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Measuring the Economic Value of Restoring Hampyeong Stream Space[1a]

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ABSTRACT

The objective of this study is to evaluate the spatial restoration of Hampyeong Stream and to analyze the determinants of demand for the multi-functionalities of the stream. A Contingent Valuation Method (CVM) was used to estimate the multi-functional public benefits of restored stream area, and major determinants were scrutinized by establishing a demand model. The research data was collected by conducting a survey intended for Hampyeong's local residents, resulting in 284 valid samples. In terms of determinants that affect willingness to pay (WTP), 'physical factor of waterfront area' and 'experience factor of stream space' showed a significantly positive influence on WTP. As a result of applying a double-bounded CVM, the willingness to pay for the restored Hampyeong Stream area indicated a potential contribution of 22,523 won (17,362~ 27,459 won, 95% confidence interval). When multiplying the number of households in Hampyeong-gun, the total annual value of Hampyeong Stream spatial restoration is approximately 302million won.

KEY WORDS: STREAM SPACE RESTORATION, ATTRIBUTES, CONTINGENT VALUATION METHOD, WILLINGNESS TO PAY

INTRODUCTION

A stream is a body of water with current which flows along a steady watercourse or stream channel. It is an important natural resource closely related to human life. Civilizations have always formed around water supplies, and humans have developed by using streams along the trend of the times. Today streams are not only used for irrigation and flood control but also play an important role as the components of terrestrial ecosystems such as habitats for aquatic organisms, city climate modifiers and flood passage channels. It also has a nature purification function (Leem and Lee, 2005). The shapes of streams, which were maintained without much change until the industrialization era, were developed and managed with a focus on irrigation and flood control while going through industrialization. Korea also straightened channels for irrigation and flood control, and as a result, available land increased. However, the value of the major attributes of streams, as diverse natural landscapes and as ecological spaces, is gradually decreasing. Also, water quality management has become a serious issue due to domestic sewage, industrial sewage and livestock wastewater.

The increase in national income has greatly raised people's awareness of the natural environment and desire for better quality of life. People started to care for

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convenience and beauty in their living spaces. In particular, people’s interest in streams that can be easily accessed increased (Yoo and Lee, 2011). Due to this, interest in eco-friendly stream management has been rising since the mid-1990s. And in recent years, projects related to river restoration and natural stream creation have been intensively carried out by the central and local governments (KRIHS, 2011). Stream space restoration projects are public projects based on public dialogue and complexity. Their aim is to restore streams, which were damaged due to poor watershed management, to their original natural state (KRIHS, 2011). The concept of these projects includes a water-friendly perspective, which considers the environmental aspect and the coexistence of humans and nature through ecological spaces along the waterfront.

Some streams have already been restored and some are undergoing restoration, but there are still many that need to be restored. Therefore, it is highly important to analyze the performance of stream restoration at this point, because efficient alternative policies and rational directions can be deduced for future stream restoration projects. The assessment of stream restoration projects is classified into a preliminary feasibility survey before implementing a project and a performance assessment after the project, but the attributes of assessment are not classified accordingly. Most of the past studies assessed the performance of the physical and the ecological aspects of streams (Kim and Park, 1999; Kim *et al*., 2004). However, because streams including the waterfront are now recognized as complex spaces, the utilization of these spaces is an important issue remaining to be addressed. Therefore, besides the physical and the ecological aspects, the complex function which includes the utilization of spaces should be included in the assessment of the performance of stream restoration.

Levee maintenance was conducted and riverside reservoir, movable weir and nature-like fishway were constructed at the 8.3 ㎞ section of Hampyeong Stream, the study site of this study, for the purposes of flood prevention, clear water securement, ecological system restoration and waterfront space creation. An ecological park was created at the riverside reservoir as a leisure space for people. Also, a waterfront space equipped with trails, wetlands with observation decks, sports facilities and nature learning center was constructed to provide the public a resting and sports space. Moreover, sightseeing activities have been organized for visitors by holding a butterfly festival every year using nearby parks and waterfront areas, and money spent by visitors has contributed to regional development.

The multifunctional public benefits, which have been diversified due to the restoration of Hampyeong Stream, are public goods from the environmental and social aspects as they are provided to unspecified individuals without restrictions and discrimination. With regards to the multifunctionality of the stream, a lot of visitors to the area can feel the improvement in utility whether they use or do not use the goods. Thus, it can be said that the restored area of Hampyeong Stream is contributing to an improvement in the residents' welfare. Therefore, the quantitative assessment on the multifunctional public benefits of the restored Hampyeong Stream area provides criteria for the direct and effective determination of the performance of the restoration project. Furthermore, if the attributes of the restored stream area, which affect the value, can be deduced, they can be used as useful information in determining the priority order of resource management and suggesting the direction for restoration.

