A STUDY ON EVALUATING ENVIRONMENTAL VALUE FOR DECIDING PORT LOCATION

By

Yeong-Jin Yeon

THESIS

Submitted to

School of Public Policy and Global Management, KDI

in partial fulfillment of the requirements

for the degree of

MASTER OF ECONOMIC POLICY

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I. INTRODUCTION

1. Background and Purpose of Study

For a long time there have been many conflicting opinions regarding various land development projects including port development, as to whether it was more important "to develop or to preserve." Before 1980s with the eye set on national development and public good, land development was pursued giving priority to those development through which it was possible to reap visible effects from economic point of view. However entering the 1990s, overall losses caused by indiscriminating land developments were presented, giving recognition to utilization and value of environment. This has caused present tension between those asserting development and those upholding preservation.

In order to solve this problem, the environmental economics, as a branch of economics base on utilitarianism, was formed in the western nations including the United States. Undergoing repeated academic development, various methods for evaluating environmental values for problem solving have been created.

Rising above obscure confrontations between development and preservation of the past, environmental value evaluation methods began to be applied as means for discovering whether it was more beneficial 'to develop' or 'to preserve' a certain project from the aspect of economics. This was done by analyzing the value of environmental assets that would be lost as a result of development and comparing such losses with the benefits that will be gained from the process of such loss and development.

The Reagan administration, in its executive order no. 12291 made estimating environmental benefits of all environment related regulations and projects that exceed over 100 million dollars, compulsory. Also in Japan and in European countries, studies on economic value estimation on environmental quality and their application are widespread.

Therefore, among SOC developments in Korea, this study focuses on harbor developments that mostly take place around the coastal region which is considered to be the treasure-house of environmental resources. The study aims to examine the economic benefits of environmental values following development by evaluating environmental values of related environmental assets and to search for the direction the process of location selection should take in order to realize greatest benefits for public welfare and economy.

2. Methodology

In order to deduce cost benefits between development and preservation through evaluating the value of environmental assets, Contingent Value Method (CVM) was applied which is a more direct method among various methods of evaluating environmental value. Though this method, the possible economic benefits regarding partial development of Sokcho Beach in accordance with 'Sokcho Port Expansion Project' was analyzed. This expansion project is one of national development projects that are under actual implementation.

The Contingent Value Method is a research method directly examining people's responses regarding hypothetical changes in environmental quality through survey which carries a hypothetical story. In this study, analysis was made using dichotomous choice method on willingness to pay (WTP), which is the most frequently use method and whose credibility has been already recognized, and by holding direct interviews.

The survey targets were largely divided into local residents and tourists. As for local residents, sampling survey was carried out among men and women over 20 years old who have set income and live in the vicinity of Sokcho City. As for tourist, direct interviews on site were impossible due to seasonal reasons, so sampling survey was carried out among men and women over 20 years old in the metropolitan area.

Table 1. Study Outline

Survey Targets		Schedule	Surveyors	Securing Surveyors
Pre-Survey		99.4.6~	· Researcher	Kwandong Univ., metropolitan area residents (50)
Local Residents	300	99.4.19~ 3	· Gov't employee of Sokcho · Kwandong Univ. Employee	Cooperation from Sokcho City (Apr. 19 surveyors training program)
Tourists	300	99.4.19~ 5	· Kwandong Univ. Students	Cooperation from Kwandong Univ. (Apr. 20 surveyors training program)

II. INTRODUCTION TO CONTINGENT VALUE METHOD (CVM)

1. Origin and History of Contingent Value Method

The discussions on Contingent Value Method dates back to 1947, when Ciracy-Wantrup who were studying about prevention of soil pollution, suggested that the results of the survey be used as information source for understanding the demands of consumers. The first corroborative research using CVM was done by Davis in 1963. His research showed that the price the respondents were willing to pay gained using the survey was similar to the case which used Travel Cost Value Method. Later, the method was further developed by Randall, Eastman and others, and finally in 1986, following the announcement mae by the US State Department, it was recognized as one of the methods for measuring the benefits and losses in relation to "comprehensive environmental response, compensation, and responsibility act (1980)".

2. Outline of Contingent Value Method

CVM is a method that directly draws out values that people hold towards said public or environmental assets. In other words, through varied interviews this method surveys the value people hold towards environmental assets. A specially devised survey establishes a hypothetical situation regarding changes in a environmental assets and by adding varied conditions respondents are drawn into this hypothetical situation. Under such conditions, this method leads the respondents to answer to what degree they are willing to pay for the hypothetical changes in environment quality.

CVM is based on firm theoretic background and has the merit of being applied in various ways, not only with cases where indirect methods can be used but also with those where application of such indirect methods is not possible. However CVM largely depends on the opinion and the ability of the respondents who wish to show their preferences and in order to successively use CVM for estimating benefits it is necessary to examine sufficiently, the co-relation among strategical action, hypothetical conditions, intentions and

behaviors that were the background discussion of CVM in the application process such as survey composition and process. Also, in order to use the survey method as means of measuring benefits, the method of drawing out willingness to pay or method of survey are also important aspects of CVM.

