and public involvement could be key factors in improving quality but verification of their effectiveness was required (Kamijo 2014). It was expected that the verification would show that the discussion of alternatives was distinctly at the heart of EIS. Accordingly this study aimed to verify quantitatively the effectiveness of the relevance of alternatives analysis and public involvement on the quality of the JICA ESCRs through statistical analysis of rating data. At the same time, concrete methods for improving the quality of the JICA ESCRs were proposed based on the examination of the effects of the number of

public involvement stages, alternatives, and criteria on the quality of reports.

2. Data and methods

The US CEQ explains alternatives and public involvement in the following way: "[The alternatives] section is the heart of EIS. ...[It] should present the environmental impacts of the proposal and alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public. Agencies shall rigorously explore and objectively evaluate all reasonable alternatives" (n.d., 15-16). Public involvement is noted as "[the involvement of] the public in preparing and implementing [environmental assessment] procedures. The agencies provide public notice of related hearings, public meetings, and the availability of environmental documents so as to inform those persons and agencies who may be interested or affected" (29). These concepts are considered common and appropriate, therefore this study has chosen to follow them.

The results of the review of the 120 JICA ESCRs using the Lee-Colley review package (Kamijo 2014) were used for this study. According to this method, the quality review of reports involved evaluating how well a number of assessment tasks - grouped hierarchically into sub-categories, categories and area - have been performed. The review areas and review categories, and the assessment symbols are summarized in Table 1 and Table 2 respectively. Lee et al. (1999) warned that "'letters' rather than 'numbers' are used as symbols to discourage reviewers from crude aggregation to obtain assessments at the higher levels in the pyramid" (10). In order to see the change before and after the JICA ESC guidelines were introduced in 2004, a total of 120 samples - 10 per year for the years between 2001 and 2012 - were randomly selected using the Japanese Industrial Standards (JIS) random number table. A list of JICA reports searched for each year within the website of the JICA library was used as the report population. The total number of JICA ESCRs was not given. The sample size was decided with reference to the past case studies, which showed 112 samples in European countries, 28 in South

Africa, 26 in Tanzania, 13 in Malaysia, and seven in India. The sample size exceeded what was previously the largest sample size and was judged sufficient for this study. The review methodology followed that of Lee and Colley, commencing at the lowest level.

Table 1. Review areas and review categories

1	Description of the development, the local environment and the baseline conditions
1.1	Description of the development
1.2	Site description
1.3	Wastes
1.4	Environmental description
1.5	Baseline conditions
2	Identification and evaluation of key impacts
2.1	Definition of impacts
2.2	Identification of impacts
2.3	Scoping
2.4	Prediction of impact magnitude
2.5	Assessment of impacts significance
3	Alternatives and mitigation
3.1	Alternatives
3.2	Scope and effectiveness of mitigation maseasures
3.3	Commitment to mitigation
4	Communication of results
4.1	Layout
4.2	Presentation
4.3	Emphasis
4.4	Non-technical summary

Source : Lee et al. 1999.

Table 2. List of assessment symbols

Symbol	Explanation
A	Relevant tasks well performed, no important tasks left incomplete.
B	Generally satisfactory and complete, only minor omissions and inadequacies.
C	Can be considered just satisfactory despite omissions and/or inadequacies.
D	Parts are well attempted but must, as a whole, be considered just unsatisfactory because of omissions or inadequacies.
E	Not satisfactory, significant omissions or inadequacies.
F	Very unsatisfactory, important tasks poorly done or not attempted.
N/A	Not applicable. The review topic is not applicable or it is irrelevant in the context of the statement.

Source : Lee et al. 1999.

The analysis of the overall quality of the JICA ESCRs (Table 3) indicated that none of the reports could be described as well performed (A), 17 generally satisfactory (B), 25 graded as just satisfactory (C), 63 just unsatisfactory (D), and 15 poorly attempted (E), and no reports received the lowest grading (F). The rating scale from A to F is an ordinal scale, but it is a common practice to convert ordinal scales to rank scores and statistically analyze quantitative data. Stevens (1946) explained the ordinal scale: "In the strictest propriety the ordinary statistics...ought not to be used with [ordinal] scales. ...On the other hand, for this 'illegal' statisticizing there can be invoked a kind of pragmatic sanction: In numerous instances it leads to fruitful results" (679). According to this interpretation the rating scale from A to F was quantified by 6, 5, 4, 3, 2, and 1, and the interval between each category was assumed to be one. The statistical analysis had the advantage of distinguishing whether the difference of groups was an effect of alternatives analysis and public involvement or merely a coincidence.