The purpose of this study is to quantitatively assess the value of the multifunctional benefits of restoring Hampyeong Stream, and to analyze the determinants of demand for the multifunctionality of the stream. The Contingent Valuation Method (CVM), a value assessment model, was used to estimate the multifunctional public benefits of the restored stream area. Assessment items for the various attributes of the restored stream were developed as the determinants of demand, and the factorized items were used as the explanatory variables of the model. Because most of the factors from the public benefit functions of the restored Hampyeong Stream area belong to the local residents, it is reasonable to say that goods, the targets of value assessment, should be regarded as local public goods. The subjects of value assessment were limited to people who live in Hampyeong-gun according to the administrative district demarcation. Accordingly, this study collected research data by conducting a survey intended for Hampyeong’s local residents.

MATERIALS AND METHODS

1. Functions and Value Assessment of Streams

Not only stream channels but also the waterfronts are being steadily restored to be used as complex ecological spaces, because the multifunctionality of streams has been a constant experience throughout the history of human civilization. Some of the representative public benefit functions of spatial restoration of streams are water quality improvement; improvement in ecological environment through creating biological habitats such as fishways and rapids; flood prevention through restoring abandoned channels and riverside reservoirs; improvement in life environment through creating waterfront facilities such as trails, observation decks and ecological learning centers; and tourism and leisure (KRIHS, 2011). In particular, due to an increase in the demand for various leisure and recreational pursuits, the functions of waterfront spaces are getting attention. Waterfront areas in cities contribute to an improvement in the quality of urban life by providing a natural environment and open space. Waterfront areas in the countryside play an important role as amenities for tourism and regional development.

As policies on streams have shifted their focus from irrigation and flood control to the ecological value of streams and the functions of waterfront spaces, various studies on stream assessment have been carried out in diverse fields. Most of the initial studies focused on assessment items related to physical, biological and chemical areas such as stream ecosystems, aquatic ecosystem soundness and stream naturalness. However, in recent years, some studies included waterfront spaces in their assessment items (e.g., Lee, 2014; Byen *et al*., 2011; Cho *et al*., 2009; Song *et al*., 2008). Lee (2014) created an assessment system for waterfront spaces in streams, which contains 15 detailed items of five categories: physical characteristics, natural environmental characteristics, geo-cultural characteristics, degree of demand for water-friendliness and landscape characteristics.

Methods to assess streams have been developed through various studies according to functions, areas and purposes they aim to assess (Song *et al*., 2008). As evaluation criteria for stream assessment, Kim et al. (2004) used the quantitative assessment method of stream environment to develop a framework for strategic stream management. Kim and Park (1999) identified physical/structural characteristics, naturalness and environmental functions of streams, and proposed assessment criteria for stream naturalness to be used when restoring small-medium streams. However, their study was not conducted to assess the value of stream functions but to identify the technical adequacy of stream development projects. It is only in recent years that assessments on the value of streams have been carried out. Most of the studies are about quantity, water quality and ecosystems that are related to flood control and irrigation of the main stream of the river or functions and attributes from the natural aspect. Studies that include value assessment on spatial characteristics are in the beginning stage.

Most of the studies used an approach called the CVM to assess the value of the multifunctionality of streams. Eom *et al.* (2001) estimated the recreational benefits of waterfront rest spaces by conducting a study on the Mangyeong River. Leem and Lee (2005) estimated economic benefits to Daejeon citizens that derived from the creation of an ecological park at Daejeon Stream. Yoo *et al*. (2009) estimated economic benefits to Anseong citizens that derived from the restoration of ecological streams. Koo *et al*. (2014) assessed the economic value of the Hongcheon River restoration project by classifying the city into the project district and the non-project district. Hong *et al*. (2014) also used CVM and estimated economic benefits to people living in metropolitan areas that derived from the multifunctionality of the Hongcheon River. In particular, they have revealed in their study that the selective attributes of consumers can change the value of Cheonggye Stream.

The CVM is not the only method used to assess the value of streams. Kwon (2006) and Kwak et al. (2006) used the choice experiment to assess the value of water resource spawning and habitational functions of the Han River estuary, as well as bird and wild animal habitat function, water purification function and aesthetic/cultural functions. Kim et al. (2012) also used the choice experiment to assess the recreational value of Gyeongin Ara Waterway. Son et al. (2012) analyzed the changes people feel in the usefulness of Cheonggye Stream in terms of stream type and water quality of the riverfront before and after the restoration.

In case of overseas studies, Poor *et al*. (2007) used the hedonic price model and quantitatively assessed a marginal value according to changes in the water quality of river basins. Fleming and Cook (2008) used the travel cost method and conducted a survey on the visitors to Lake Mckenzie, Fraser Island, Australia and estimated the use benefits of the lake. Alam (2008) conducted a benefit-cost analysis on the restoration of the Burigana River, a dead city river in Bangladesh, and a feasibility assessment on business development. The value system of the city river was classified into direct use, indirect use and nonuse value, and assessed some expected functions including recreation, fish species protection, biodiversity and flood prevention by using the CVM.