3. Theoretic Background of CVM

CVM is based on Environmental Economics which started out from humanist point of view based on utilitarian principle that claims "greatest happiness for greatest number". It holds the belief that the natural environment can only hold value through criteria set by man whether it be market based or a non-market based method.

Neo-classical theory of environment economy regarding natural environment is based on man-centered philosophy founded on protecting and preserving natural resources. From this point of view, the major goal in terms of policy, is to effectively distribute environmental resources by estimating the values that man bestow on such resources. It is based on belief that environmental resources hold value because it is beneficial to men regardless of whether it is used or non-used service. The recognition for non-use values and the endeavor to estimate such values also result from man-centered motives. Environmental problems are interpreted as contributing to market failure and its solution being, effective distribution of environmental resources economically through public policies, laws, education and tax.

The non-use concept of environmental resources which is the focus of such principle is not claimed because the natural environment has its own value, but because man claims that it has such values and it is a concept that corresponds completely to the philosophical tradition of economics based on utilitarian philosophy.

John V. Krutilla was the first person to present the problem of non-use value in an economic journal. Mentioning beautiful sceneries and ecology that are unique and easily

destroyed, he asserted that their preservation and validity forms an important part in actual income of many people.

In the field of environmental economics the concept of non-use value is accepted at least in theory. Among them, the majority believe this value is significant at least in case of special situations. However consensus has not been achieved as yet among economists regarding its definition and meaning, through what motives people gain non-use values and how to measure such value corroboratively. In this study use values are understood as values achieved through present or future use of resources and non-use value is understood as value that exists without being connected to actual individual use of resources.

Table 2 Categorization of Benefits

Use Values		
Current Use	Present use value of natural resources including use of consumer and non-consumer goods.	
Expected (Future) Use	Intended future use value of natural resources	
Non-use values		
Option Values	Personal value held by those who know that environmental resources can be beneficial for future use, regardless of above expected use value.	
Existence Values	Vicarious values	Value that results from knowledge that other individuals can make use of the said resources.
	Bequest values	Value that results from knowledge that the future generation can use the said resources.
	Inherent values	Value that results from the knowledge that the said resource exists regardless of its other use or non-use value

4. Evaluation Method of Contingent Value Method

The estimation of benefits using CVM must be accompanied by serious of decision-making process such as selecting suitable storyline elements, deciding on the method for drawing out willingness to pay in order to induce certain value from the respondents, sampling, and choosing interview methods and so on.

○ Hypothetical policy or program, and storyline survey regarding selective situation that the respondents will face must include in its storyline, policies and programs that will bring change to environmental resource that is the object of value estimation, and selective situations that the respondent will face.

○ The structure from which the respondent will draw out value.

Such questions can take on the form of direct expression, votes, contingent ranking, distribution game and so on. Through this process, the respondent expresses his/her value of assets in the storyline.

○ Questions that express the socio-economical characteristics of the respondent

Questions which will draw out informations on socio-economic characteristics of the respondent such as his/her income, age, sex, and standard of education are necessary to find out value function and indirect use function.

4.1 Composition of Storyline

The researcher must understand the characteristics and standards, payment method and payment conditions and so on of the assets whose value will be induced through the storyline that will be read during the interview, and he must also construct a related hypothetical market. The storyline must define and express the reference standard of usage, the state of public assets, the price of related assets, conditions for supply and payment, the characteristic of price that people are willing to pay and so on. In order to draw out value properly, it is important to describe such elements accurately.

The storyline must describe in detail the state of natural environment that is the object of interest and the object of forming value. In this survey the state of natural environment of the beach concerned was explained comparatively in detail. The object of value was focused on protecting the beach and the surrounding pine forest to be preserved in its natural state.

The respondents were told that the beach could be destroyed as a result of port development and were asked how much they were willing to pay in order to choose preservation over development. In order to promote respondent's understanding of the situation, the storyline included a comparative analysis of the nearby beaches to provide concrete description on environment value standard of beaches.

Regarding method of payment for the price that the respondent was willing to pay, it is important to provide a neutral description of the value. For example, in the case of measuring the environment value of beaches, opting for entrance fees as a means of payment can easily become a negative choice. This is because the respondents tend to associate it with general entrance fees and regard it as a form of 'fair price'. Should payment method influences the price that people are willing to pay, it then set value to the policy itself instead of becoming a public asset independent from any payment system. As shown above, this study chose taxes as payment method for preserving environment quality of Sokcho Beach.

On the other hand, it is important to provide respondents to whom it is difficult to conceptualize object assets, with the option of selecting "Don't Know" as an answer. In addition, before presenting the main questions of the survey, the surveyor briefed the respondents about the basic content of questions about respondents' opinion regarding general public assets, providing respondents with the opportunity to adapt themselves to the survey. After presenting questions for drawing out values, a filtering process was included to verify their statement and confirmed that their answer was indeed their true preference.

