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The Measurement of the Conservation Value for Korean Coastal Wetlands

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표희동

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머리말

최근 급속한 도시화와 산업화, 그리고 무분별한 간척사업 등 연안개발로 인하여 해양환경오염이 확산되고 있고, 이는 심각한 사회문제로 부각되고 있다. 이와 같은 환경오염의 심각성으로 인하여 20세기에는 경제발전과 환경을 동시에 고려한 지속가능한 개발(sustainable development) 또는 환경친화적 관리(environmental friendly management)라는 새로운 사회경제적 패러다임이 등장하였다. 한편, 생태경제학자들은 환경경제학에서 더 나아가 환경과 자연자원의 자본화(natural capitalization)를 주장함으로써 바야흐로 21세기에는 환경친화적 관리에서 환경우선적 관리라는 새로운 패러다임이 우리 사회를 지배할 것으로 전망된다. 뿐만 아니라 이와 같은 새로운 패러다임을 뒷받침하기 위해서는 모든 경제활동분야에 환경의 질적 개선과 악화효과가 반영되는 녹색회계(green accounting)제도가 정착될 것이다.

녹색회계제도가 도입되면 환경과 자연자원과 같은 비시장성 재화를 화폐적 가치로 환산하는 것은 매우 중요하다. 많은 경제학자들은 수십년 동안 이와 같은 비시장성재화의 경제적 가치를 추정하는 경제학적 이론과 기법을 개발하는 데 노력을 기울여 왔다. 특히 최근 환경자연자원의 가치평가는 Samuelson의 후생경제학 이론에 근거를 두고 있는데, 이 중 조건부가치측정법(contingent valuation method)은 소위 고급가치평가기법(the state-of-the-art assessment technique)으로 활용되고 있다.

본 연구는 이와 같은 조건부가치측정법을 이용하여 연안자원의 보존가치(비사용가치)를 계량화함으로써 최근 우리나라에서 이슈로 떠오르고 있는 개발과 보존간의 상반관계를 해결하는 유용한 자료가 될 것으로 기대된다. 뿐만 아니라 생태자원을 효율적으로 관리하기 위해서는 관련비용과 편익을 계량화하고, 이들의 상반관계를 평가하는 것이 필수적인데 본 연구는 연안습지의 보존가치를 추정하는 것으로 만족하지 않고, 개발과 보존의 논쟁지역의 하나인 영산강4단계 유역의 연안습지를 대상으로 편익–비용분석을 시도하였다. 이 분석에서 주목할 만한 점은 전통적 편익–비용분석과 보존가치를 고려

한 광의의 편익–비용분석에 따른 결과를 비교분석함으로써 보존가치가 이들 분석에 얼마만큼의 영향을 미치는가를 계량적으로 보여준다는 것이다. 또한 목표탐색법(goal-seeking model)을 이용하여 연안자원의 우리나라 가구당 최소 보존가치를 추정함으로써 정책입안자가 관련정책과정에서 활용할 수 있도록 하였다.

그 밖에도 본 연구는 연안자원의 생태계서비스의 잠재적 가치를 화폐화하였을 뿐만 아니라 향후 연구를 위한 기반구축과 관련분야에서의 연구와 토론을 자극하는 데 기여할 수 있을 것이다.

본 연구보고서는 본원의 표희동 책임연구원이 작성한 것이나, 본 연구를 위한 설문지설계와 분석 및 내용에 대한 검토와 토의에 있어서 고려대학교 곽승준 교수와 서울대학교 유승훈 박사의 도움을 크게 받았다. 또한, 본 연구는 캐나다 생태경제학회와 포르투갈에서 개최된 연안생태계의 지속적 관리에 대한 국제회의에서 발표된 논문이 근간이 되었는데, 이와 같은 연구활동을 적극 지원하여 주고 격려하여 준 본원의 최동현 환경안전연구실장, 임진수 기획조정실장과 정주열 행정실장에게 감사드린다. 그리고 심사를 맡아 좋은 지적과 조언을 준 심사위원장인 박성쾌 박사, 이지현 박사, 고려대학교의 곽승준 교수, 포스코경영연구소의 김정인 박사, 해양수산부의 권석창 서기관 등에게도 이 지면을 빌려 심심한 감사를 드리는 바이다. 또한 본 보고서를 세심하게 검토수정하여 주신 과학기술정책연구원의 정성철 박사께 특별히 감사드리고, 그 외 연구를 수행하는 데 도움을 준 김새로나, 김복희, 홍수진 씨에게도 감사드린다.

끝으로 본 보고서의 내용은 전적으로 필자 개인의 학문적 소견이며, 한국해양수산개발원의 공식적인 견해가 아님을 밝혀둔다.

1999년 12월

韓國海洋水産開發院

院長 李 廷 旭

<초 록>

우리나라 연안습지 보존가치의 추정에 관한 연구

우리나라의 연안습지는 세계 5대 습지중의 하나로 국제적으로 중요한 습지로 알려져 있다. 본 연구는 보존가치에 대한 기존의 실증연구문헌을 검토하였고, 실증분석으로서 개발과 보존에 대한 논쟁지역인 영산강 4단계 유역의 연안습지를 대상으로 개발 대신 현재 수준으로 보존하고자 할 때의 지불의사금액인 비사용가치를 추정하였다. 경제적 가치평가기법으로는 조건부가치측정법(CVM)중의 하나인 이중경계양분선택형 질문법과 서울거주 1,000명의 세대주 또는 주부를 대상으로 한 개인면접법을 적용하였다. 이와 같이 설문에 의한 보존가치는 Haneman의 전통적 모델과 Kristrom의 Spike모델을 토대로 하여 최우추정법(maximum likelihood estimation)에 의해 추정되었다. 특히, 본 연구에서 이용된 Spike모델은 Kristrom의 단일경계양분선택형 질문법에서 이중경계양분선택형 질문법으로 확대분석되었다는 점에서 이 분야의 새로운 기여라고 할 수 있다. 분석결과 영산강4단계유역에 대한 우리나라의 연간 총보존가치는 1,757억원으로 추정된다. 갯벌의 보존가치를 고려한 광의의 편익/비용분석 결과 보존가치인 가구당 연간 13,562원씩 추가적인 세금을 5년간 지불한다면 내부수익률(전통적인 편익/비용분석에 의한)을 30% 정도 하락시키는 것으로 분석되었다. 한편, 목표탐색법에 의한 추정결과 가구당 5년동안 연간 3,000원의 세금을 추가적으로 지불한다 할지라도 이 지역의 개발계획은 취소되어야 할 것이다. 이와 같이 본 연구는 고급경제적 평가기법을 이용하여 연안습지의 보존가치를 추정함으로써 연안자원보존의 중요성을 재조명하고, 보존가치의 규모를 구체적으로 화폐화함으로써 해양환경정책을 수립하는데 주요한 참고자료가 될 것이다.

<ABSTRACT>

The Measurement of the Conservation Value for Korean Coastal Wetlands

South Korean coastal wetlands are known as one of the five most important wetlands in the world. This research, yet, addresses some controversial issues relating to the nonuse values of the wetlands, and applies a contingent valuation (CV) method to estimate the conservation or nonuse values of the coastal areas around Youngsan River in Korea. The CV survey used a double-bounded dichotomous choice(DBDC) format and was conducted for 1,000 households in Seoul. The conservation values were estimated based on Hanemans model and Kristrom's spike model using the maximum likelihood method. In addition, spike model was expanded from single-bounded dichotomous choice data to DBDC-CV data. This is the main contribution of this study to the empirical research in this field. An estimate of the annual aggregated conservation value of the coastal wetlands for entire Korean households approximates 175,745 million won (US$175.7 million). On the other hand, cost-benefit analysis (CBA) related to the Korean wetland development was conducted to identify how much the nonuse value affects the result of CBA. An extended CBA reflecting the estimated nonuse values resulted in an IRR that is about 30% lower than that of conventional CBA, implying CBA can be heavily affected by nonuse values. A goal-seeking model was used to evaluate the economic feasibility of

wetland preservation and development based on the magnitude of nonuse values. The result shows that the wetland development project can be rejected if the annual nonuse value for wetland is 3,000 won per Korean household for the first five years. Therefore, a more broadly defined economic value of coastal wetlands may lead to different policy decisions.