When the preceding studies are examined, it can be seen that a value assessment with consideration for the physical factors and the structural characteristics of rivers was carried out in the beginning stage of studies. And in recent years since the importance of river environment became evident, more studies started to include eco-environmental factors in their stream assessment. Moreover, we can see that studies on value assessment, which were recently conducted, have included the waterfront functions such as waterfront recreation and river landscape, and the spatial functions such as resting spaces for local residents. In particular, the assessment on the irrigation and the flood control functions of rivers in cities where population is concentrated is highly important. This is because the restoration of rivers provide several long term benefits in addition to the benefits derived from the direct use of rivers, for these restoration projects, through water purification, bring about a qualitative improvement to river functions such as the riverfront due to healthier ecosystems and better water regulation function.

2. Demand Model for the Restoration of Stream Space

1) Demand for Public Goods and the CVM

All the goods and services in a market economy are classified into market goods and non-market goods depending on whether goods can be traded through market systems. In case of market goods, their value can be evaluated based on the prices formed through transactions. However, when it is difficult to exclude a specific person (non-excludability) or when non-market goods such as public resources with no rivalry in consumption (non-rivalry) are involved, there are no market prices, thus making it difficult to assess their economic value. The value of non-market goods can be broadly classified into use value and nonuse value, and nonuse value can be classified into existence value, option value and bequest value (Krutilla, 1967; Weisbrod, 1964).

Use value refers to the value obtained through using the relevant public resource. Existence value refers to the value we put on something for just existing and utility is not required to be derived from direct use of the resource. Option value refers to the expected value, somewhat like premiums paid for insurance policies, we are willing to pay for the choice we may make in the future even if there is little or no likelihood of us actually ever using it. Bequest value is associated with the willingness to pay to preserve resources for future generations. Ultimately, non-market value is the combination of existence, option and bequest values where the weight of each value is different. The value of stream space stated in this study refers to nonuse value.

In this study, the Contingent Valuation Method (CVM) was used for the demand analysis of stream space. The CVM is a method to evaluate the monetary value of goods or services that are yet evaluated in markets by identifying consumers' willingness to pay (WTP). The CVM is classified into open-ended and dichotomous choice (DC) according to how the survey is conducted to assess WTP in a virtual market. The respondents who answer the open-ended questions are willing to pay the highest price. On the other hand, the respondents of the dichotomous choice questions answer "yes" when the value they are willing to pay is higher than the offer price and "no" when the offer price is higher. Because the respondents can only answer "yes" or "no," there is a suitable inducement that helps people to give answers according to their preference (Mitchell and Carson, 1989).

The dichotomous choice format is again classified into the single bounded dichotomous choice format, in which the respondents' WTP process is completed by choosing between "yes" or "no" on the suggested price, and the double bounded dichotomous choice (DBDC) format, in which the respondents are offered with a different price depending on the results of the first survey. In DBDC, for example, after conducting a survey on the respondents' willingness to pay for the price randomly deduced from the preset prices, suggest a price two times higher than or 1/2 the initial price depending on their answer, and ask again whether they are willing to pay the price.

2) DBDC-Type CVM and WTP Estimation

The paradigm of economics is built on the assumption that each individual consumer seeks maximum satisfaction from every action he or she makes. This satisfaction is expressed as utility by economists as a connotative concept: all goods, whether big or small, need to have utility to have value. Individual consumers tend to choose goods or services that provide greater utility after comparing a price or cost they need to pay or bear. If we consider that public resources created for people also have utility as the subjects of esthetic, recreational and social values, some consumers will have WTP to obtain that utility.

Theoretical basis of DC CVM for Hick's compensating or equivalent surplus estimation is based on the utility difference model (Hanemann, 1984). An individual can maximize his utility by selecting "yes" or "no" on the price suggested to acquire a certain good, and at this time, his utility is assumed to be given to him: $U = U(r, Y; S)$. Here, r is an indicator value, and it is expressed as r=1 when the individual is willing to pay and r=0 when he is not. Y is an income, and S is a vector which refers to personal characteristics that can affect the preference. The individual's utility can be treated as a random variable which has an average $v(r, Y; S)$, an indirect utility function, and an error term ϵ_r due to random elements, which are included in the function, that cannot be observed. Here, the average of $\epsilon_r (r = 1, 0)$ is 0, and it is a random variable that has an independent and identical distribution.

When a respondent chooses "yes," it means that the utility level of obtaining the utility through paying a certain suggested price (A) is greater than maintaining the current income (i.e. the utility level of paying a certain price for the maintenance of the multifunctionality of Hampyeong Stream, such as flood prevention, eco-environmental improvement and sightseeing/leisure opportunities, is greater than or equivalent to that of not paying the price and losing the public benefit function), and this can be expressed as the following formula:

(1) $v(1, Y-A; S) + \epsilon_1 \geq v(0, Y; S) + \epsilon_0$

Or can be expressed as the following formula by using the indirect utility difference (Δv):

(2) $\Delta v(A) = v(1, Y-A; S) - v(0, Y; S) \geq \epsilon_0 - \epsilon_1$

By using Formula (2), the percentage of the individuals answering "yes" is as the following when it is expressed in the utility difference model:

(3) $\mathrm{Prob}[yes] = \mathrm{Prob}[\Delta v(A) \geq \eta] = F_\eta[\Delta v(A)]$

Here, $\eta = \epsilon_0 - \epsilon_1$, and $F_\eta[\Delta v]$ is the cumulative distribution function of η, i.e. the cumulative distribution function of WTP. It means $\Delta v \geq 0$ when an individual consumer chooses "yes" on the suggested goods and prices, and $\Delta v < 0$ when he answers "no."