Table 3. An overview of the results of a quality review of a sample of 120 JICA ESCRs

Summary of category grades		A	B	C	D	E	F	N
1.1	Description of the development	0	24	85	11	0	0	0
1.2	Site description	0	22	81	16	0	0	1
1.3	Wastes	0	4	12	5	3	0	96
1.4	Environmental description	1	23	51	39	6	0	0
1.5	Baseline conditions	2	17	35	32	33	1	0
2.1	Definition of impacts	0	11	34	48	24	3	0
2.2	Identification of impacts	0	9	32	60	16	3	0
2.3	Scoping	3	15	28	45	24	5	0
2.4	Prediction of impact magnitude	1	13	21	37	37	11	0
2.5	Assessment of impacts significance	0	12	20	37	39	11	1
3.1	Alternatives	4	20	20	30	31	14	1
3.2	Scope and effectiveness of mitigation maseasures	1	16	15	51	30	7	0
3.3	Commitment to mitigation	0	12	30	36	31	6	5
4.1	Layout	1	16	40	52	11	0	0
4.2	Presentation	1	16	34	55	14	0	0
4.3	Emphasis	0	13	31	53	21	2	0
4.4	Non-technical summary	1	12	36	53	16	2	0
	Four areas for review							
1	Description of the development and the environment	1	22	52	44	1	0	0
2	Identification and evaluation of key impacts	0	10	27	54	26	3	0
3	Alternatives and mitigation	2	18	17	46	32	5	0
4	Communication of results	1	16	32	59	12	0	0
	Overall quality	0	17	25	63	15	0	0

Source : Kamijo 2014.

The category of ‘wastes’ was excluded from the analysis because many reports were not applicable and wastes were included in the impacts of other categories. In the figures that show the average scores, the category of ‘alternatives’ (3.1) was put before the definition of ‘impacts’ (2.1) so that the category orders were placed in line with the EIA process. Samples were distributed in six sectors and six regions, and the number of EIA and initial environmental examination (IEE) reports was 36 and 84, respectively (Table 4).

In order to assess the effects of the relevance of alternatives analysis and public involvement on the quality of JICA ESCRs, the 120 samples were stratified into four groups: 1) both processes of alternatives analysis and public involvement; 2) alternatives analysis process only; 3) public involvement process only; and 4) neither alternatives analysis nor public involvement processes (Table 5). In the same way, the group containing both processes (n=49) was stratified by the number of public involvement stages so as to assess the effect of public involvement on quality (Table 6). “Three times” means: public involvement at the scoping stage, the intermediate stage between scoping and draft reporting, and at the draft reporting stage; “two times” refers to public involvement at the scoping stage and the draft reporting stage; and “one time” means involvement at the draft reporting stage. One time at EIA level is excluded from the analysis due to there having been only one sample. The groups which had public involvement stages two and three times (n=34) were then stratified by the medians of alternatives (five at EIA level and three at IEE level) and criteria (seven at EIA level and four at IEE level) to assess the effects of the number of alternatives and criteria on the quality (Table 7). At the same time, the number of alternatives and criteria from 34 samples is displayed on scatter diagrams by the EIA and IEE levels as well as by quantitative and qualitative techniques. For statistical analysis, the scores of overall quality were analyzed using the upper sided Turkey-Kramer multiple comparison tests between more than three groups and the upper sided *t* test between two groups. The difference with $P < 0.05$* was considered significant. Statistical analysis was performed using Excel 2010 and the add-in software

multiple comparisons Toraneko (Ogura 2012) and Statcel3 (Yanai 2014).

Table 4. Distribution in sectors and regions

Sector	EIA	IEE	Total
Transportation	21	26	47
Regional development	1	20	21
Power	6	13	19
Water resource	4	13	17
Pollution control	3	8	11
Agriculture	1	4	5
Total	36	84	120

Region	EIA	IEE	Total
Asia	24	47	71
Middle East	3	12	15
South America	4	10	14
Africa	3	10	13
Europe	1	4	5
Pacific	1	1	2
Total	36	84	120

Source : Kamijo 2014.

Table 5. Distribution in alternatives analysis and public involvement in 4 year interval (n=120)

Alternative analysis and/or public involvement	EIA level			IEE level			Total
	2001 ～04	2005 ～08	2009 ～12	2001 ～04	2005 ～08	2009 ～12	
Both processes	1	8	9	1	14	16	49
Alternatives analysis	7	0	1	10	8	1	27
Public involvement	0	0	1	1	3	5	10
Neither process	7	1	1	13	6	6	34
Total	15	9	12	25	31	28	120

Source : Author

Table 6. Distribution in number of public involvement stages (n=49)

Number of stages	EIA level			IEE level			Total
	2001 ～04	2005 ～08	2009 ～12	2001 ～04	2005 ～08	2009 ～12	
Three times	0	3	3	0	3	3	12
Two times	0	5	6	0	7	4	22
One time	1	0	0	1	4	9	15
Total	1	8	9	1	14	16	49

Source : Author

Table 7. Distribution in number of alternatives and criteria (n=34)

Number of stages	Number of alternatives				Total	Number of impacts				Total
	EIA level		IEE level			EIA level		IEE level		
	1 to 5	6 and over	1 to 3	4 and over		0 to 7	8 and over	0 to 4	5 and over	
Three times	2	4	6	0	12	2	4	3	3	12
Two times	8	3	7	4	22	8	3	8	3	22
Total	10	7	13	4	34	10	7	11	6	34