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EXECUTIVE SUMMARY

South Korean coastal wetlands are identified as one of the five most important wetlands in the world. A strong motivation for wetland development, however, exists since net benefits of the development often exceed those of wetland preservation in a conventional benefit/ cost analysis.

This research addresses some controversial issues relating to the nonuse values of the wetlands, by reviewing the past empirical studies. This research applies a contingent valuation (CV) method to estimate the nonuse values of the coastal areas around Youngsan River in Korea. For this a survey was conducted for 1,000 households in Seoul. Within the survey, respondents were asked for the maximum amount of additional household taxes which they would be willing to pay (WTP) monthly for a conservation programme designed to maintain the current levels of conservation quality at coastal areas.

The CV survey used a double-bounded dichotomous choice (DBDC) format. The conservation values were estimated based on Haneman's model and Kristrom's spike model using the maximum likelihood estimation method. In addition, Kristrom's spike model was expanded from single-bounded dichotomous choice data to DBDC-CV data. This is a main contribution of this study to the empirical research in this field.

Overall, respondents answered that they would be willing to pay 3,904 Korean won per month per household for conserving the wetlands under study. Provided that our sample is broadly representative of the national population, an estimate of the annual aggregated conservation value of the coastal wetlands for entire Korean households approximates 175,745.3 million won (US$175.75 million). That is actually the lowest of several estimate based on conservative approach, and closest to the use values.

On the other hand, a cost-benefit analysis (CBA) of the wetland development was conducted to identify how much the nonuse value affects the result of CBA. An extended CBA reflecting the estimated nonuse values resulted in an IRR that is about 30% lower than that of conventional CBA, This means CBA can be heavily affected by nonuse values. A goal-seeking model was used to evaluate the economic feasibility of wetland preservation and development, considering the nonuse values. The result shows that a wetland development project can be rejected if the annual nonuse value for the wetland exceeds 3,000 won per Korean household for the first five years. Therefore, the more broadly defined economic value of coastal wetlands lead to different policy decisions on wetland development.

KEY WORDS: nonuse values; contingent valuation method; double-bounded dichotomous choice method; spike model; WTP; extended cost-benefit analysis; goal seeking model; coastal wetland development and preservation

1. INTRODUCTION

It is widely accepted that coastal wetlands are very valuable in that they may posses unique, rare, or endangered plant or animal species so that they play multifunctional roles such as nutrient purification, ground water buffering, provision of habitat for fish and migratory birds, erosion control, and so on. Korea has internationally important wetland with an area of 2,393km^2, which is regarded as one of the five important wetlands in the world. At least forty-two Korean wetlands located at or near the coast meet Ramsar waterfowl-based criteria. The Ramsar Convention adopted the waterfowl-based criteria because waterfowl are very good indicators of wetland health, ecological character and productivity. The more productive wetland, the greater the number of waterfowl it can support. The more diverse species in wetland, the greater the number of waterfowl species. They are used as wintering areas for enormous numbers of ducks and geese, and as migration stopover sites for possibly 500,000 to 1,000,000 shorebirds annually, which represent about 20 to 30% of all of the shorebirds migrating along the East Asian Australasian Flyway (Moores, 1999). In addition, Korean coastal wetlands support much commercial fisheries such as various shellfishes, seaweeds, fishes, etc.

Wetlands, however, are continuously degraded or decreased in many parts of the world, and about 30% of Korean wetlands have been converted into landfill and reclamation since 1980. Even remaining ones are under great development pressure for agricultural, industrial, and other land uses in Korea. Moreover, there is a strong moti-

vation for wetland development since some argue that net benefits of the development often exceed those of wetland preservation in the context of a conventional cost-benefit analysis (CBA). In order to address this conflict between conservation and conversion of wetland, there is an urgent need to understand trade-off between wetland conservation through sustainable utilization and wetland conversion by assessing the value of the multiple functions of wetlands.

The extended CBA including non-use values emphasizes preservation of environmental and natural resources. Controversy, however, exists over the method, because there is no direct evidence for the magnitude of non-use values based on observable behavior (Hanley and Spash, 1994). Much of the research associated with CBA has sought to expand the types of benefits that can be measured in monetary terms. For example, the recreational services provided by projects were not taken into account until the development of travel cost model for estimating the demand for outdoor recreation sites. One of the frontier in CBA research is associated with modeling and measuring nonuse benefits (Smith, 1987). The extended CBA provides useful results for policy decision-making, particularly in solving the conflicts between preservation and development of coastal wetlands.

The ecosystem of coastal wetlands is quite complex, and it may be difficult to obtain the accurate estimates of its values. However, as a potential means of decision-making between preservation and development of them, various economic valuation techniques have been adopted to evaluate the preservation value. Environmental economist employs total economic value approach that is focusing

on monetizing a set of human preferences on natural system. The total economic value includes use and non-use values of environmental resources. In the economic literature, natural resource values that are independent of peoples present use of the resource have been variously termed as existence, intrinsic, nonuser, and nonuse, passive use, preservation or conservation values.

This paper has four major goals. The first one is to address some controversial issues relating to nonuse values by reviewing the past empirical studies. The second one is to estimate the conservation value of the coastal wetlands in the Youngsan River areas in Korea. There have been many attempts to measure the conservation value of wetland (for example, see Bateman, et al., 1995; Goodman, et al., 1998; Hoehn & Loomis, 1993; Kaoru, 1993; Whitehead & Blomquist, 1991). However, there are mostly for developed countries and far less information is available for developing countries. Even if figures for developing countries exist, they are usually based on approximation and extrapolation and are clearly less reliable than those referring to developed countries. The results of this paper are, therefore, all the more useful because there are few studies on the issue in the developing world, where adverse effects of the development of wetlands might be more serious than in developed countries. The third goal of this paper is to modify the spike model suggested by Kristrom (1997) to deal with WTP data with zero observations collected by WTP survey and to obtain appropriate welfare measures. Finally, this paper is to compare the economic impact of nonuse values on CBA of Korean coastal wetlands development. And a goal-seeking model is used to evaluate

the economic feasibility of wetland preservation and development based on the magnitude of nonuse values.

The remainder of this paper is structured in the following way. Section 2 reviews the theoretical underpinning and previous empirical studies of nonuse values. Section 3 discusses CV method as the methodology employed in this study. Section 4 deals with modeling welfare measures which are the willingness to pay for the nonuse values, using Hanemans conventional double-bounded dichotomous choice model (DBDC) and Kristroms spike model of CV method. Section 5 reviews the methodological issues on questionnaire design and survey. Section 6 presents the estimation results of the conservation values of the Korean coastal wetlands. Section 7 applies the method to an economic analysis of a Korean coastal wetlands to compare the economic benefits between development and conservation. Along with this, I discuss some controversial issues related to nonuse values in the context of a conventional and extended CBA. The final section contains concluding remarks.