A probit model, which assumes a cumulative normal distribution, or logit model, which assumes a logistic function, is usually used for the assumption of the probability model expressed by Formula (3). Because a logit model is used in this study, the logistic distribution function $F_\eta[\Delta v]$ is expressed as follows:

(4) $F_\eta[\Delta v] = \dfrac{1}{1 + e^{-\Delta v(\cdot)}}$

The logit model deduced according to the indirect utility function is expressed as the function of the suggested price (A), and the demand quality indicated through willingness to pay is determined by A. Meanwhile, as factors that determine the demand quantity are expressed through the demand curve movement, not only the attribute variables of streams recognized by the consumer but demographic characteristics can be included in the vector S.

By using the maximum likelihood method, assume WTP from the parameter of the assumed logit model. In general, the central tendency of WTP distribution is measured to assume WTP. Calculating the truncated mean of the assumed WTP distribution is one of them, and it can be expressed as follows:

(5) $WTP = \int_0^{A^{\max}} \mathrm{Prob}(yes)\, dA$

The upper value Amax of the integral in Formula (5) refers to the highest price among the prices offered to the respondent. This approach is a generalized estimation method in the CVM (Bishop and Heberlein, 1979; Willis and Saunders, 1995; Lee and Chun, 1999), and provides a conservative estimation compared to integrating the infinite-valued (Hanemann and Kanninen, 1998).

3) Virtual Market Designing

To make a double bounded dichotomous choice (DBDC) question and its answer more realistic, it is important to create a market environment where consumers can get absorbed in the consumption behavior. The supply level of the good being valued, payment means and ways to induce WTP are the components of a virtual market. A virtual market should be designed and the questionnaire should be developed considering whether the respondents are fully aware of the good being valued, whether the payment means is acceptable and the suggested price range and stage are appropriate. In this study, the good that was valued in a virtual market was the multifunctionality (flood prevention function, eco-environmental improvement, waterfront spaces for sightseeing/leisure), which was realized by restoring Hampyeong Stream. The current level of multifunctionality was regarded as the highest level, and a virtual situation was set as the loss of multifunctionality that would develop as an outcome of having no additional budget.

Also, the necessity of securing economic resources was mentioned as a condition to maintain the above multifunctional public benefits, and this study developed a theory that a payment vehicle called "Hampyeong Stream Revival Fund" set up by residents is the sole source of income. Tax and burden charge are used as payment means in a virtual market in CVM studies to assess the value of environmental goods. However, considering that the resource of the study site is limited to this area, it was judged that the fund, which has a discussable nature, was more suitable. The respondents in the virtual market were suggested with the burden charge per household they need to pay every year while the project is in progress. There were seven initial asking prices, KRW 1,000, KRW 3,000, KRW5,000, KRW 10,000, KRW 15,000, KRW 30,000 and KRW 50,000, and the respondents answered whether they were willing to pay the price randomly suggested to them or not. The next question was given to the respondents to identify their willingness to pay again by suggesting a price twice higher than or 1/2 of the initial asking price according to their answers to the first question.

RESULTS AND DISCUSSION

1. Survey and Data

The data necessary for analysis were collected between July 30, 2013 ~ August 13, 2013 from people living in Hampyeong-gun (Table 1). A face-to-face survey was conducted with people who were randomly chosen. A total of 350 copies of the questionnaire, 50 copies per each of the seven initial asking prices, were distributed, and among them, this study used 284 valid samples that did not have

Table 1. Survey summary

Item	Details
questionnaire contents	questions related to valuing for the spatial restoration of Hampyoung stream, measurement variables for attributes of stream space, demographics
survey target	local residents in Hampyoung (household)
survey method	interview survey with random selection
survey period	2013. 7. 30 - 2013. 8. 13
valid samples	284

Table 2. Demographics of residents

Characteristics		Sample size	Ratio(%)	Characteristics		Sample size	Ratio(%)
gender	male	154	54.2	monthly household income (10,000₩)	under 75	10	3.5
	female	130	45.8		75~150	28	9.9
marital state	married	221	77.8		150~250	55	19.4
	not married	61	21.5		250~350	66	23.2
	other	2	0.7		350~450	58	20.4
job	expert	37	13.0		450~550	35	12.3
	office	46	16.2		550~650	12	4.2
	agriculture	19	6.7		650~750	9	3.2
	service	23	8.1		over 750	11	3.9
	public official	38	13.4	eduction	elementary school	5	1.8
	self-employed	45	15.8		middle school	16	5.6
	student	31	10.9		high school	77	27.1
	unemployed	3	1.1		university	164	57.7
	homemaker	42	14.8		grad school	22	7.7

missing values regarding variables that were included in the set model. The content of the survey was classified into the questions related to valuing for spatial restoration of Hampyeong Stream, and measurement variables for attributes of stream space and demographics. The demographic characteristics of sample are as shown in Table 2.