Source : Author

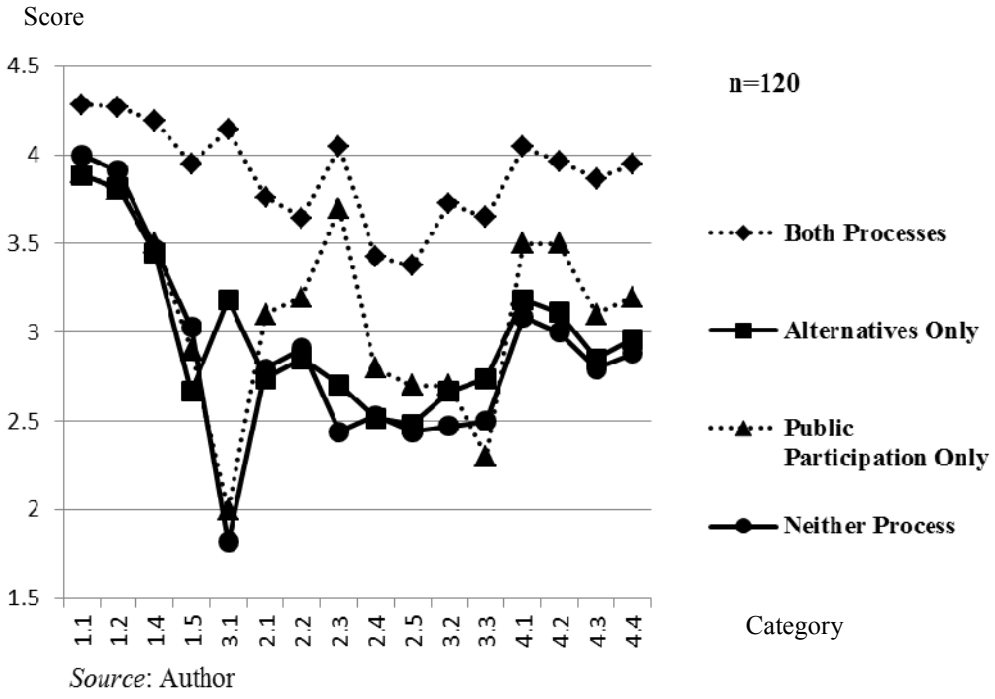
A path analysis with structural equator modeling (SEM) was conducted to obtain a causal model between five variables and the overall quality of JICA ESCRs with path coefficients. The five variables were: number of alternatives, number of criteria, alternatives analysis, public involvement, and mitigation. The effect of four of the variables, with the exception of mitigation, on quality was analyzed; mitigation was then added because it was regarded as a conclusion of the EIA process and indispensable due to the importance of its role. One big feature of path analysis with SEM is that a set of adaptation indexes is used to reject an incorrect model and a good result of adaptation indexes is a necessary condition for a correct model. A causal model with satisfactory adaptation indexes could be evidence to verify the effectiveness of the relevance of alternatives analysis and the public involvement to the quality of JICA ESCRs. The correlation coefficient calculated between the scores of quality review, the number of alternatives, criteria, and public involvement stages was used as path analysis data. The path analysis was performed using Excel 2010 and the add-in software Covariance structure analysis (Kojima and Yamamoto 2013).

3. Results

3.1 Quality difference by alternatives analysis and public involvement

The average scores of the four groups of alternatives analysis and public involvement, and the

results of the Turkey-Krammer test are shown in Figure 1 and Table 8. The overall quality of both processes was significantly higher than those of the other three groups (P<0.01) and the scores of every category were also higher than the other three groups. A significant difference was not recognized in the other three groups. The processes of only alternatives analysis or only public involvement did not show any difference from either the alternatives analysis or public involvement processes. The alternatives analysis and public involvement showed effectiveness only when they worked together. The alternatives analysis and public involvement would have some kind of causal relationship, which may justify the effectiveness of both processes.



Source: Author

Figure 1. Average score of four groups of alternatives analysis and public involvement (n=120)