2. NONUSE VALUES

2.1 Concept of Nonuse Values

The concept of the value of wetlands depends upon the disciplinary perspective of individuals. To a wetland scientist whose perspective is wetland ecosystems, wetland values are related to the primary values for the development and maintenance of the wetland

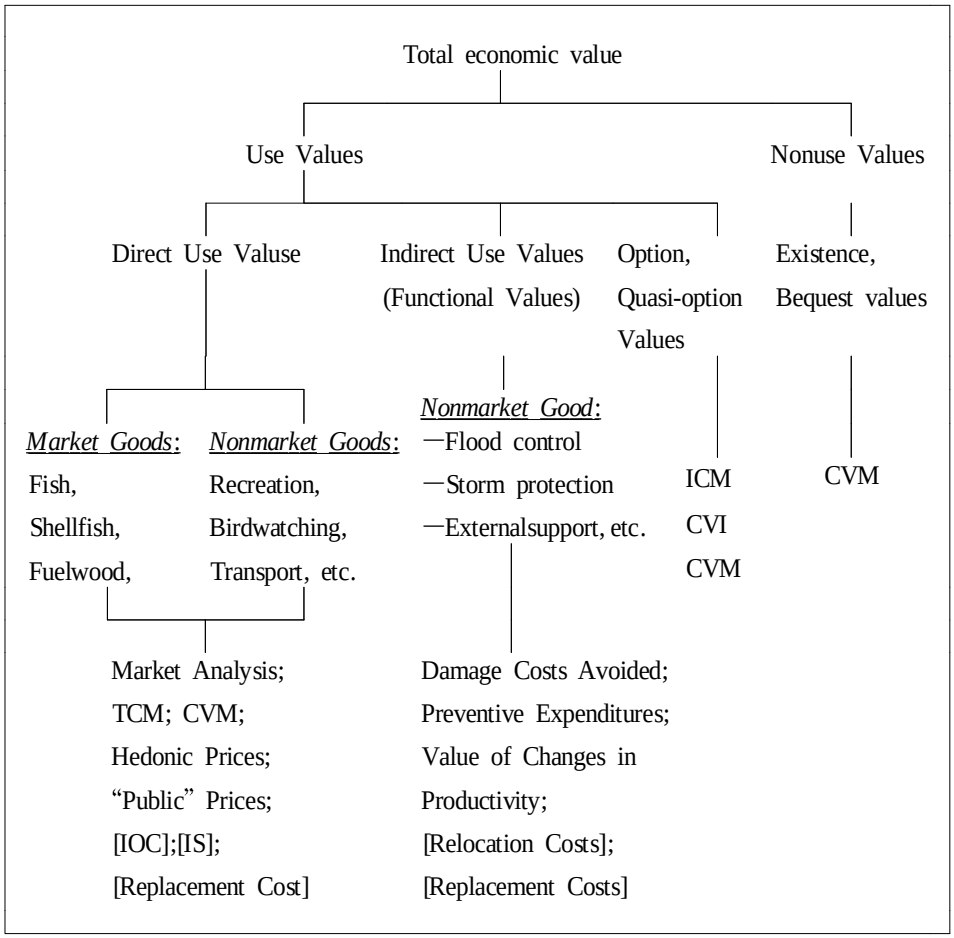
itself, and related to the secondary values for the life-support system to other ecosystems and human society (Gren et al., 1994).

On the other hand, environmental economist employs the concept of total economic value that is focusing on monetizing a set of human preferences on natural system. Since Krutilla(1967), total economic value has been classified into use and non-use values derived from individuals' preferences as shown in Figure 1. Direct use values of the wetlands include both its consumptive uses such as fishes, shellfishes and fuelwood, and non-consumptive uses of wetland services such as recreation, ecotourism, birdwatching, in situ research and education, navigation. Various regulatory ecological functions of wetlands may have important indirect use values. Their values derive from supporting or protecting economic activities such as fisheries via nursery/habitat functions, waste treatment, flood control, storm protection, etc.

Option value is a special value which represents a difference between ex ante and ex post valuation because an individual may be uncertain about his or her future demand for a resource and/or its availability as a wetland in the future. And quasi-option value is simply the expected value of the information derived from delaying exploitation and conversion of the wetland today (Barbier, 1994).

In the economic literature, natural resource values that are independent of people's present use of the resource have been variously termed existence, intrinsic, nonuser, and nonuse values. Since Weisbrod (1964) and Krutilla(1967) introduced the concept of existence or nonuse values, the difference between total value and use value has been called as a nonuse value, or an existence value, an intrinsic

Figure 1. A Typology of Total Economic Values of Wetlands



Notes : ICM = Individual Choice Models
CVI = Conditional Value of Information
CVM = Contingent Valuation Method
TCM = Travel Cost Method
IOC = Indirect Opportunity Cost Approach
IS = Indirect Substitute Approach
[ ] = Valuation Methodology to be used with care

Source : Adapted from Barbier(1994)

value, or a preservation value[1] Despite the apparent importance of nonuse values for wetlands, there exist several theoretical and methodological issues. Those include embedding problem (part-whole or disaggregation bias), theoretical problems to separate. the use and non-use components from individuals' holistic value assessments, and application of non-use values to unfamiliar and complex commodity like coastal wetlands.

2.2 Empirical Studies on Nonuse Values

Empirical studies on nonuse values provide some empirical support for the hypothesis that individuals hold values for some aspects of natural resources that are independent of their use of specific resources. All of the studies tabulated in the Appendix I have been based on some variation of CVM[2]. These studies can be classified either by the type of natural resource attributes they have valued or by the structure of the contingent valuation instrument and how nonuse values have been identified. These studies have been used to estimate the values for specific locations or sites such as rivers or wilderness areas, individual characteristics of these sites such as water quality or visibility, and the preservation of viable populations of a number of species of fish, birds and mammals.

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1) Fisher and Raucher(1984) use the term “intrinsic value” which is the sum of option value, aesthetic value, existence value, and bequest value. Sutherland and Walsh(1985) use “preservation value” that refers to the sum of option, existence, and bequest values.

2) Adamowicz, et al.(1998) used choice experiments of conjoint methods in measuring passive use values for a woodland caribou habitat enhancement as an alternative method of CVM.

Table 1 lists the studies classified by the type of natural resources valued for which empirical studies on natural preserve and water quality were primarily conducted, and shows the specific elicitation method for WTP. These include direct question (open ended or referendum : OE) and dichotomous choice methods(DC) which are widely used to estimate the nonuse values. Even though DC method was recommended by the NOAA Panel (Arrow et al., 1993) rather than OE question method or iterative bidding method, experimental studies have found that DC questions tend to higher values than the OE format (Bateman et al., 1995; Hoehn and Randall, 1987). In addition, mail and personal interview survey methods are mostly employed. Apart from the tradeoffs between the mail and telephone methods and the more expensive in-person technique, NOAA suggests personal interview method, if conducted professionally, is likely to yield the most reliable results, and shows that payment vehicle for nonuse valuation generally introduces special tax, fee, and contribution, of which contribution seems to be conservative from a view of the scale of their estimated values.

Table 1. Characteristics of Previous Empirical Studies for Nonuse Values

Classification		Frequency
Research Trend in the Types of Natural Resources	Wetland	3
	Natural Preserve	10
	Endangered species (bird)	8
	Visibility	1
	Wilderness Areas	2
	Fisheries	3
	Water quality	10
	Air quality	2
	Forest	2
	Disaster	2
WTP Elicitation Method	Direct question (OE or referendum)	20
	Dichotomous choice (DC)	19
	Bidding	6
	Payment card	8
Survey Instruments	Personal interview	18
	Mail	23
	Telephone	4
Payment Vehicle Methods	Tax	15
	Contribution	10
	Fee	14
	Others	4

Source : calculated from Appendix 1

Table 2 shows that nonuse values occupy 30% to 85% of total value in which a rough portion of nonuse values may be referred to 50% out of total value. This means that nonuse values is no less than use value in terms of magnitude.

There are several approaches to measure the nonuse values of natural resources. The most straightforward approach is to ask the total value of the resource to nonusers of the specific resource. Second approach is to ask individuals about the total value of the resource users and nonusers. The total value perceived by nonuser group must be nonuse value. Third approach is to use a question to determine respondents' total values for the resource and then to ask respondents to allocate this total value between use and various nonuse categories (Freeman, 1995).