4.2 Method of Inducing Value

The respondents are made to show the value they hold by expressing the greatest price they are willing to pay for the assets described in the storyline. First, strengths and weaknesses of direct question method, bidding game, payment card method, dichotomous choice method which are the main forms used in contingent value method, are examined and the dichotomous choice method is chosen as the method for corroborative research.

○ Direct Question Method

This method simply asks the highest price the respondent is willing to pay for the environment asset concerned. The weakness of this method is that people experience difficulties in answering this kind of questions and therefore it is easy to give no-response and over or under-rated price.

○ Bidding Game

This method starts from a set price that the respondents would confirm as the price that they are willing to pay. The price is increased until the respondent finally answers in the negative. This method has the advantage of discovering complete consumer surplus by deducing the highest price. However, it contains a the fatal problem of having a starting point bias. This means that the first price suggested (the starting point) has the tendency to greatly influence the size of the price (the greatest price that the respondents are willing to pay) that is ultimately decided.

○ Payment Card Method

This method was devised to avoid starting point bias of the bidding game and difficulties in answering open-style surveys. This method solves to a certain degree, problems inherent in the bidding game to a certain degree but the problem that it is weak bias related to the interval and starting point used with the card still remains.

○ Dichotomous Choice Method

Dichotomous Choice Method asks whether the respondents are willing to pay the

price for environmental change drawn from the questions asked through the single-bounded dichotomous choice method which is limited to a single bound and is the most simplistic format. Should the response be "yes:, it then signifies that the price the respondent is willing to pay is same or larger than the suggested price. Should the response be "no", it signifies that the suggested price is in the upper bound of the actual price that the respondent is willing to pay.

The role of the respondent is to decide whether he would agree to buy or refuse to buy the asset concerned at the given price. Accordingly the respondent is put in the same selective process as that of buying personal property. Therefore, the advantage of this method lies in that it places the respondent in a more familiar social situation. Another advantage is that since the survey only requires "yes or no" answer, questions are relatively more easier to answer. Accordingly it becomes possible to reduce the number of no-response and those who refuse to participate in the survey process.

The greatest disadvantage of this method is its statistical inefficiency. That is, compared to the quantity of resource material, the standard of information gained is rather low. In order to solve this problem, double-bounded dichotomous choice method with limits set on two sides, was suggested. Here two questions are asked and when a positive answer is given to the first question, a higher price than the first is suggested. When the answer is negative, a lower price is presented. It has been reported that the efficiency of statistical information increases quite significantly in this case than that of the single-bounded model.

As strategical convenience does not occur in dichotomous choice method and since there is no concern of starting point bias, this method was judged to be the most credible and desirable method among the four methods mentioned above.

The double-bound dichotomous choice method was chosen for this study. The

bidding price which is set forth to allow the respondents to choose the price during the process of double-bound dichotomous choice method, was decided at 3,000 won through a prior survey. Centering on this price the upper bound price was set at 5,000 won and higher and lower bound price was set at 1,000 won and lower. Here, the random selected price was alloted to the respondents. Especially in the case of bidding price, there are other studies for setting the most appropriate price, but difficulties lie in the fact that it requires prior knowledge of bidding price.

4.3 Sampling and Implementation

In order to estimate value through surveys, it is necessary first to decide how to define the mother-group of the economic subject which can be easily influenced by the standard of change in environmental resources. Next it must decided how to confirm this and create a sampling list. Next stage is to decide the sampling research method and then to accomodate the responses that show value from economic subject in the sample.

4.4 Deciding the Mother-Group

Mother-group can be defined as the object group from whom information must be gained through statistical estimation. In order to define the mother-group accurately, it is necessary to confirm clearly the four elements which are, the study object, sampling unit, extent and time. Here sampling unit is the economic body which can be drawn as a sample in the sampling stage and the important issue remains as to whether an individual or a household should be regarded as the economic body. This study defined all citizens residing in the Republic of Korea as of April 1999, as the range within the mother-group.

○ Establishing sample category and Sampling

Appropriate sample category must be established and procedures must change according to survey method. A desirable sample category is the case where it is consistent with the mother-group. In other word, it is the case where no other elements overlaps.

○ Method of Survey

In order to select survey method, it is necessary to consider the following few issues. First, the hypothetical market needs a complicated storyline which needs careful explanation, use of visual equipment or a series of continued interview content. Second, in order to gain monetary value, the survey must stimulate motive which leads the participants to make more than average efforts. Third, in order to estimate benefits from varied mother-groups, it is necessary to be able to utilize methods which compensate for materials that were lost while inserting resources from outside. In most situations, the method which satisfies all these condition is personal interview survey carried out at the respondent's place of residence. The existence of an interviewer provides greatest opportunity to stimulate motive for the respondents to respond with credibility to complicated and extensive issues.