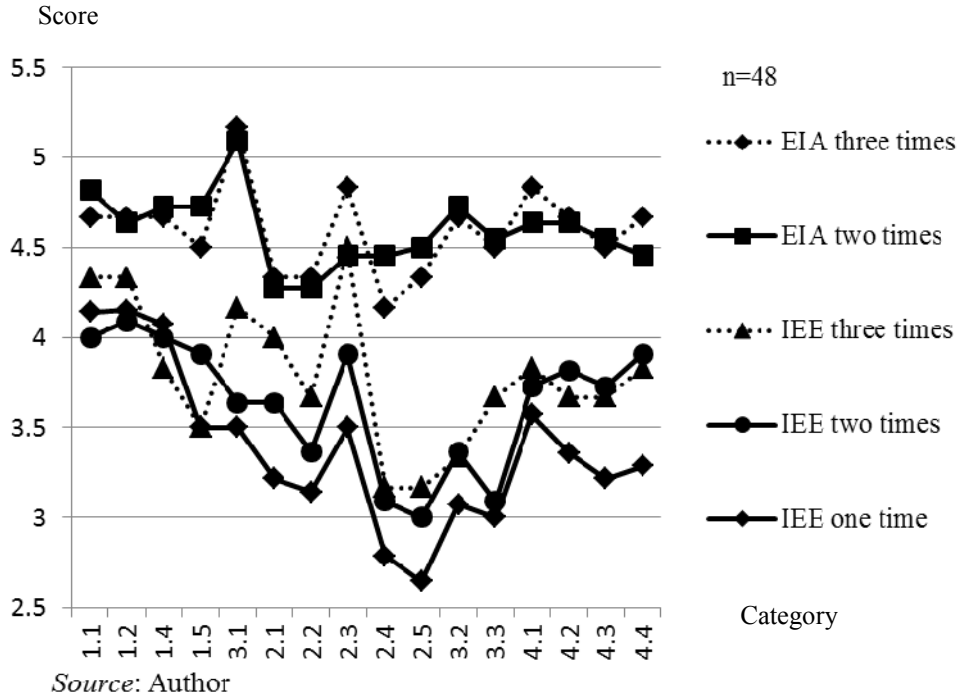
Table 8. Turkey-Krammer test results of four groups (Significant at P<0.05*, 0.01)**

Group	Altrernatives analysis	Public involvement	Neither process
Both processes	7.6981**	5.8715**	8.7732**
Alternatives analysis		0.5196	0.4390
Public involvement			0.2202
Neither process			

Source : Author

3.2 Quality difference by number of public involvement stages

Figure 2 and Table 9 show the average scores of five groups at the public involvement stage, the results of *t* test between two groups at the EIA level, and of Turkey-Krammer tests between three groups of the IEE level. No significant difference was recognized in the groups at the EIA or IEE level. There was no difference between two and three times at the EIA and IEE levels but a certain degree of difference was recognized between one and two times at IEE level.



Source: Author

Figure 2. Average score of five groups at public involvement stage (n=48)

Table 9. Results of *t* test and the Turkey-Krammer test of five groups (Significant at *P*<0.05*)

Group	EIA level two times	IEE level two times	IEE level one time
EIA level three times	0.2467		
IEE level three times		0.3508	1.8840
IEE level two times			1.8397
IEE level one time			

Source : Author

3.3 Quality difference by number of alternatives and criteria

The number of alternatives and criteria for 34 samples (the groups of two and three times of public involvement stages) were shown in a scatter diagram (Figure 3). The number of alternatives and criteria at the EIA level varied widely compared to those at the IEE level, and a scatter of the number of criteria was wider than the one for alternatives. The relationship between the technique of alternatives analysis and the number of alternatives and criteria is shown in Figure 4. The number of qualitative and quantitative techniques was 24 and 10 respectively. What meaning did the difference between qualitative and quantitative techniques have? The quantitative technique was often used when the number of criteria was nine and over.