Table 2. Ratio of Nonuse Value vs. Total Value

Study	Natural Resource	Survey Method	Elicitation Method/ Payment Vehicle	Nonuse (A)	Total Value (B)	A/B
Boyle & Bishop (1987)	Bald eagle, Striped shiner	Mail	DC/ Membership Fee	Bald eagle: $4.92 28.38, Shiner: $1.00-5.66	$6.50-75.31	0.41, 0.08
Greenlay *et al.* (1981)	Water quality	Personal	Bidding/ Sales tax	$42 (for nonusers)	$67 (for users)	0.63
Kaoru (1987)	Water quality	Mail	OE/ Contribution	$97	$130.69	0.74
Kay *et al.* (1987)	Salmon restoration	Mail	OE for users DC for nonusers/ Tax	$38.26	$70.19	0.55
Langford *et al.* (1992)	Monkseal	Personal	OE / Tax	$3.15	$10.48	0.30
Silberman *et al.* (1992)	Beaches	Personal	Bidding/ Contribution	$9.26 for nonuser	$15.10 for user	0.61
Smith & Desvousges (1986)	Water quality	Personal	OE, Payment card, bidding/ Tax	$14-53 for nonusers	$21-58 for users	0.85
Sutherland & Walsh (1985)	Water quality	Mail	OE/ Fee	$56.79	$64.16	0.89
Walsh *et al.* (1984)	Wilderness areas	mail	OE/ Fee	$13.92	$27.92	0.50

Source : calculated from Appendix 1

Cummings and Harrison(1995) develop two arguments about measuring the components of total value estimates separately. First many prominent studies (Brookshire, Eubanks and Randall, 1983; Schulze et al., 1983; and Greenley et al., 1981) demonstrated that existence values can be measured and that they are large relative to total values that individuals may hold for environmental goods. In spite of their effort to explore new ground in the area of valuing non-market goods, these studies did not provide compelling evidence that separable motive-related values can be measured or that existence values are in any sense large relative to total values. Secondly, another comment is primarily focused on an assumption that use-related questions elicit only use-related values, and nonuse related questions elicit only nonuse related values (Sutherland and Walsh, 1985; Walsh et al., 1984; Walsh et al., 1985; and Walsh et al., 1987).

The following assumptions are implied by this decomposition approach. First, subjects Valuing the environmental resources can have only value-motives related to use, option, existence and bequest, as these motives are perceived by the investigators. Second, subjects know values associated exclusively with each of these motives. Just how subjects might differentiate between values described in questions for nonuse subjects is surely questionable. As pointed out by Freeman(1992), such allocation approaches do not have any theoretical justification. Cummings and Harrison(1995) suggests the following conclusions. First, there is no argument with the concept of nonuse values per se. Second, there exists no operationally meaningful way to decompose total value into use value and nonuse value

components, and to further decompose nonuse value into motive-related components. We can observe values, but we cannot observe motives. Third, while nonuse values of a nonuser might be obtained as the total value reported by such subjects, the state-of-the-art for empirical decompositions of a resource user's value for an environmental good into use and nonuse components is not at all well advanced in valuation methodology.

McConnell(1997), however, argues that plausible motives strengthen the case for existence value. Motives may range from a broad concern for the natural order to a desire to save higher mammals, or to altruism, the desire to preserve, protect, and enhance natural resource for the well-being of others. When paternalistic alturism prevails, existence value plays a role in determining whether or not benefits exceed costs. Lazo, et al. (1997) also show paternalistic altruism and current overuse of a natural resource provide theoretically appropriate motives for bequest values.

3. MEASUREMENT METHOD : CVM

The cornerstone principle in measuring the conservation value of environmental resource is the concept of consumer's WTP for the resource (Brent, 1995). This concept represents the amount people would be willing to pay to avoid a specified environmental damage, to achieve a stated improvement in environmental quality, or to receive a specified supply of a public good. The WTP principle

makes good intuitive sense. If an additional unit of a particular air pollutant, for example, causes a person $10 of extra cleaning expenditures, then the person would normally be willing to pay up to $10 to avoid such an increase in pollution. Moreover, the WTP concept is not only consistent with the tenets of modern welfare economics, but is also related to the actual benefits of a given proposal (Fisher, 1996).

The major objective of this study is to measure the economic benefits of conserving tidal flats for the residents of Seoul aiming to provide policymakers with at least a preliminary evaluation of conservation policy. To this end, this study employs a survey approach called contingent valuation (CV) method. CV is a standardized and widely used survey method for estimating WTP for use, option, existence, and bequest values (Mitchell and Carson, 1989). CV method involves constructing a hypothetical market or referendum scenario in a survey. The proposed increase (if respondents pay) or decrease (if respondents do not pay) in the quantity or quality of a resource is communicated to respondents in words and with visual aids. Next, respondents are informed of how much they should pay for the proposed quantity or quality. Then the provision rule is clear: if you agree to pay, you get the proposed quantity or quality; if you do not pay, you remain at the current quantity or quality level. Respondents use the hypothetical market to state their WTP or vote for or against a public program at a particular tax price (Loomis, 1996).

The technique of using statements of value from a survey as a

measure of WTP has its critics. The obvious concern is validity: would respondents actually pay the monetary amounts they state in the survey? There have been several approaches to testing the validity of stated WTP. These include comparison of values derived from CV surveys with values obtained from actual behaviour valuation methods, such as the travel cost method (Bishop and Heberlein, 1979), the hedonic price method (Brookshire et al., 1982), and actual cash (Bishop and Heberlein, 1979).[3] These studies indicate that when surveying users of resources, CV values can be equal to or at least not more than 25% greater than actual WTP values. Evaluating the validity of survey responses of those who do not use the resource, hence who have no easily observable valuation behaviour toward the resource in question, is much more difficult, and acceptable experimental designs have yet to be formulated. While there are legitimate concerns about the accuracy of the CV estimates of WTP for natural resources with which the public is unfamiliar, the method has been shown to be reliable in empirical studies (Kealy et al., 1988; Loomis, 1990). The accuracy of CV method results is tied, in part, to the accuracy and unbiasedness of information contained in the survey and survey implementation (Gonzalez-Caban and Loomis, 1997).

Governmental agencies have recommended using CV to perform CBA (U.S. WRC, 1983) and to value natural resource damages (U.S. DOI, 1986) and its use was upheld by the U.S. courts (SO

3) A good review on the validity of CV method is found in Bishop *et al.* (1995).

vs. US DOI, 1989). More recently, a blue-ribbon panel, including two Nobel laureate economists, concluded that CV method can produce estimates reliable enough to be the starting point for administrative and judicial determinations (Arrow et al., 1993). In addition, CV method would seem to fit very comfortably within the traditional concept of microeconomics, anchored squarely in individual preferences. Under the CV method, an appeal is made directly to citizens to evaluate various policy options. Ordinary citizens are those who will, in the end, bear the costs and reap the benefits of any policy option; who is better, then, to make the decision, or at least have a direct influence on the decision? Such a framework is especially desirable because any attempts to conserve tidal flat may fail without strong public support (O'Doherty, 1996).

4. MODELING WELFARE MEASURES IN DICHOTOMOUS CHOICE VALUATION METHOD

4.1 Basic Model

The utility difference model used by Hanemann (1984, 1989) provides one method for developing Hicksian compensated measures from DC-CV data.[4] The observed discrete choice response of each individual is assumed to reflect a utility maximization process. The indirect utility function, v, for each respondent depends on income

4) Alternately, the WTP-function approach to DC-CV models was discussed by Cameron and James (1987).

along with individual characteristics and the quality of the resource to be valued.

The respondent will pay the increased bid amount to use a resource if

$$v(1,m-A;S)+\varepsilon_1 \geq v(0,m;S)+\varepsilon_0, \qquad (1)$$

or

$$\Delta v(A) \equiv v(1,m-A;S)-v(0,m;S) \geq \varepsilon_0-\varepsilon_1, \qquad (1')$$

where state 0 represents no access to the resource or site and state 1 represents access when the respondent must pay the stated bid amount, A, and income is m. Random elements which influence the respondent's indirect utility function are defined by ε_0 and ε_1 which are independent and identically distributed random variables with zero means. Other observable attributes which influence preferences are represented by S and also appear in the utility difference specification.