The difference between the preceding studies and this study in regards to the establishment of demand model is that this study parameterized the attribute factors of stream space and included them in the model. Although it is a hypothesis that needs verification, it is certain that the value of Hampyeong Stream is affected by the various attributes of the restored area. The attributes of stream space in this study were deduced and considered from the perspective of regarding the stream as a complex space. Also, because the subjects of the value assessment were the local residents, this study engaged them to conduct the assessment on the attributes of Hampyeong Stream. To deduce the attribute items of stream space, this study referred to the preceding studies, the study on stream restoration plan, study on stream district classification methods and assessment on waterfront spaces, that were illustrated above. As a result, a total of 22 attribute measuring variables were deduced for the stream space. Each measuring item was evaluated using a 5-point scale (① Not important at all ~ ⑤ Very important), and measured the degree of the respondents' awareness.

The attribute measuring items of stream space were classified according to the principle of similarity, and a factor analysis was conducted on them to use the classification as an explanatory variable in the value assessment model. The Varimax method was used in the factor analysis, and four factors were deduced as the result of extracting factors with an Eigen value of 1.0 or more. They all had high internal consistency as all of their Cronbach α value was above 0.6, and the variance explanatory power was also fairly high (67.5%).

The factors were named in accordance with the characteristics of the measuring items of each factor. Factor 1 was named as the physical factor of waterfront area and it is composed of six items, rest area (bench, sitting wall), convenient facilities (convenience store, public toilet), facilities for children (playground, outdoor

Table 3. Results of factor analysis on the attributes of stream area

factor	variables	factor loading
FAC1: physical factor of waterfront area (3.685[a], 19.39%[b])	- rest area (bench, sitting wall)	.808
	- convenient facilities (convenient store, public toilet)	.776
	- facilities for children (playground, outdoor swimming pool)	.716
	- waterfront facilities (trail, observation deck, square)	.676
	- guidance facilities	.651
	- sport facilities	.593
FAC2: experience factor of stream space (3.365, 17.70%)	- natural environment of the stream (flora & fauna)	.804
	- educational factors (wetland experience, ecology classroom)	.800
	- cultural aspects of the stream (events, festivals, exhibitions)	.694
	- overall security for facilities	.674
	- degree of maintenance for facilities	.642
FAC3: physical factor of the main stream (3.220, 16.95%)	- stream width	.885
	- stream depth	.864
	- stream velocity	.824
	- stream length	.783
FAC4: accessibility and connectivity (2.550, 13.42%)	- time taken to the stream	.788
	- accessibility to the stream	.777
	- connectable destination for tourism	.634
	- diversification of amusement facilities	.587

extraction method: Principal Component Analysis, rotation method: Varimax
KMO(Kaiser-Meyer-Olkin)=0.901, variance explained: 67.47%,
Barlett`s Test of Sphericity=3253.3(p<0.000)
a: eigen-value, b: variance ratio

swimming pool), waterfront facilities (trail, observation deck, square), guidance facilities and sports facilities (physical training facilities, golf course). Factor 2, the experience factor of stream space, is composed of four items, educational factors (wetland experience, ecology classroom), cultural aspects of the stream (events, festivals, exhibitions), overall security for facilities and degree of maintenance for facilities. Factor 3, the physical factor of the main stream, is composed of four items, stream width, stream depth, stream velocity and stream length. Factor 4, accessibility and connectivity, is composed of four items, time taken to reach the stream, accessibility to the stream, connectable destination for tourism and diversification of amusement facilities (Table 3).

2. Estimation Results of the Demand Model of Stream Space

1) Variable Labeling and Model Estimation

The demand model for the value assessment of stream space is estimated by using the maximum likelihood estimation after substituting the WTP cumulative distribution function with the indirect utility difference function ($\triangle v$). The conceptual expression of $\triangle v$ is as shown below. The descriptive statistics of the variables used for setting the demand model is as shown in Table 4. A total of nine variables, comprised of offer price, attributes of stream area (4 variables) and demographics (4 variables), were used as the explanatory variables. Among the explanatory variables, the attribute variables are the factor score of each factor, and are expressed as a standard normal distribution with average "0" and standard deviation "1."

$$\triangle v = f(\text{A, FAC1, FAC2, FAC3, FAC4, GENDER, INCOME, EDU, WHITE})$$

The estimation results of the demand model is as shown in Table 5. The assessment of the estimated results can be judged through theoretical verification and statistical verification. The theoretical verification for the assessment of the estimated results identified whether the sign of parameter coincides with the expected sign, and for the statistical verification, a likelihood ratio test and a t-test were conducted on the entire model and the individual explanatory variables, respectively. As for the suitability of the model, because Chi-square value (869.9) was significant at a 1% level, the model was judged to be suitable.