For this study, personal interview research was selected which is the most effective form of survey. For sampling, random selection was carried out among household living in parts of the metropolitan area and East Sea district of Kangwon Province.

The interviewers in charge of the survey had sufficient credibility, having been selected carefully from those who received sufficient training on content, method and purpose, that lasted for more than two hours.

III. EVALUATING VALUE OF SOKCHO BEACH THROUGH CONTINGENT VALUE METHOD

1. Theoretic Basis of Contingent Value Method

In order to measure the benefits resulting from enhancement of environment quality, CVM leads the respondents to answer directly the compensating surplus which is the difference between cost needed to maintain the first standard of use in the environment quality of the first standard (Y0) and the cost need to maintain the first standard of use in the changed environment quality (Y1). Therefore unlike indirect method of estimating benefits, this method draws out the greatest WTP which is compensating surplus for enhancement of environment quality, directly from cost function without going through complicated middle process such as general assumption regarding use function or deducing of general demands function. The compensating surplus is defined as is gained by subtracting cost necessary to maintain first standard of use in the enhanced environment quality from cost necessary to maintain first standard of use in the first standard of environment quality.

$$CS = E(p, q_0; U_0, Q, T) - E(p, q_i; U_0, Q, T) \qquad \text{(equation-1)}$$

In (equation-1) the value of the first expense function is Y0. That is, this is the present income of the respondents which is the minimum standard of expense for attaining efficiency of U0 from the first environmental quality standard q0 in the state where other conditions are all uniform. The value of the second expense function is Yi and it is the minimum standard of expense that can maintain U0, the first standard of use when the environmental quality standard has changed to qi and when other given conditions are all uniform. Here the amount that people are willing to pay, which is the compensating surplus according to changes in environment quality is defined as the difference (△ between Y_0 and Yi.

The case which supposes the change in environmental quality of Sokcho Beach the subject of this study, is the case where supply of public asset increases and therefore the amount people are willing to pay which is the Hick's compensating surplus regarding preservation of Sokcho Beach, has the value of quantity. Accordingly, the function of amount people are willing to pay following enhancement of environment quality can be shown as follows as a means of estimating the benefits of enhancement quality.

$$WTP(qi) = f(p, q_i, q_0, Q, Y_0, T) \qquad \text{(equation-2)}$$

It can be noted that the amount the respondents are willing to pay are influenced by the price of market goods (p), the first standard of environmental quality (q0), the changed standard of environmental quality (qi), the standard of unchanged public assets (Q), respondents' preferences (T), present income (Y0) and so on.

WTP function expressed as (equation-2), is the valuation function which expresses in monetary terms the changes in economic welfare caused by changes in environmental quality and is the basis of CVM's theory.

2. Deducing Modal Using Dichotomous Choice Method

Let us assume a respondent received a proposal to pay A won for enhancing environment quality of a beach and for spending his/her leisure time there. Here, by paying A won the utility enjoyed by him/her will be composed of non-use value for enhancement of environment quality and use value of the beach. Here, the utility to the respondent would be a definite price to him but from the position of the researcher observing the situation, this becomes a kind of random variable dependent on the personal traits of the respondent. It can be expressed as follows.

$$u(j, M; S) = v(j, M; S) + \varepsilon_j, \quad j = 0, 1 \qquad \text{(equation-3)}$$

※ \ case of choosing to pay A won when j=1 and attain the accompanying utility.

If j=0 the proposal is refused. Here the average of ε 와 ε is 0 and is a random variable independent of income M.

When A won is proposed, the respondent will accept the proposal in the following case

$$v(1, M-A\,; S) + \varepsilon_1 \geq v(0, M\,; S) + \varepsilon_0 \qquad \text{(equation-4)}$$

Therefore the probability P_1 that the respondent will accept the proposed price A won is

$$P_1 = \Pr\{v(1, M-A\,; S) + \varepsilon_1 \geq v(0, M\,; S) + \varepsilon_0\} \qquad \text{(equation-5)}$$

Therefore the probability of refusal P_0 is

$$P_0 = 1 - P_1 \qquad \text{(equation-6)}$$

Now let us say that η = ε_0 - ε_1 and that Fη · is accumulative distribution function of η Here the above P1 can be expressed as follows.

$$\begin{aligned} P_1 &= \Pr\{v(1, M-A\,; S) - v(0, M\,; S) \geq \varepsilon_{0-\varepsilon_1}\} \\ &= \Pr\{\triangle v \geq \eta\} \\ &= F_\eta(\triangle v) \end{aligned} \qquad \text{(equation-7)}$$

Here

$$\triangle v = v(1, M - A\ ; S)\ -\ v(0, M\ ; S) \qquad \text{(equation-8)}$$

If accumulative distribution function Fη · is the accumulative distribution function of changes in standard logistics

$$P_1\ =\ F_\eta(\triangle v)\ =\ (1\ +\ e^{-\triangle v})^{-1} \qquad \text{(equation-9)}$$