Each respondent will maximize utility by answering "yes" and agree to pay the bid amount, if the difference in indirect utility (Δv) from paying and having continued access to the resource is positive. Using equation (1′), the utility difference model yields the single equation binary response model specification when the probability of a yes response is a random variable whose probability is given by:

$$\Pr\{\text{response is"yes"}\}=\Pr\{\Delta v(A) \geq \eta\}=F_\eta[\Delta v(A)], \qquad (2)$$

where $\eta = \varepsilon_0 - \varepsilon_1$ and $F_\eta(\cdot)$ is the cumulative distribution function (cdf) of η· A yes response is observed when $\Delta v \geq 0$ while a no response to the CV question is observed when $\Delta v < 0$. We recognize WTP (hereafter denoted *C*) is a random variable with a cdf defined here as $G_c(A)$. As an alternative to (2), the probability can be expressed as:

$$\Pr\{\text{response is"yes"}\} = \Pr\{C \geq A\} \equiv 1 - G_c(A), \qquad (3)$$

thus, we obtain:

$$1 - G_c(A) \equiv F_\eta[\Delta v(A)]. \qquad (4)$$

This result indicates that the fitting of the binary response model (2) can be interpreted as estimating the parameters of the distribution function. We define the WTP for the change from state 0 to state 1. When can be positive or negative the mean (hereafter denoted) from the utility difference model are calculated as:

$$C^+ = E(C) = \int_0^\infty [1 - G_c(A)]dA - \int_{-\infty}^0 G_c(A)]dA. \qquad (5)$$

In addition, the median WTP (hereafter denoted) is obtained by solving for in the following equation:

$$G_c(C^*) = 0.5. \qquad (6)$$

If WTP must be greater than or equal to zero, the mean WTP

(hereafter denoted C^{++}) is:

$$C^{++} = \int_0^{\infty} [1 - G_c(A)]dA. \qquad (7)$$

4.2 Conventional DBDC Model

This section focuses on theoretical aspects of discrete response surveys. The discrete valuation question asks the respondent to accept or reject a suggested bid for a given environmental change. The single-bound dichotomous choice CVM, pioneered by Bishop and Heberlein(1979), is related to only one dichotomous choice question about the threshold dollar amount, that is, only yes or no responses while the double-bounded dichotomous choice method (DBDC)[5], first proposed by Hanemann(1985), is involved in two rounds of bidding: respondents are asked a first and second dollar amount questions. In practice, if a respondent indicates a willingness to pay the first offered amount, the new threshold is about double the first one. If the respondent is unwilling to pay the first offered amount, the second threshold is reduced to about half the original one (Cameron and Quiggin, 1994). Double-bounded model shows statistically more efficient estimates than single-bound approach because the latter requires a larger sample to attain a given level of precision (Hanemann, *et al*., 1991).

There are the different structures of the models developed by

5) Cameron and Quiggin(1994) called it double-bounded referendum approach or dichotomous choice with follow-up question method.

Hanemann(1984) and adopted by Cameron(1988) to estimate welfare functions and calculate welfare measures. The Hanemann's model is based on the difference in indirect utility functions while the Cameron's response model is focused on the difference in cost functions.[6] Alberini (1995) conducted a Monte Carlo analysis of the bivariate normal model and the normal version of the model. And she found that the standard double-bound or interval data model of Hanemann, *et al*.(1991) is often superior to the bivariate model of Cameron and Quiggin(1994) in terms of the mean square error of the estimates and that the interval-data estimates of mean or median WTP are always more efficient than those obtained by fitting a bivariate probit model, even though Cameron and Quiggin(1994, 1998) claim that estimation by interval-data models can produce misleading inferences if bivariate model is the appropriate specification.[7]

This section, therefore, treats the theoretical aspects of DBDC-CV surveys based on Hanemann et al. (1991). The DBDC-CV question asks the respondent to accept or reject a suggested bid for a given environmental change. When each respondent is presented with two bids, there are four outcomes: : (a) both answers are "yes" (Yes-Yes);

6) For more detailed comparison of Hanemann and Cameron's models, see McConnell (1990) and Alberini(1995).

7) Cameron and Quggin (1994) treated the responses to the two bids as though they were valuations of separate items, employing bivariate normal setting. They argued that interval data models assumption–that the first and follow-up questions are identical value distributions and are driven by a single WTP amount–is implausible. This assumption also precludes an assessment of the starting point (the first bid response) effects.

(b) both answers are "no"(No-No); (c) a "yes"followed by a "no" (Yes-No); and (d) a "no" followed by a "yes"(No-Yes) whose binary-valued indicator variables are I^{YY}, I^{YN}, I^{NY}, and I^{NN}, respectively such that:

$$\begin{aligned} I_i^{YY} &= 1(i\text{th respondent's response is "Yes-Yes"}) \\ I_i^{YN} &= 1(i\text{th respondent's response is "Yes-No"}) \\ I_i^{NY} &= 1(i\text{th respondent's response is "No-Yes"}) \\ I_i^{NN} &= 1(i\text{th respondent's response is "No-No"}) \end{aligned} \tag{8}$$

where $\mathbf{1}(\cdot)$ is an indicator function, which is one if the argument is true and zero otherwise.

Given the assumption of a utility-maximising respondent and a sample of N respondents, where A_i is the first bid, $A_i^u (A_i < A_i^u)$ is the higher second bid when the individual responds "Yes" to the first bid, and $A_i^d (A_i < A_i^d)$ is the lower second bid when the individual responds "No" to the first bid, used for the ith respondent, the log-likelihood function takes the form[8)]

$$\begin{aligned} \ln L = \sum_{i=1}^{N} \{ & I_i^{YY} \ln[1-G_c(A_i^u)] \\ & + I_i^{YY} \ln[G_c(A_i^u) - G_c(A_i)] \\ & + I_i^{NY} \ln[G_c(A_i) - G_c(A_i^u)] \\ & + I_i^{NN} \ln G_c(A_i^d)] \} \end{aligned} \tag{9}$$

8) For more detailed procedure to derive this function, see Hanemann, *et al*. (1991).

Following the practice of former studies, formulating $F_{\eta}(\cdot)$ as logistic the cumulative distribution function(cdf)[9] and combining this with $\Delta v = a - bA$ yields:

$$G_c(A) = [1+\exp(a-bA)]^{-1} \quad (10)$$

we can measure the mean and median WTP based on (5), (6) and (10) as follows:

$$C^{+} = C^{*} = a / b, \quad (11)$$

and

$$C^{++} = (1/b)\ln[1+\exp(b)]. \quad (12)$$

4.3 Spike Model

A typical characteristic of WTP for a resource is that many respondents would not be willing to pay anything for it (Yoo *et al*., 2000). There are goods that contribute negatively to some consumer's utility for various reasons. As a simple example, if people are asked about improving a salt water pond's water quality to the point that shellfish taken from it would be edible, there may be individuals in the sample who use the pond for other recreational activities that would be hindered by the presence of people shellfishing.

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9) Bishop and Heberlein(1979) alternately use the log-logistic cdf : $G(A) = [1+e^{a-b(\ln A)}]^{-1}$

In addition, anyone who enjoys quietness around and on the pond also might want to be paid a certain amount to allow the ponds to be made shellfishable. In short, not every "public effect" is on net good to every affected person, but anticipating the varieties of reasons for the negative valuation is at least difficult if not impossible (Kwak *et al*., 1997).

In practice, zero values are often found in CV studies using open-ended valuation questions (Mitchell and Carson, 1989). In our sample from a CV survey relating to WTP for conserving tidal flats, this is the case for 42.1% of all observations. The zero responses in the sample often complicate modeling household behavior and examining the process generating a household's WTP (Donaldson *et al*., 1998). In order to deal with the problem and fully utilize the information in this database, the analysis should consider the fact that some households would not be willing to pay for the conservation policy. In this case, a more flexible specification of the WTP is required. One possibility is to use spike models suggested by Kristrom (1997). The spike models take into account a spike at zero which is the truncation at zero of the negative part of the WTP distribution.

Thus, we can use a spike model when dealing with our DBDC-CV survey data with zero observations. To this end, the spike model is modified to so that DBDC data can be used because only a SBDC data was used in Kristrom's original paper.[10] We note that the

10) Alternately, An and Ayala (1996) and Werner (1996) used mixture models of WTP distributions to allow a point mass at zero.