As the offer price (A), the determinant that affects willingness to pay for the multifunctional public benefits of stream space, had a significantly negative influence at 1% level, it was judged to be in accordance with the demand theory. Also, the physical factor of waterfront area (FAC1) and the experience factor of stream space (FAC2) had a significantly positive influence at a 1% level, and accessibility and connectivity had a significantly positive influence at a 5% level. Among the demographic characteristics, only gender had a significantly positive influence at a 1% level, and income, job and education level did not have statistically a significant influence.

The analysis results of the demand model can be interpreted as follows: local residents' willingness to pay for the preservation of the public benefit function Hampyeong Stream provides was high when they though the facilities or utilization of waterfront spaces were more important than the physical characteristics of the main stream. This means that in order to receive support from the residents in case of improving the value of stream space or implementing a similar stream project, the accessibility should be improved by developing experience programs along with investment in facilities to improve the utilization of waterfront spaces. However, there may

Table 4. Defined variables and descriptive statistics

variable name		definition of variables	mean	std. dev.
offer price	A	bid amount offered(1,000Won)	1.551	1.556
attributes of stream area	FAC1	physical factor of waterfront area	0.0	1.0
	FAC2	experimental factor of stream space	0.0	1.0
	FAC3	physical factor of the main stream	0.0	1.0
	FAC4	accessibility to the stream	0.0	1.0
demographics	GENDER	male=1, female=0	0.541	0.499
	INCOME	monthly household income(10,000₩)	343.8	177.2
	EDU	university and more=1, otherwise=0	0.655	0.476
	WHITE	white collar=1, otherwise=0)	0.427	0.496

be a limitation to generalizing the attributes of stream space, which affect the preservation of the public benefit function of Hampyeong Stream, to other streams. Because, in terms of the expectable form and level of public benefit function, there may be a difference according to the form and attributes of a stream, and even if another stream is similar to Hampyeong Stream, differences in the stream's natural geographical factors and industrial structure can influence the restoration direction of stream space.

Table 5. Estimation result of DBDC CVM

Variables	Coefficient	t-value
Constant	0.385	1.129
BID	-0.429	-14.205**
FAC1	0.349	2.584**
FAC2	0.466	3.628**
FAC3	-0.062	-0.492
FAC4	0.287	2.246*
GENDER	0.741	2.721**
INCOME	0.001	1.231
EDU	-0.298	-1.443
WHITE	0.271	1.007
log-likelihood function	434.94	
model chi-square	869.88**	
number of observations	284	

* & ** are statistically significant at 5% and 1%, respectively.

2) Benefit Estimation

According to the estimated model, the value of the multifunctional public benefits of Hampyeong Stream was quantitatively estimated. WTP per household was deduced by substituting the parameter estimated using the Logit model to Formula (5). At this time, because the parameter estimations that were used for benefit estimation were random variables, the benefit estimation was also a random variable with an unknown distribution. Therefore, the suitability of the given model does not guarantee the credibility of the benefit estimation. As an alternative, it is rational to express as a confidence interval, which is based on an average value, instead of the benefit estimation.

For the variance estimation of the average WTP estimated by using the Logit model, the confidence interval of the WTP estimated by the CVM was set applying the simulation proposed by Krinsky and Robb (1986). The average value and the standard deviation of benefit estimations were calculated by simulating 1,000 times from a multi- variate normal distribution. The average WTP per household was estimated to be KRW 22,523 per year, and this value, the quantified benefit, is a value given to the public benefit function of Hampyeong Stream space by the local residents. The 95% confidence interval of the average value was estimated to be KRW 17,362 ~ KRW 27,459. The annual total value of Hampyeong Stream space was about KRW 320 million, which was deduced by multiplying the WTP per household by 13,408 households (the total number of households in Hampyeong-gun), and the 95% confidence interval was estimated to be KRW 232.78 million ~ KRW 368.17 million.

3. Proposal

The purpose of this study was to assess the value of the public benefit function provided by Hampyeong Stream space as a complex space, and analyze the effects of important attributes of stream space on the value assessment of the public benefit function. Besides the offer prices and the demographic characteristics as the explanatory variables of the WTP demand model, which provided parameters for the value assessment, the attribute variables of the stream space were included to identify the attributes that have a significant influence on the public benefit function among the multifunctional attributes of the stream space. To deduce the attribute variables of the stream space, a factor analysis was conducted on the measuring items, which refer to the attributes of the stream space such as irrigation, flood control, ecological environment and waterfront areas. In conclusion, four attribute variables of the stream space, the physical factor of waterfront area, experience factor of stream space, physical factors of the main stream and accessibility and connectivity, were deduced.

According to the estimation results of the demand model, because the offer price had a significantly negative influence as the determinant of WTP for the preservation of public function, it was deemed to be suitable for the demand theory. Among the demographic characteristics, only gender had a significant influence, and other variables did not have a significant influence. Among the attribute variables of stream space, while the physical factor of waterfront area and the experience factor of stream space had a positive influence on WTP demand, the physical factor of the main stream did not have a significant influence. This means that in order to receive support from the residents in case of improving the value of stream space or implementing a similar stream project, the accessibility should be improved by developing experience programs along with investment in facilities to improve the utilization of waterfront spaces.