Now assuming functional form of v(j, M;S), the difference of △ will be calculated. First the linear logistic modal proposed by Hanemann is

$$v(j, M\ ; S)\ =\ \alpha_j\ +\ \beta M, \qquad \beta > 0, \quad j\ =\ 0,\ 1 \qquad \text{(equation-10)}$$

Now from the above (equation-8) △ is

$$\begin{aligned} \triangle v\ &=\ \alpha_1\ +\ \beta(M - A)\ -\ \alpha_0\ -\ \beta M \\ &=\ \alpha\ -\ \beta A \end{aligned} \qquad \text{(equation-11)}$$

※ Here α = α - α

The probability that the respondent will accept the proposal becomes P1 = Fη α ·β).
On the other hand, the logistic modal used by Bishop and Heberlein takes on the following form.

$$\triangle v\ =\ \delta_0\ +\ \delta_1 \ln A \qquad \text{(equation-12)}$$

In the case of linear logistic modal of (equation-10) there is no effect of income since △ does not depend on income M. Hanemann asserted that linear logistic modal is the only modal which possess such characteristics and that log logistic modal does not coincide with the theory of maximizing utility.

Now using the material answered by the method of expressing value scale will be examined. If E is the maximum amount that the respondent is willing to pay for enhancing environment, the proposed price A will be accepted when A is smaller or same as E. That is, when G is the accumulative distribution function of E

$$P_1 = \Pr(E \geq A) \equiv 1 - G_E(A) \qquad \text{(equation-13)}$$

When the average of this distribution is expressed as equation, it is,

$$E^+ = E\{E\} = \int_0^\infty [1 - G_E(A)]aA \qquad \text{(equation-14)}$$

Also the median E* is defined as follows.

$$\Pr\{u(1, M - E^* ; S) \geq u(0, M ; S)\} = 0.5 \qquad \text{(equation-15)}$$

Now the average and median of the modal introduced previously will be calculated. Since the function of v has been specifically established, they can be gained quite easily. Since E expresses the greatest amount that a person is willing to pay,

$$u(1, M - E^* ; S) = u(0, M ; S) \qquad \text{(equation-16)}$$

Here even though E holds set value to individuals, to the researcher the utility function u is only known as a probable element and thus becomes a random variable. When the above equation is applied to linear logistic model it is,

$$\begin{aligned} \alpha_1 + \beta(M-E) + \varepsilon_1 &= \alpha_0 + \beta M + \varepsilon_0 \\ (\alpha_1 - \alpha_0) - \beta E &= \eta \\ \therefore \quad E &= \frac{\alpha}{\beta} - \frac{\eta}{\beta} \end{aligned} \qquad \text{(equation-17)}$$

Here the average E+ is

$$E^+ = E\{E\} = E\left\{\frac{\alpha}{\beta} - \frac{\eta}{\beta}\right\} = \frac{\alpha}{\beta} \qquad \text{(equation-18)}$$

Now the median of the model will be calculated. Regarding accumulative distribution function of standard logistic model it is known that Fη ι) = 0.5. Now in the following equation,

$$\Pr\{u(1, M-E^*; S) \geq u(0, M; S)\} = 0.5 \qquad \text{(equation-19)}$$

$$\begin{aligned} \Pr\{\triangle v(E^*) \geq \eta\} &= F_\eta[\triangle v(E^*)] = 0.5 \\ \therefore \quad \triangle v(E^*) &= 0 \end{aligned} \qquad \text{(equation-20)}$$

Regarding linear logistic model it is,

$$\begin{aligned} \alpha_1 + \beta(M - E^*) &= \alpha_0 + \beta M \\ \therefore \quad E^* &= -\frac{\alpha}{\beta} \end{aligned} \qquad \text{(equation-21)}$$

Here when it is linear logistic model, it can be seen that the median and the average are alike.

On the other hand, as approximate estimated value, the average and the median of the model (equation-12) suggested by Bishop and Heberlein will be calculated. The average of (equation-19), (equation-13) (equation-14) are

$$\begin{aligned} E^+ &= \int_0^\infty (1 + e^{-\delta_0 - \delta_1 \ln A})^{-1} dA \\ &= -e^{-\frac{-\delta_0}{\delta_1}} \frac{\pi/\delta_1}{\sin(-\pi/\delta_1)} \quad -1 < -\frac{1}{\delta_1} < 0 \end{aligned} \qquad \text{(equation-22)}$$

In the case of the median, following calculation can be achieved using (equation-20)

$$\begin{aligned} \delta_0 + \delta_1 \ln E^* &= 0 \\ \therefore \quad E^* &= e^{-\frac{\delta_0}{\delta_1}} \end{aligned} \qquad \text{(equation-23)}$$

In the case of linear logistic model, there is no special problem as the median and average are alike. But in the case of log logistic model, the problem of selecting one between the two, arises. For this Hanemann recommended the median reasoning that median was more stable than average with regard to extreme outlier.