"No-No" respondents are composed of two sets of agents: those who really have a zero WTP, and those who have a positive WTP that is less than A_i^d. For people who gave a "No-No" response, a third follow-up question was asked: "Are you willing to pay anything at all?" Those providing a "No" answer to this question represent a valid representation of their value or reflect a protest about some feature of the hypothetical market (Mitchell and Carson, 1989). Thus, the answer to the question allows us to estimate the spike model. That is, "No-No-No" answers are taken as zero responses.

For each respondent i, I_i^{NN} in equation (8) is classified into I_i^{NNY} and I_i^{NN} such that:

$$\begin{aligned} I_i^{NNY} &= 1(i\text{th respondent's response is "No-No-Yes"}) \\ I_i^{NNN} &= 1(i\text{th respondent's response is "No-No-No"}) \end{aligned} \tag{13}$$

To estimate the distribution of WTP, we assume that WTP is distributed as a logistic on the positive axis. The log-likelihood function for the spike model with no covariate is given by:

$$\begin{aligned} \ln L = \sum_{i=1}^{N} \{ & I_i^{YY} \ln[1-G_c(A_i^u)] \\ & + I_i^{YN} \ln[G_c(A_i^u) - G_c(A_i)] \\ & + I_i^{NY} \ln[G_c(A_i) - G_c(A_i^u)] \\ & + I_i^{NNY} \ln[G_c(B_i^d) - G_c(0)] + I_i^{NNN} \ln[G_c(0)] \} \end{aligned} \tag{14}$$

where:

$$G_c(A) = \begin{cases} [1 + \exp(a - bA)]^{-1} & \text{if } A > 0 \\ [1 + \exp(a)]^{-1} & \text{if } A = 0 \\ 0 & \text{if } A < 0 \end{cases} \qquad (15)$$

Thus, the spike is defined by $\ln[1+\exp(a)]^{-1}$. Using (5), (6), and (13), the mean and median WTP in spike model can be calculated as:

$$C^{+} = \ln [1+\exp(a)] / b \qquad (16)$$

and

$$C^{*} = \begin{cases} a/b, & \text{if } [1 + \exp(a)]^{-1} < 0.5 \\ & \text{otherwise} \end{cases} \qquad (17)$$

respectively.

If we would estimate the model with covariate, in former equations, a is simply replaced with $a + x_i'\beta$. Maximum likelihood (ML) estimation procedure can compute parameters and standard errors derived from analytic second derivatives by using the likelihood function for observations. Mean and median WTP for welfare measure can be easily derived when parameters are computed by ML procedure.

Hanemann(1984) argued that the mean is very sensitive to slight changes in the shape of the distribution resulting from different

estimation method or outliers in the data, while the median is relatively robust measure of central tendency. For this reason, median may be more reliable than mean. Johansson, *et al*.(1989), however, in a comment on Hanemann, argued the mean should be the preferred measure because it can be shown that the mean is consistent with Pareto-efficiency while, in general, the median is not. In addition, aggregating a median estimate does not have the natural interpretation available for the mean estimate while multiplying the mean estimate by the population size gives the total value. Of course, the choice between the use of the mean versus the median arises in any type of contingent valuation study. A particular value judgment arises within a discrete choice experiment because one is usually forced to impose a distributional assumption on WTP (Kristrom, 1990).

5. METHODOLOGICAL ISSUES ON SURVEY

5.1 The Resource to be Valued

The CV questionnaire was designed to evaluate the value of coastal conservation by asking respondents for the amount of money that they would be WTP to maintain the current level of conservation quality of the coastal wetlands areas around Youngsan River.

The Korean Government in 1998 undertook an economic appraisal of a coastal wetland development project in the areas shown in the

Figure 2. The project was delayed because of economic crisis of 1997 and the strong protest of NGOs. According to a conventional CBA the project was expected to yield an NPV of $146.7 million with a social discount rate of 10%, and an IRR of 10.97%. As shown in Table 3, a key feature of the project is to convert the wetland into agricultural and industrial lands.

Figure 2. Location to be Reclaimed around Youngsan River

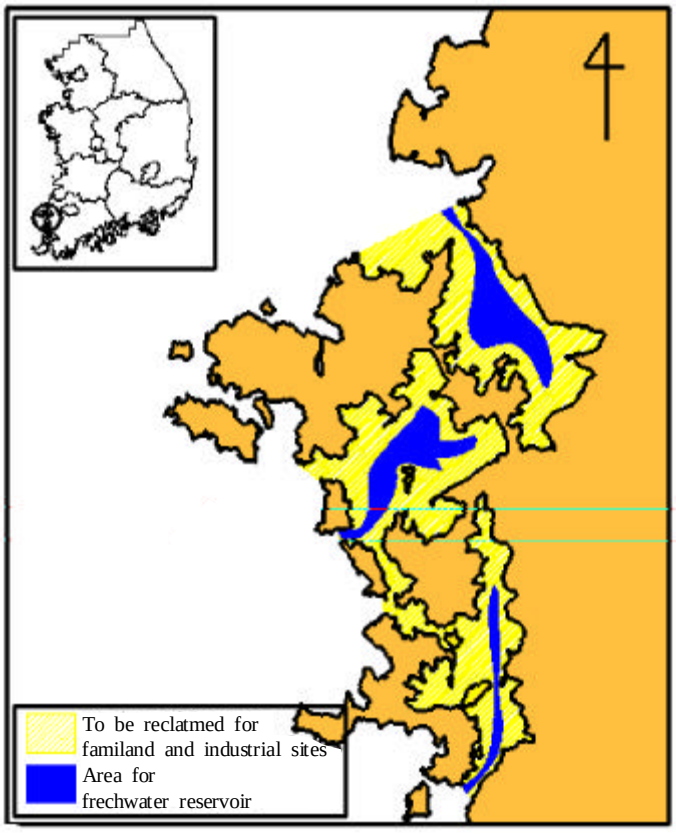

Table 3. Reclamation Project of Coastal Wetlands around Youngsan River

Classification	Amount
1. Area	
·Reclaim area	·33,560 ha
— Reclaim land	— 21,690 ha
— Freshwater Reservoir	— 11,870 ha
·Development area	·39,040 ha
— Farmland	— 16,450 ha
— Hinterland	— 17,350 ha
— Industrial site	— 5,240 ha
2. Major facilities	
·Freshwater Reservoir	11,870 ha
·Embankment	13 trillion and 42km
·Docks	7
·Waterway	27km
·Pumping stations	22
·Irrigation channel	72 trillion and 508 km
·Access road	6 trillion and 20 km
·Pumps for removing salt	3
3. Effects of the Project	
·Water resource	570 million ton
·The loss of coastline	160 km
·Inland transportation improvement	30 km
·Farmland creation	16,450 ha
·Industrial site creation	5,240 ha
4. Total project cost	$111,997.3 million
5. Project period	15 year

Source : Korea Industrial Research Institute(KIRI), 1998

5.2 Sampling and Survey Methods

The data on household WTP for conserving tidal flats around Youngsan River used in this analysis come from a survey of households conducted by the Dongseo Research Inc. in 1999. The survey was conducted for heads of household or housewives whose ages range from 20 to 65. The survey was restricted to the residents of Seoul, the capital of Korea, whose population is one-fourth of the entire national population. In order to draw a representative sample of the population by Dongseo Research, Inc. extracted a stratified sample of twenty-five districts in Seoul, and then randomly selected respondent households within each district.

We employed person-to-person interviews for the CV survey for cultural or practical reasons. First, we felt that randomly chosen Korean citizens would be even less likely than Europeans and Americans to be familiar with the idea of supplying unprompted values for proposed environmental goods if they were confronted with a telephone interview or mail survey questions. However, person-to-person interviews with well-trained interviewers can offer the scope for detailed questions and answers. In this regard, we selected 60 of the most experienced of the polling firm's interview experts to conduct the interviews. Second, a telephone interview was the least preferred method because conveying information on the goods may be difficult over the telephone, partly because of the respondents' limited attention span. Finally, mail surveys are rarely used in Korea because they suffer from non-response bias and extremely low response rates; thus it seemed especially risky to use in the

context of Korea.