However, there may be a limitation to generalizing the attributes of stream space which affect the preservation of the public function of Hampyeong Stream to other streams. Because, in terms of the expectable form and level of public function, there may be a difference according to the form and the data pertinent to a stream, and even if another stream is similar to Hampyeong Stream, differences in the stream's natural geographical factors and industrial structure can influence the restoration direction of stream space. According to Hong et al.(2014), in case of Cheonggye Stream, a stream in urban area, the physical characteristics of channels among the attributes of stream space had a positive influence on WTP for the preservation of public function, but the physical characteristics of waterfront area and experiential activities did not have a significant influence. Such results indicate that it is necessary to analyze data deduced from individual approaches for different streams or to adopt approaches by types to suggest a direction for the restoration of stream space.

The benefit of the Hampyeong Stream restoration project was valued at KRW 22,523 per household each year in the present study. The 95% confidence interval of the average value was estimated to be KRW 17,362 ~ KRW 27,459. According to the studies that were carried out using the CVM to quantitatively identify the effects of improvement in stream environment due to restoration projects, the economic value of environmental changes due to the creation of an ecological park in Daejeon Stream was KRW 3,485 ~ KRW 5,062 a year per household (Leem and Lee, 2005), the benefit of restoring the ecological space of Ancheon Stream was KRW 1,899 a year per household (Yoo et al., 2009), the benefit of restoring the ecological space of the Hongcheon River was KRW 3,300 ~KRW 4,628 a year per household (Koo et al., 2014) and the preservation value of Cheonggye Stream, a stream in urban area, was estimated to be KRW 11,324 a year per household (Hong et al., 2014). In case of the overseas paper of Loomis et al. (2000), the benefit of restoring the South Platte River in the U.S. was estimated to be USD 21 a month per household.

The benefit of restoring Hampyeong Stream space estimated in this study is similar to that of Anseong Stream, but it is higher than the other mentioned cases. On the other hand, the economic value of restoring the South Platte River is very low. There can be a difference in the estimated benefit according to the types of payment means, price ranges and question methods that are used in a virtual market even if the same CVM approach is used. However, in general, the benefits of restoring streams can show results of various sizes depending on the composition and scope of environmental goods, the targets of assessment, and their functions and roles within the relevant region. Therefore, a simple comparison between the estimated benefits of the Hampyeong Stream restoration project and that of other streams is not recommended. As an alternative, a comparison between the sizes of benefit per unit can be considered. For instance, Loomis et al. (2000) and Holmes et al. (2004) estimated that the benefit of restoring the South Platte River and the Tennessee River was USD 5.6 and USD 4.5 per mile, respectively.

The total value of the Hampyeong Stream Restoration Project was estimated to be about KRW 319.9 million per year. The estimated total value is the result of assessment on the public benefit function of the restored Hampyeong Stream, which was conducted by the local residents. The comparison between the current value of annual benefits that occur over the period of the restoration project and that of the investment costs and operating expenses spent on the project is called a benefit-cost analysis. The estimated annual total value corresponds to the benefits among the economic analysis items, and in this case, its size is variable according to the regional scope of the benefiting area. Here, the estimated annual total value of Hampyeong Stream space is only valid when the beneficiaries of public benefit function are limited to the residents of Hampyeong-gun.

This study estimated the economic value of the multifunctionality of the restored Hampyeong Stream space. However, rather than individually estimating the value of each of the multiple functions provided by the restored stream space, the value of multifunctionality, which was regarded as one composite good, was estimated. Such an approach does not distort the size of the value of multifunctional public benefits, but there is a limitation when it is required to identify the sizes of individual functions and compare them. If a researcher aims to assess the value of individual public benefits within a given space, it is recommended to use the choice experiment.

REFERENCES

Alam, K.(2008) Cost-benefit analysis of restoring Buriganga River. Bangladesh Water Resources Development 24(4): 593-607.

Bishop, R.C. and T.A. Heberlein(1979) Measuring values of extra-market goods: Are indirect measures biased. American Journal of Agricultural Economics 61(5): 926-930.

Byen, K.O., K.D. Han, Y.J. Sung, S.H. Oh, J,E. Sang and S.H. Choi(2011) River Amenity restoration planning guide. ECORIVER21. (in Korean)

Cho, H.J., J.H. Ra, H.T. Lee and J.N. Ku(2009) A study on the evaluation of wide-scale site suitability for waterfront recreation area planning. Journal of the Korean Institute of Landscape Architecture 37(2): 1-13 (in Korean with English abstract)

Eom, Y.S., C.Y. Kim, T.H. You and C.S. Kim(2001) Valuing intentions to visit Man Kyoung ecological river. Korea Environmental Policy and Administration Society 9(1): 81-100. (in Korean with English abstract)

Fleming, M.C. and A. Cook(2008) The recreational value of Lake McKenzie, Fraser Island; An application of the travel cost method. Tourism Management 29(6): 1197-1205.