The double-bounded model with limits set for both sides, provides each respondent with the opportunity to answer twice. By including a second question that depends on the answer of the first, this method was contrived to solve the statistical inefficiency of the single-bounded model whose limit was set to only one side. When the proposed price (A) is refused in the first question, a lower price (Ad) is presented to the respondent and when he accepts it, a higher price (Au) is proposed. (That is Ad<A<Au. Here the probability of the expected four cases can be expressed as follows.

The probability Pyy where the respondent answers "yes" to both first and second questions is

$$\begin{aligned} P_{yy} &= \Pr\{A \le E \text{ and, } A^u \le E\} \\ &= \Pr\{A^u \le E\} = 1 - G_E(A^u) \end{aligned} \qquad \text{(equation-24)}$$

The probability Pyn where the respondent answers "yes" to first question and "no" to the second is

$$\begin{aligned} P_{yn} &= \Pr\{A \le E \le A^u\} \\ &= G_E(A^u) - G_E(A) \end{aligned} \qquad \text{(equation-25)}$$

The probability Pyn where the respondent answers "no" to first question and "yes" to second is

$$\begin{aligned} P_{ny} &= \Pr\{A^d \le E \le A\} \\ &= G_E(A) - G_E(A^d) \end{aligned} \qquad (\ -26)$$

(equation-26)

Finally the probability Pnn where the respondent answers "no" to first and "no" to second is

$$P_{nn} = \Pr\{E < A, \text{ and } E < A^d\} = G_E(A^d) \quad \text{(equation-27)}$$

The function form and the benefit estimates for drawing out the value is applied in a similar way as that of the single-bound limit.

3. Benefits According to Existence and Non-Existence of Sokcho Beach

Based on previous discussions, the first survey intended to measure the benefits that will result after enhancing environmental quality of Sokcho Beach continued for three days from April 6 to April 8 1999. A total of 600 survey pamphlets were distributed. Excluding 111 surveys that were not useable, 489 copies, about 81.5% of the total research quantity, were used as valid research materials.

Looking at the socio-economic characteristics of the sampling, 343 (70%) were men and 146 (30%) were women showing high relative ratio of male respondents.

Table 3 shows the number of time the respondents visited Sokcho Beach during the past five years and the next column shows the age distribution. 5.3% of the respondents did not visit Sokcho Beach during the past five years, showing them to be non-users of the environment assets that were the subject of value estimation. Considering that it is highly likely that they will remain as non-users of the same environment assets for years to come, it demonstrates that the value of environmental resources resulting from

this estimation, will mostly be composed of non-use values. Looking at the age distribution, the number of respondents in their thirties were highest and the next in line were those in their twenties.

<Table 3> Number of Visits to Sokcho Beach and Age Distribution of Survey Respondents

Number of Visits	
0 time	26
1 time	144
2 times	94
3 times	74
4-5 times	99
6-9 times	19
10 over times	32

Age Distribution	
20~ 9 years old	136
30~ 9 years old	159
40~ 9 years old	117
50~ 9 years old	70
60~ 9 years old	6

Information regarding income level and occupations of the respondents are shown on Table 4. The distribution of income level became smaller as the value of interval grew larger.

<Table 4> Income Level and Occupation of Survey Respondents

Income Level (won)	
500thousand ~ 1 million	187
1 mil.~ .5 mil	182
1.5 mil ~ mil	67
2 mil~ 5 mil	34
2.5 mil~ mil	9
3 mil~ 5 mil	3
over 3.5 mil	4

Occupation	
Self-employed	113
Company employees	118
Government employees	110
Free-lance professional	41
Daily workers	21
Housewives	30
Unemployed	10
Retired	4
Others	42

The occupations were concentrated to company employees, government employees and those self-employed which became the element that reduced the degree of occupations suitability.

In order to estimate the value regarding enhancement of natural environment, first analysis of the linear logistic model was implemented. In order to reflect the socio-economic information onto the model (equation-11) was adapted as follows.

$$\Delta v = \alpha + \beta_1 S_1 + \cdots + \beta_k S_k + \gamma M + \delta A \qquad \text{(equation 28)}$$

Social variables such as age, number of visits, sex, income were taken into consideration. The estimation result of the model regarding these variables are shown on Table 5.

<Table 5> Estimation Result of Model on All Variables

	Coefficient Value (Standard Error)	x^2-value	Significant Probability
Intercept	-5.0845 (0.7816)	18.66	0.0000
Number of Visits	-0.1288 (0.1268)	1.03	0.3096
Occupation	-0.0840 (0.1131)	0.55	0.4577
Income	0.0081 (0.0053)	2.33	0.1264
Age	-0.5237 (0.2465)	4.51	0.0337
Sex	1.9835 (0.6624)	8.96	0.0028
Bidding Price	0.0074 (0.0008)	78.09	0.0000

After studying the suitability degree of these variables, it was observed that occupation and number of visits had little relation to the probability of accepting the

bidding price A. Therefore, taking the age variable as the socio-economic variable, logit analysis through maximum likelihood method was implemented. Here the model for (equation-28) is

$$\Delta v = \alpha + \beta S + \gamma M + \delta A \qquad \text{(equation-29)}$$

On the other hand, logit analysis was carried out following similar procedures as above for Bishop-Heberlein's log logistic model. Here the model is

$$\Delta v = \alpha + \beta \ln S + \gamma \ln M + \delta \ln A \qquad \text{(equation-30)}$$

Coefficient and standard error of each variable according to the results of the analysis are shown on Table 6.