The person-to-person interviews were done at respondents' home during August and September 1999. Interviewers visited the third houses from the house of Tong-Jang, subdivision's head of the areas selected for sampling until the quotas needed were completed. If the house visited was vacant, the interviewers would move to the next door in the block. Team Supervisors checked the completed questionnaires, and conducted surveys for different interviewers again, when errors were found.

5.3 Survey Development

In order to identify the technical information and attributes of tidal flats, Delphi techniques, which involve consultation with forty environmental scientists, were conducted for this study. And then with the leading market research firm, focus group sessions were held to evaluate participants' perception of the tidal flats and describe the characteristics of tidal flats in a way that was understandable and realistic to the public. As a result, questionnaire and visual aids were made easier to understand the general information about tidal flats was simplified because participants' awareness of the importance of tidal flats was high. Professional interviewers were trained to conduct personal interviews for pre-test on forty residents in Seoul. One of the goals of the pre-test was to obtain benchmark prese- rvation values (i.e. the range of bid amounts) for the dichotomous choice method employing open-ended questions.

The survey instrument (questionnaire) was set up with the assistance

of experts at the polling firm. Questionnaires should be pre-tested before the survey occurs. This pre-testing was done using small focus groups (50 persons) assembled to discuss their understanding of and reaction to the questionnaire prior to a pilot study. The final version reflected these focus groups' input as well as advice from experts at the survey firm employed to organize the fieldwork. The survey instrument listed a brief explanation of the purpose and contents of the interviews, clarified the context of the policy decision by providing general background information on tidal flats in Korea.

5.4 Survey Structure

In designing a CV survey, a scenario should offer respondents the information about the characteristics of the specific good and the context which meets the requirements of understandability, plausibility, and meaningfulness so that it can enhance the credibility of the survey and make it more likely to produce reliable results.

The questionnaire format consists of (i) introductory questions like respondents' perception after general background information on tidal flats; (ii) respondents' attitudes towards various characteristics of tidal flats; (iii) monthly WTP question for proposed project, counter-plan against tidal flats impairment; and (iv) household information.

General background information on Korean tidal flats includes the definition, nature, function and role, and conservation value of Korean tidal flats with the distribution map of Korean tidal flats. And then respondents are asked about frequency and preferred coast

of their visit, and important degree of tidal flats conservation compared with other environmental problems such as air pollution, water pollution or waste problems. Additionally with ten categorization of tidal flats function respondents' attitudes are checked.

Before the key WTP questions were asked, the questionnaire was used to attempt to construct the general situation of the contingent market. It did so by showing the specific tidal flats area around Youngsan River, and explaining their characteristics and situations under development pressure for agricultural, industrial and other uses by reclamation, and their negative and positive aspects of the development. After that, respondents are suggested how to conserve the tidal flats such as cancellation of reclamation and landfill, the construction of waste treatment plants, continuous monitoring system, and so on.

We also presented a detailed description of what is known about the likely effects of the hypothetical policy change and, importantly, what is likely to happen if nothing is done. Among other things, this description could spell out the beneficial effects expected to result from the conservation of tidal flats and where and when those benefits will occur. Examples of benefits include: fishery for a living; recreation or leisure such as sea fishing, sea bathing, digging clams, and seeing migratory birds; purifying pollution from land; and mollifying a natural disaster such as a flood or a typhoon.

Moreover, this study strove to present the sample households with the best information possible about where the negative effects of landfill or reclamation would be felt by providing several well-illustrated

visual cards. The descriptive material presented to respondents also included a description of how the proposed policy intervention would work. It explained, for example, how a tax laid on various products would translate into increased prices for clothes, electricity, and other products not initially subject to the tax, but making use of the taxed products as inputs. Finally, household information includes monthly recreational and environmental expenditure, income, age, education, gender, membership of environmental organizations, occupation, and so on.

5.5 Elicitation Method

The elicitation format employed in this study is a dichotomous choice (DC) question according to the "blue-ribbon CV panel" of Arrow *et al*. (1993), which strongly endorsed a DC question rather than an open-ended question.[11] The DC model has had great appeal since it was popularized by Hanemann (1984). Typically, a random sample of the population is asked a "yes" or "no" question identifying their willingness to contribute a specific amount toward the preservation of some environmental resource or the provision of a public good. The question format is usually called the single-bounded (SB) question because it asks a respondent only one close-ended question. Among its merits, apparent incentive compatibility and the

11) The most common criticism of the open-ended format is that it puts pressure on respondents to determine a value, thus tending to produce an unacceptably large number of non-responses or protest zero responses to the WTP questions (Mitchell and Carson, 1989).

elimination of protest bids rank high.

Specifically, the double-bounded (DB) question (Hanemann, 1985) employed in this study is a frequently used elicitation method in DC-CV studies. Hanemann *et al*. (1991) demonstrate the dramatic increase in efficiency associated with this method. A DB question presents each respondent with a sequence of two bids and asks for a "yes" or "no" vote as to whether the respondent's WTP equals or exceeds each bid. The second bid is conditional on the respondent's response to the first bid; it is lower if the first response is "no" and higher if it is "yes". The gain in statistical efficiency arises from the series of WTP questions that allow the researcher to bracket many of the respondent's WTP amounts between two of the monetary bid amounts.

The results of pre-test for focus groups were used to refine the range of bid amounts for the DC WTP questions. Respondents were assigned randomly to four subgroups, with each subsample being asked to respond to a different set of bids (in Korean won).[12] The sets of the first original bids used in this study were: 1,000, 2,000, 3,000, 4,000, 5,000, 6,000, 7,000, 8,000, 9,000, 10,000, 11,000, 12,000, 13,000, 14,000, 15,000, 16,000, 17,000, 18,000, 19,000, and 20,000. The second bid is double the first bid if the respondent's response to the first bid is "yes" and half the first bid if it is "no". In order to randomly assign the twenty different bid amounts, they generate the random number for fifty sets, and then put random ordering in each set.

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12) US $1 is assumed to be about equal to 1,000 Korean Won.

5.6 Payment Vehicle

The payment vehicle used for this study included general taxes, such as a tax laid on various products usually purchased and an income tax, which are likely to be familiar to most respondents. It also has a plausible connection with the proposed conservation program to be valued, because they are the main source of covering the cost involved in the program implementation. Despite its high level of familiarity and obvious connection with the good being considered, it may encourage respondents to restrict their WTP amounts to the range associated with a fair or customary expenditure (Mitchell and Carson, 1989, pp.221 222). Therefore, donation to a conservation fund of tidal flats was included as an additional payment vehicle.

The WTP question was "Would your household be willing to pay a given amount in higher indirect tax and income tax, or donating to conservation fund each month for the tidal flats conservation program, provided that the success of this policy is guaranteed? If you would not pay, it is difficult to conserve the tidal flats" Regarding the definition of the costs that the households themselves were likely to bear, they were told that, "The amount you indicate will tell us what it is really worth to your household to have the policy implemented. If the policy actually costs less than people are willing to pay, you would only have to pay what it would cost. If the policy turned out to cost more than people are willing to pay, it would not be implemented." The information given to respondents about all aspects of the hypothetical market,

together with such information as is provided on the good being valued, constitute the framing of the good.

6. ESTIMATES OF THE CONSERVATION VALUE

6.1 WTP Responses

Following the blue ribbon panel's testing protocol that a total sample size of at least 1,000 respondents is required for a DC method, a total of 1,037 personal interviews were administered by trained interviewers at respondents' homes during August and September 1999. The survey yielded 1,037 usable interviews, 37 of which were rated by enumerators as being of poor quality. Thus, the findings from the survey are based on the analysis of 1,000 interviews. Based on interviewers' comments, the WTP elicitation procedures were well within the respondents' abilities.