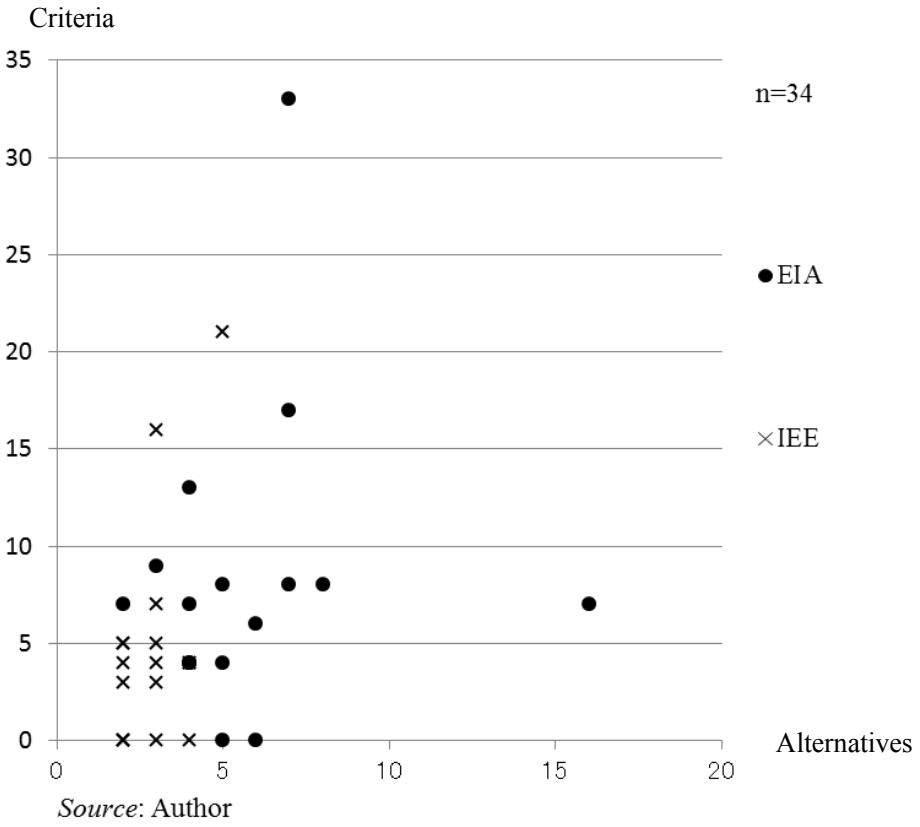
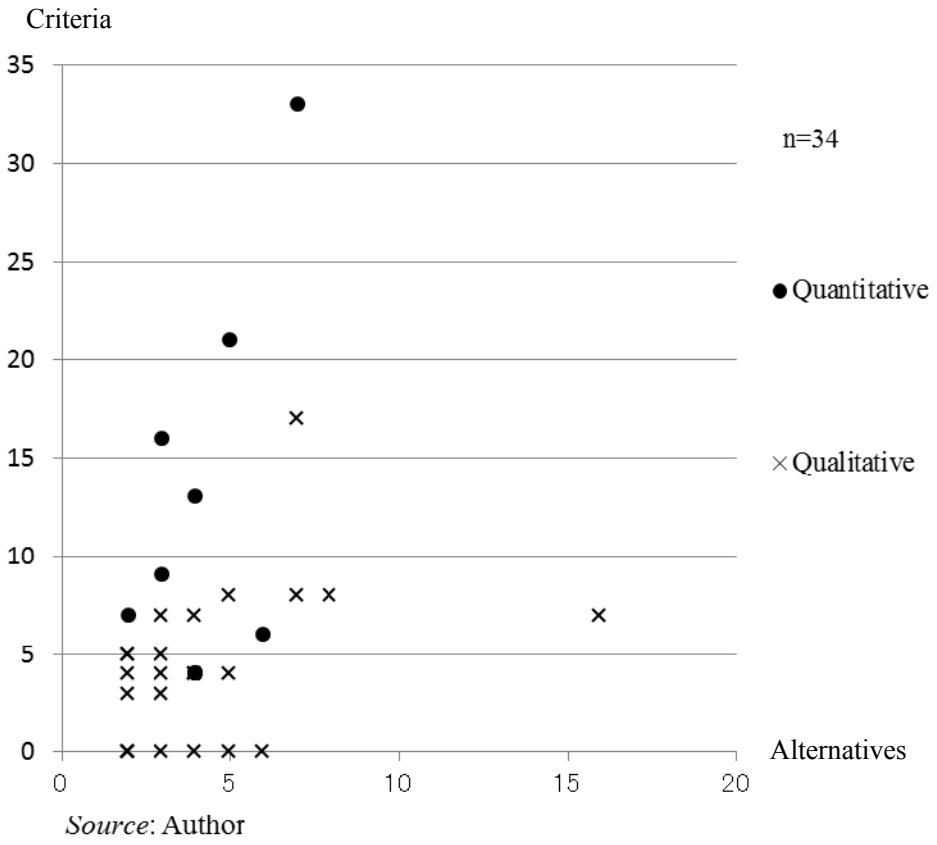


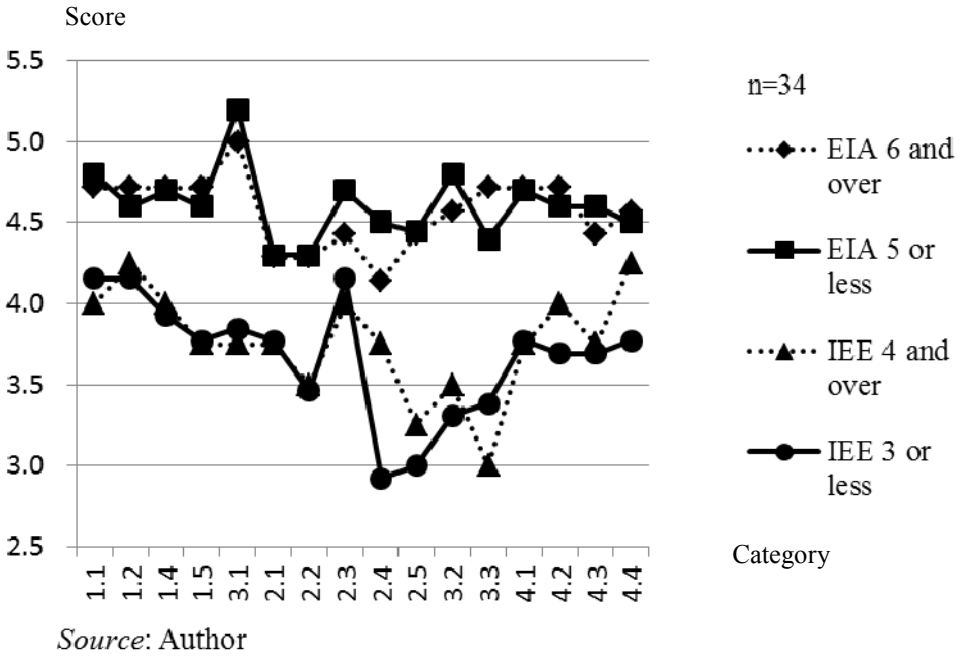
Figure 3. Number of alternatives and criteria (n=34)