<Table 6> Estimated Coefficient Value of Linear Logistic and Log Logistic Models

	Linear Logistic Model	Log Logistic Model
Intercept	-5.7592★★★ 1) (1.0492)	-30.2185★★★ (8.3638)
Social Variable (1)[1)]	-0.5223★★ (0.2423)	-1.1380★★ (0.5600)
Social Variable(2)	1.9651★★★ (0.6628)	1.6838★★★ (0.6099)
Income Variable	0.0089★ (0.0049)	2.6715★ (1.3858)
δ /alue	0.0073★★★ (0.0008)	2.8171★★★ (0.6167)

Note: 1) Social Variable (1) is Age, Social Variable (2) is Sex
2) ★★★ ★★ is significant at the level of 5%, ★ s significant at the level of 10%

In order to calculate the standard value and the median, the model was simplified into an equation of multiplying the average of each variable to the coefficient. That is, the

above equation-29 is,

$$\begin{aligned} \alpha' &= \alpha + \beta\overline{S} + \gamma\overline{M} \\ \therefore \quad \triangle v &= \alpha' + \delta A \end{aligned} \qquad \text{(equation-31)}$$

Also the above equation-30 is

$$\begin{aligned} \alpha' &= \alpha + \beta\ln\overline{S} + \gamma\ln\overline{M} \\ \therefore \quad \triangle v &= \alpha' + \delta\ln A \end{aligned} \qquad \text{(equation-32)}$$

By substituting the coefficient shown on equation-31 to equation-18 and equation-21, the median and standard value of benefits regarding linear logistic model was gained to be calculated as 598 won. Similarly by substituting coefficient shown on equation-32 to (equation-22 and equation-23, the measure on Bishop-Heberlein's logistic model was calculated. In this case the median was calculated to be 657 won.

In accordance with assertions made by Hanemann, this study regards linear logistic model to the be proper model suited to the theory of welfare. As a result, should natural environment of the Sokcho Beach be preserved without any port development, the benefits gained by an individual expressed in monetary terms, is calculated to be 598 won per year. This signifies that with Korea's population being 4,717 as of 1999, benefits worth approximately 2.83 billion won is produced.

IV. CONCLUSION

This study analyzed the environmental value that would be lost as a result of constructing port facilities at Sokcho Beach and destroying the beach.

In the past, port location was selected simply through technical and economical analysis. However, it was seen that when environmental value of the subject location was taken into consideration, significant element of change existed with regard to location selection.

Under the hypothesis of constructing a port at Sokcho Beach, it was possible to discover that the need for mutual comparison and the price of environmental value made up a comparatively important part, by calculating the effects on local economy, port construction costs and environmental value costs.

Progressing one step further from the past which simply considered the creation of benefits provided port development, and by including environment value which had been neglected until now, it became possible to evaluate the real benefits validity of SOC (ports, airport, roads etc.) development. Furthermore, it has become possible to persuade the conflicting opinions of the environmentalists developmentalists with justified logic.

In conclusion, since the preservation value of Sokcho Beach is high (at 2.82 billion won per year), it is possible to judge that port development in the Sokcho area should be separated as much as possible from those environmental assets with high preservation values. It would be better to renovate or expand existing port areas whose environmental value is comparatively lower.

Future issue would be to estimate detailed benefits of local economy resulting from port development and by comparing port development costs, means for making appropriate policy decisions for SOC development must be created.

APPENDICES

SURVEY FOR EVALUATING ENVIRONMENTAL VALUE OF SOKCHO BEACH

Ports and Harbours Bureau, Ministry of Maritime Affairs and Fisheries is carrying out a study on evaluating the environmental value around Sokcho Beach in relation to "Expansion Plans of Sokcho Port". The results of this survey will be used as a very important information for the study and will also be reflected in future policies regarding development of port and coastal area around Sokcho City of Kangwon Province. It would be appreciated if you answer all of the questions listed in the survey. Thank you.

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<People surveyed are men and women between ages 20 and 70 with an income>

◆ Sokcho Beach

Located in Choyang-dong, 5km from Sokcho City Hall, Sokcho Beach is known for its expansive sandy beach with dense pine forest at the background providing shadow area for visitors to rest. The sandy beach extends for more than 1km from Chongho-dong, through Choyang-dong to Daepo-dong. With a width of 25m to 75m, the total area of the sandy beach is over 9,000 pyongs. The beach is covered with high quality golden beach and its water is also clean and clear. There are there are famous tourists attractions such as Sorak Mt., Choksan Hot Water Spring, Youngrang Lake, Youngkum-jong and so on in the surrounding areas and the beach is located only 300m from the express bus terminal. Since deep sea fishing is possible, the beach is popular among anglers.