Hanemann, W.M. and B. Kanninen(1998) The Statistical Analysis of Discrete-Response CV Data. Department of Agricultural and Resource Economics. University of California at Berkeley. Working Paper 798.

Hanemann, W.M.(1984) Welfare evaluation in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics 66(3): 332-341.

Holms, T.P. J.C. Bergstrom, E. Huszar, S.B. Kask and F. Orr(2004) Contingent valuation, net marginal benefits and the scale riparian ecosystem restoration. Ecological Economics 49(1): 19-30.

Hong, J.Y., H.C. Lee and A.K. Kim(2014) Study about the effect of destination selection attributes on estimating the value of Cheonggae stream's public benefit functions. Korean Journal of Hospitality Administration 23(1): 219-233. (in Korean with English abstract)

Kim, D.C. and I.S. Park(1999) A study on the evaluation criteria of stream naturalness for ecological environment restoration of stream corridors. Jounal of Korean Wetland Society 17(3): 123-134. (in Korean with English abstract)

Kim, J.O., O.S. Kim and S.H. Kim(2004) A study on the quantified evaluation and application of stream environment. Jounal of Korean Wetland Society 6(3): 83-93. (in Korean with English abstract)

Kim, S.Y., S.I. Choi and T.G. Kim(2012) Valuing Tourism Resource Using the CVM: Focusing Ara-Waterway. Korean Journal of Hospitality Administration 21(5): 207-218. (in Korean with English abstract)

Koo, Y.M,. H,S, Kang and M.S. Lee(2014) An economic value for construction of ecological in Hong Cheon Area, Korea. Korean Journal of Environmental Ecology 28(1): 71-79. (in Korean with English abstract)

Korea Research Institute for Human Settlements(2011) Socio-economic evaluation of river restoration project.

Krinsky, I. and A. Robb(1986) On approximating the statistical properties of elasticities. Review of Economics and Statistics 68(4): 715-719.

Krutilla, J.V.(1967) Conservation reconsidered. American Economic Review 57(4): 777-786.

Kwak, S.J., S.H. Yoo and J.I. Chang(2006) Valuing the Han-river estuary: Using conjoint analysis. The Korean Economic Review 54(4): 141-160. (in Korean with English abstract)

Kwon, O.S.(2006) Valuing recreational benefits of dam lakes Using a choice experiment approach. Environmental and Resource Economics Review 15(3): 555-574. (in Korean with English abstract)

Lee, H.-C. and H.-S. Chun(1999) Valuing environmental quality change on recreational hunting in Korea: A contingent valuation analysis. Journal of Environmental Management 57(1): 11-20.

Lee, H.S.(2014) A study on analysis of importance weights of river-front assessment items using analytic hierarchy process: Focused on the Gyeong-An stream in Gyeonggi Province. Journal of the Korean Society of Rural Planning 20(1): 27-36. (in Korean with English abstract)

Leem, Y.T. and J.Y. Lee(2005)An Estimation of the value of urban ecological riverside park. The Korean Regional Development Association 17(3):95-110. (in Korean with English abstract)

Loomis. J., P. Kent, L. Strange, K. Fausch and A, Covich(2000) Measuring the total economic value of restoring ecosystem services in an impaired river basin: Results from a contingent valuation survey. Ecological Economics 33(1): 103-117.

Mitchell, R.C. and R.T. Carson(1989) Using Survey to Value Public Goods: The Contingent Valuation Method. Resource for the Future. Washington. D.C.

Poor, P.J., K,L. Pessagno and R.W. Paul(2007) Exploring the hedonic value of ambient water quality: A local watershed-based study. Ecological Economics 60(4): 797-806.

Son, M.S., W.Y. Cho and H.S. Kim(2012) Elicitation of WTP before and after waterfront restoration -Ca-se study of Cheonggyecheon stream restoration project. Journal of the KRSA 28(2); 23-37. (in Korean with English abstract)

Song, J.I., J.H. Lee and S.E.Yoon(2008) Development of stream assessment technique for restoration and management of urban stream. Journal of The Korean Society of Civil Engineers 28(3b): 283-296.(in Korean with English abstract)

Weisbrod, B.(1964) Collective-consumption services of individual-consumption goods. Quarterly Journal of Economics 78(3): 471-477.

Willis, K., G. Garrod and C. Saunders(1995) Benefits of environmentally sensitive area policy in England: A contingent valuation assessment. Journal of Environmental Management 44(2): 105-125.

Yoo, S.H. and J.S. Lee(2011) Economic valuation of the river environment improvement. Journal of Water Policy and Economy 17: 63-77. (in Korean with English abstract)

Yoo, S.H., J.H. Han and S.H. Park(2009) The economic benefits from restoring the ecological integrity of the Anseong River. Journal of the KRSA 25(1): 57-73. (in Korean with English abstract)