Source: Author

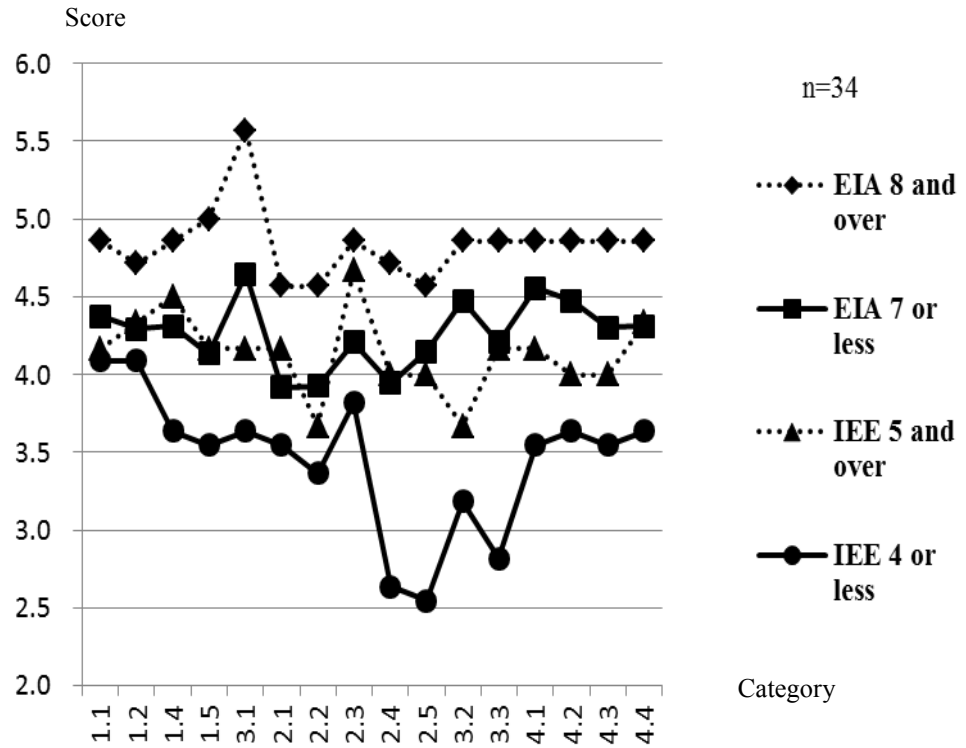
Figure 4. Technique of alternatives analysis (n=34)

The average scores of groups of alternatives and criteria in large and small sizes at the EIA and IEE levels are shown in Figures 5 and Figure 6. The results of *t* test between large and small sizes of alternatives and criteria are shown in Table 10. There was barely a recognizable difference in groups of alternatives at both the EIA and IEE levels. On the other hand, the overall quality of five criteria and over at the IEE level was significantly higher than the group of four criteria or less ($P<0.05$). The difference was not significant but the overall quality of eight criteria and over at the EIA level was higher than the group of seven criteria or less in all categories. The number of criteria was likely to have an effect on the quality of the JICA ESCRs compared to one of the alternatives, in particular at the IEE level.



Source: Author

Figure 5. Average score of groups of alternatives (n=34)



Source: Author

Figure 6. Average score of groups of criteria (n=34)

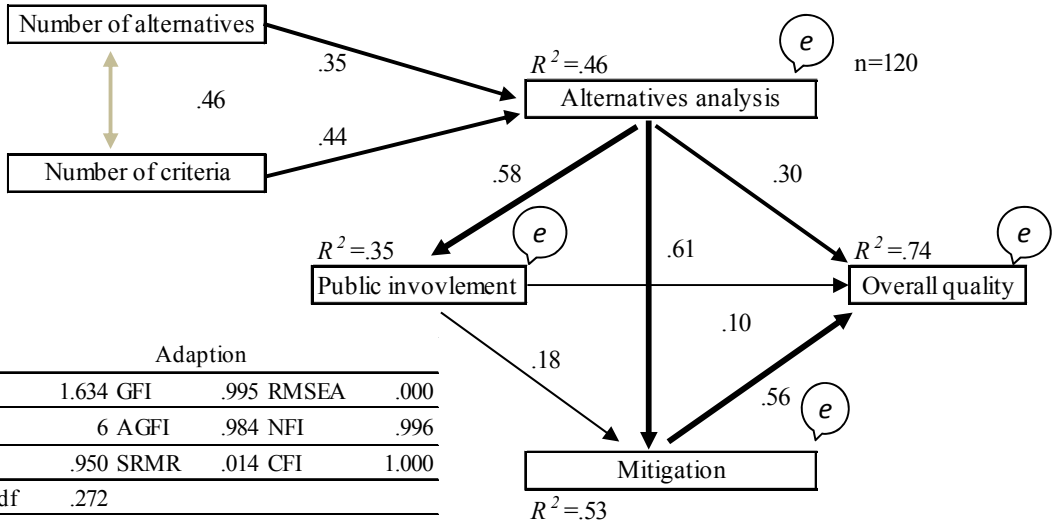
Table 10. Results of *t* test for groups of alternatives and criteria (Significant at *P*<0.05*)