◆ Number of visitors to Sokcho Beach is 150,000 per year and annual income is about 180 million won (as of 1996, based on entrance fees and regional tax revenue). Plenty of accommodation facilities, including Welcome Condominium are located in the surrounding area and being only a short distance away from Sokcho City, the visitors can enjoy variety of convenience facilities. Also at the near-by Daepo Port, which is a tourist fishing port, the visitor can enjoy varied types of marine products.

◆ As a part of the project to renovate ports in the East Sea zone and Sokcho Port, a developmental plan is underway to expand Sokcho Port with the goal of constructing a gateway to tourism in Sokcho for the 21st Century. However considering various conditions of the plan and results of the research analysis, it is possible that a part of or large parts of Sokcho Beach which is located near existing Sokcho Port can be reclaimed.

◆ The purpose of this survey is to simply analyze the preservation and use value the local residents have for Sokcho Beach and to discover whether the monetary worth of that value is larger or smaller than development profit to be gained by port development.

◆ In this survey the term Sokcho Beach does not include the surrounding 위락 facilities, but only signifies natural resources such as the sea, sandy beach, and pine forest within Sokcho Beach.

◆ Please answer the questions of the survey by circling or checking the appropriate answer number of each question, unless stated otherwise.

◆ Following are questions asking the degree of satisfaction you have for Sokcho Beach. Please express the degree of satisfaction or the value you feel towards Sokcho Beach while you lived in or around Sokcho or when you visited Sokcho Beach to enjoy your vacations. (Question No. 1 excluded)

◆ Even if you have never visited Sokcho Beach, please refer to the content included in

the survey and evaluate your degree of satisfaction regarding the beach.

1. What is the degree of your satisfaction regarding Sokcho Beach?

① Very high ② Little high ③ Average

④ Little low ⑤ Very low

2. Satisfaction degree of the visitors regarding Sokcho Beach

Degree of your satisfaction

Aspects where Sokcho Beach is related to our everyday lives

Very satisfied Little satisfied Average Little unsatisfied Very unsatisfied

2-1 Satisfaction you feel for natural scenery

2-2 Satisfaction you feel for Sokcho Beach as an excellent leisure and amusement area

2-3 Satisfaction you feel for Sokcho Beach as a natural ecology system and function of purification

2-4 Satisfaction you feel for the degree that the natural environment has been preserved

2-5 Satisfaction you feel for the degree that the natural resources have been preserved for handing down to our descendents

3. How many times have you visited (or expect to visit) Sokcho Beach annually?

( )

4. Total number of your family members, including yourself ( )

Pre-school children ( ) Children in elementary school ( )

Children in middle and high school ( )

Children in university (graduate school) ( )

Adults under age 60 (students excluded) ( )

Adults over age 60 ( )

5. What is your personal monthly average income?

① Under 1 mil won ② 1 mil -1.5 mil won ③ 1.5 mil - 2 mil won
④ 2 mil - 2.5 mil won ⑤ 2.5 mil - 3 mil won ⑥ 3 mil - 3.5 mil won
⑦ 3.5 mil - 4 mil won ⑧ Over 4 mil won

6. What is the monthly average income of your family? (Total income of your whole family)

① Under 1 mil won ② 1 mil -1.5 mil won ③ 1.5 mil - 2 mil won
④ 2 mil - 2.5 mil won ⑤ 2.5 mil - 3 mil won ⑥ 3 mil - 3.5 mil won
⑦ 3.5 mil - 4 mil won ⑧ Over 4 mil won

◆ Following are questions asking the price you are willing to pay for preservation or maintenance of Sokcho Beach. Please take all aspects into consideration as you would when paying taxes or purchasing an article and decide the price within the scope that would be possible for you to pay. (Hypothetical questions)

<Picture 3> View of Sokcho Beach from Waewungchi

◆ The prices given after question no. 10, are price standards that you would pay for preservation and maintenance of Sokcho Beach in addition to existing entrance fees. The prices were gained through preliminary survey of different form and based on that standard dichotomous choice questions regarding your willingness to pay have been asked. However, if you have a price that you are willing to pay other than the prices given, you can state your own price at the last question of each item.

7. If Sokcho Beach is to disappear due to development and expansion of the waterfront, land and ports, would you give your support?

① Yes (☞ 8) ② No (☞ 9)

8. (This question is only for those who answered 'yes' to question 7)

For what reasons do you support developing Sokcho Beach into other facilities?

( ) (☞ 9)

9. If you were to pay environment preservation tax as 환경보전비 명목, in order to preserve the beach which could disappear due to development plans, would you be willing to pay the tax?

① Yes (☞ 10) ② No (☞ 11)

10. (This question is only for those who answered 'yes' to question 9)

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