Group of alternatives	EIA 5 or less	IEE 3 or less	Group of criteria	EIA 7 or less	IEE 4 or less
EIA 6 and over	0.0598		EIA 8 and over	1.1198	
IEE 4 and over		0.0392	IEE 5 and over		2.3621*

Source : Author

3.4 A path analysis with SEM

The causal model of six variables with path coefficients is shown in Figure 7. Causal relationships between them indicated statistical inferences to the quality of JICA ESCRs. The adaptation indexes including chi-square, goodness of fit index (GFI), adjusted GFI (AGFI), standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), normed fit index (NFI), and comparative fit index (CFI), were very satisfactory. The degree of freedom (df) was six and the p-value was .950, which was very high. The positive path coefficients implied the effect and the overall quality was increased. The coefficient of the determination (R^2) of overall quality was .74. The causal influence of the model explained 74% of the fluctuations in the variable of overall quality. The residual (*e*) explained fluctuations by means of various causes outside of the model.



Adaption					
χ2	1.634	GFI	.995	RMSEA	.000
df	6	AGFI	.984	NFI	.996
p	.950	SRMR	.014	CFI	1.000
χ2/df	.272				

Source : Author

Figure 7. Causal model with path coefficients (n=120)

The causal model showed not only the direct effects on the overall quality but also the indirect effects. Alternatives analysis showed the total effect on the overall quality was .76. The direct effect was .30 and the indirect one was .46 [=.58×(.10+.18×.56)+.61×.56]. The effect of public involvement on the overall quality was .20. The direct effect was .10 and the indirect one was .10 (=.18×.56). The effect of the number of criteria was .44 and was higher than that of alternatives (.35), which ensured that the number of criteria was likely to have an effect on the quality of JICA ESCRs compared to one of alternatives (Figure 5, Figure 6 and Table 10). The path from alternatives analysis to public involvement, which was .58, was one indirect effect of alternatives analysis through public involvement: this path showed the relevance between both processes and provides clear evidence that the overall quality of both processes was significantly higher than for the other three groups (Table 8). The effect on public involvement was smaller than that for alternatives analysis.

4. Discussion

4.1 Verification of effectiveness of alternatives analysis and public involvement

The multiple comparisons between the four groups and the causal model with pass coefficients verified the effectiveness of both processes quantitatively, and in particular the indirect effects were positive results of this analysis. The alternatives analysis had indirect effects on the overall quality through the two intermediate variables of public involvement and mitigation. The public involvement also had an indirect effect through mitigation. The direct effects of alternatives analysis and public involvement on the overall quality revealed remaining causal relationships that the indirect effects could not explicitly explain through intermediate variables. The path coefficient from alternatives analysis to public involvement shows the effectiveness of both processes. This indirect effect explains the fact that a good alternatives analysis produced a good public involvement and a good public involvement produced a good

mitigation, therefore the overall quality was improved. Another indirect effect was that a good alternatives analysis produced a good mitigation, and the overall quality was improved. In this causal model, the effect of public involvement was small. The public involvement may play an essential role even if its effect was small. The role of public involvement needs to be further clarified.

A causal model indicated the effectiveness of alternatives analysis through routes of indirect effects. There was a causal relationship between alternatives analysis and the public involvement, yet a causal model without alternatives analysis or public involvement could not be prepared. Accordingly, it could not be concluded that the only process of alternatives analysis or public involvement was effective. The comparison of four groups with the results of the Turkey-Krammer test showed the effectiveness of both processes of alternatives analysis and public involvement; the causal model showed the causal relationships between variables through indirect effects and path coefficients. One future challenge is to improve the causal model and find other measures for improving the quality of JICA ESCRs by obtaining new knowledge.

4.2 Preferable number of public involvement stages

There was no difference between public involvement of two and three times at the EIA and IEE levels but a certain degree of difference was recognized between one and two times at the IEE level (Figure 2 and Table 9). This meant that one-time involvement at the report drafting stage only was unsatisfactory; two-time involvement at the scoping and report drafting stages was satisfactory; and the effectiveness of involvement at the intermediate stage was limited. It is suggested that the preferable number of public involvement is two and when necessary three times from the perspective of consensus building or additional alternatives analysis. The difference between one-time involvement and two-time involvement may be one concrete benefit of public involvement. Finding out the reason for two-time involvement being

satisfactory is therefore a research task for the future.

4.3 Preferable number of alternatives and criteria

A significant difference was not recognized in groups of alternatives but was recognized in groups of criteria (Figure 5, Figure 6 and Table 10). The appropriate number of alternatives may be the median number, which was five at the EIA level, and three at the IEE level. The groups of the median number of criteria and over showed high average scores at both the EIA and the IEE levels. What is that reason for this? Many kinds of criteria may collect a wide range of secondary information about the environment, the economy and society, which may be effective not only for alternatives analysis but also for public involvement and mitigation. In particular the overall quality of the group of five and more criteria at the IEE level was significantly higher than the group of four or less ($P<0.05$).

Increasing the number of criteria may improve the quality of ESCRs. What are reasons for increasing the number of criteria? One interpretation is that project proponents may have increased the number of criteria to justify the project and a selected option when they explained alternatives analysis to stakeholders at public meetings. Consequently a lot of information may have been collected and the quality of the JICA ESCRs improved, which may also a benefit of public involvement. In other words, the effectiveness of alternatives analysis with even two stages of public involvement at the IEE level may be limited when the numbers of criteria are four or less (Figure 6). Setting more numbers of criteria would be expected to raise the quality of JICA ESCRs. What number of criteria is reasonable? One answer is to set the same number of criteria for the environment, the economy, and society, which are the main themes of sustainable development. Then, in the case of three criteria on each theme, nine criteria in all could be one criterion. Setting three criteria on each theme is not particularly difficult. The quantitative techniques of alternatives analysis are used in the cases of nine criteria and over (Figure 4). It may be difficult for evaluators to judge nine criteria and over

using qualitative techniques due to limits on our capacity to process information. The quantitative technique may be preferable for nine criteria and over. In addition a verification of the most suitable number of alternatives and criteria, and the technical guidelines about the quantitative technique of alternatives analysis become tasks for the future.

4.4 Methods for improving the quality of JICA ESCRs

Summarizing the above, the comparison of groups and tests, and the causal model provided examples of concrete knowledge that could be used to improve the quality of JICA ESCRs. The methods could be: 1) alternatives analysis and two-time public involvement at the scoping and report drafting stages; 2) setting five alternatives at the EIA level and three alternatives at the IEE level, and nine criteria and over at the both levels for alternatives analysis; and 3) the use of quantitative technique of alternatives analysis.

4.5 Limitations of the study

This study focused on the effects of the relevance between alternatives analysis and public involvement, the number of public involvement stages, and the number of alternatives and criteria. Other qualitative factors such as types of alternatives (locations, scales, processes and equipment, site layouts and designs), the process of public involvement (information disclosure, involvement of stakeholders, methods of involvement, and inputs from the public), the levels of mitigation (alternatives, physical design, project management), and mitigation hierarchy (avoidance, minimization, abatement, repair, compensation), were not analyzed in this study. It is not the case that only the numbers of public involvement stages, alternatives, and criteria have an effect on the quality of JICA ESCRs, but the qualitative factors are also considered to have an effect on the quality.

Conclusion

The main objective of this study was to quantitatively verify the effectiveness of alternatives analysis and public involvement for improving the quality of the JICA ESCRs using comparison of groups and tests, and a pass analysis with SEM. Results indicated that the relevance between both processes could improve the quality of the JICA ESCRs. In practical terms, working both processes together with a wide range of criteria was crucial for a good quality report. The study showed that the discussion of alternatives was at the heart of the EIS based on clear evidence of the indirect effect between alternatives analysis and public involvement in the causal model. Such results have not been previously shown and would be beneficial for enhancing justifications and understandings of alternatives analysis and public involvement within EIA. The quantitative analysis results serve as a good starting point for improving the quality of the JICA ESCRs in a concrete manner. This study suggested the possibility of improving the quality of EIS in developing countries even under the constraint of a lack of EIA expertise and related information. More knowledge and ability to set and analyze suitable alternatives and criteria, and to promote public involvement is required. Further research is needed to improve the causal model by adding new knowledge, to find the concrete benefits of public involvement on the quality of JICA ESCRs, to verify the suitable number of alternatives and criteria, and to prepare technical guidelines on the quantitative technique of alternatives analysis in case studies. In addition, an analysis of the differences between projects by sectors or regions is also a task for the future.

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Abstract (in Japanese)

要約

2004 年に国際協力機構環境社会配慮ガイドラインが導入され、環境社会配慮報告書の質の向上の主な要因として代替案分析と住民協議の関連性が指摘されている。本稿では、代替案分析と住民協議の有効性を定量的に検証し、環境社会配慮報告書の質を向上させる方法を提案した。報告書の質の評価手法としてリー・コリー評価法を使用し、2001 年から 2012 年の 120 冊の報告書をサンプルとした。また、構造方程式モデリングを用いたパス分析により因果モデルを作成した。評点（順位尺度）を順位得点に変換して統計分析を行った。分析の結果、報告書の質に対する代替案分析と住民協議及び評価項目数の有効性が示された。また、因果モデルによりこれらの変数の有効性の検証も行った。考察の結果、広範囲の評価項目を設定した代替案分析と住民協議の有効性を指摘した。今後の課題として、因果モデルの改良、報告書の質に対する住民参加の具体的な利益、適切な代替案と評価項目の数の設定、代替案分析定量手法の技術指針、セクター・地域分析についての事例研究の必要性をあげた。