Table 4 presents the distribution of responses to the valuation question, indicating the total number of respondents who stated that they would be willing to pay for the conservation program at each bid level, ranging from 1,000 to 20,000 won per month. If the respondent says 'yes' to the initial question about whether he is willing to pay 1000 won, then he is asked a second question about whether to pay 2000 won or not. In the contrary, if he says 'no' to the initial question, he is asked further whether to pay 500 won or not. Focusing on the column of YY responses, we see the fifty percent of the version 1000 won sample said 'yes' and 'yes' to the

Table 4. Distribution of Responses by Bid Amount

		Number of responses				
First bid (won)	*Sample size*	*YY Votes*	*YN Votes*	*NY Votes*	*NNY Votes*	*NNN Votes*
1,000	*50*	*25*	*11*	*5*	*2*	*7*
2,000	*50*	*6*	*16*	*17*	*1*	*10*
3,000	*50*	*9*	*16*	*6*	*5*	*14*
4,000	*50*	*3*	*10*	*14*	*7*	*16*
5,000	*50*	*6*	*7*	*10*	*9*	*18*
6,000	*50*	*2*	*11*	*11*	*8*	*18*
7,000	*50*	*2*	*1*	*9*	*10*	*28*
8,000	*50*	*3*	*4*	*10*	*14*	*19*
9,000	*50*	*2*	*6*	*5*	*19*	*18*
10,000	*50*	*3*	*3*	*6*	*15*	*23*
11,000	*50*	*2*	*5*	*4*	*13*	*26*
12,000	*50*	*1*	*2*	*6*	*20*	*21*
11,000	*50*	*3*	*2*	*3*	*23*	*19*
14,000	*50*	*2*	*5*	*3*	*11*	*29*
15,000	*50*	*2*	*6*	*1*	*16*	*25*
16,000	*50*	*4*	*4*	*3*	*11*	*28*
17,000	*50*	*4*	*1*	*0*	*16*	*29*
18,000	*50*	*1*	*4*	*3*	*14*	*28*
19,000	*50*	*2*	*5*	*5*	*18*	*20*
20,000	*50*	*1*	*3*	*4*	*17*	*25*
Totals	*1,000*	*83*	*122*	*125*	*249*	*421*

Note: The second bid is double the first bid if the respondent's response to the first bid is "Yes" and half the first bid if it is "No". YY, YN, NY, NNY, and NNN indicate "Yes-Yes", "Yes-No", "No-Yes", "No-No-Yes", and "No-No-No", respectively.

two questions, implying that their WTP was 2000 won or higher. Similarly, focusing on the YN column, we see that twenty-two percent of these version 1000 subjects said ‘yes’ to 1000 won but then said ‘no’ to 2000 won. Thus we can infer that the percentage of version 1000 won samples that said ‘yes’ to the initial DC question of 1000 won was the sum of these two: 72% =50%+22%. Note that the number of “Yes” responses to the first bid amount falls, roughly, as the bid increases. For example, 36 (72%) favored the program at a monthly cost of 1,000 won, whereas only 4 (8%) approved of it at the 20,000 won level. The number of households which agreed to pay the first or second bid amount is 330 (33.0%), and the number of households which provided a “No-No-Yes” response 249 (24.9%).

Table 5. Distribution of NO-NO Response to the First and Second Bid Questions

	Number of sample	% of sample
Agree to pay the first or second bid amount	330	33.0
No agree to pay the first or second bid amount	670	67.0
Households, of which respond NO-NO to the first and second bid questions, pay more than 1 Korean won	249	24.9
Households not pay even 1 Korean won	421	42.1
Reasons why Households would not pay even 1 Korean won		
(01) The cost is too high for my household to afford.	30	3.0
(02) Polluters should pay.	47	4.7
(03) I don't trust new policy of government.	63	6.3
(04) I'm already paying enough in taxes.	220	22.0
(05) The tidal wetland is well-conserved enough.	15	1.5
(06) I don't like these hypothetical questions	8	0.8
(07) Developing tidal wetlands for multiple purposes is more beneficial than conserving them	9	0.9
(08) The environment of tidal wetlands will not be well-conserved even if development of them would be banned.	12	1.2
(09) I don't think that the conservation program is effective.	10	1.0
(10) I don't think that it is valuable to ban the development of tidal wetlands to conserve it.	5	0.5
(11) Others	2	0.2

As shown in Table 5, the percentage of households which agreed to pay the first or second bid amount is 33%, and the percentage

of households, of which respond NO-NO to the first and second bid questions but pay more than 1 Korean won, is 25%. This resulted in a total of 579 respondents (57.9%) expressing a WTP additional tax for the tidal flats conservation programme, and 421 respondents (42.1%) not being WTP additional taxes. It was a surprising result to us that 42.1% declined to pay anything toward conserving tidal flats. We think our current economic crisis and taxation policies of the government made many respondents protest or reject the notion of paying additional taxes even though they perceived the importance of tidal wetlands to conserve.

A primary concern when estimating welfare benefits through the CVM is how to interpret zero value response. As discussed above, a zero response could be consistent with economic behaviour, indicating that the individual derived no benefits from the good or faced income constraints. Alternatively a zero response could be due to an individual's rejection of some aspects of the valuation scenario, or their engaging in “free-riding” behaviour. To determine the validity of zero responses, these reasons were analyzed in Table 5. Only 3.5%(35 respondents) of these reasons suggest that the respondent's true value was zero. This includes respondents who answered that the first item –the cost is too high to afford, or the tenth one– that I don’t think that it is valuable to ban the development of tidal wetlands to conserve it. Most of the remaining categories represent protest or scenario rejection responses. The spike model, therefore, appears to be ideally suited for estimating WTP in our sample, since a sizable fraction of the population has a zero WTP.

6.2 Estimation Results

We estimated the conventional model (equation (8)) and the spike model (equation (11)) by the ML estimation method. The conventional model assumes that the third follow-up question has not been used. Table 6 describes estimation results from the DBDC data models.

Table 6. Estimation Results for Logit Models without Covariates

Variables	Conventional model	Spike model
Constant	0.0391	0.1621
	(0.46)	(2.71)**
BID[a]	0.1734	0.1900
	(17.04)**	(23.81)**
Number of observations	1,000	1,000
Log-likelihood	-1,018.1	-1,467.5
Wald statistic:[b]	1,085.8	1,383.6
(*p*-value)	(0.000)	(0.000)
Mean WTP	226	4,093
Standard error[c]	523	181
t-value	(0.43)	(22.63)
95% confidence interval[d]	[-666-1,091]	[3,482-4,403]
Truncated mean WTP	4,111	
Standard error[c]	215	
t-value	(19.13)**	
95% confidence interval[d]	[3,771-4,484]	

Note: [a] The unit is 1,000 won. [b] The hypothesis is that all the parameters are jointly zero and the corresponding *p*-values are reported in the parentheses below the statistic. The numbers in parentheses below the coefficient estimates are *t*-statistics, computed from the analytic second derivatives of the log-likelihood. ** indicates significance at the 1% level. [c] Standard errors are computed by using delta method. [d] The confidence intervals are calculated by the use of Monte Carlo simulation technique with 5,000 replications.

Using the Wald statistic, all equations estimated are statistically significantly different from zero at the 1% level. All the parameters in the spike model are statistically significant at the 1% level, while constant term in the conventional model is not. The spike is calculated as 46.0%. This is close to the observed fraction of people declining to pay (42.1%). Welfare measures are also provided in Table 6. To estimate the mean WTP, we used equation (11) in the conventional model and equation (16) in spike model. Several interesting findings flow from these results.

The conventional model gives an estimated mean of 226 won and an estimated standard error of 523. The *t*-value is calculated as 0.43, thus, we can reject the hypothesis that the mean is statistically different from zero and conclude that mean WTP is not different from zero. However, the mean in the spike model, computed as 4,093 won, is highly significant (as evidenced by the standard error of 181 and the *t*-value of 22.63). Moreover, we used the Monte Carlo simulation technique of Krinsky and Robb (1986) with 5,000 replications to get the 95% confidence intervals for the point estimates of mean WTP. The confidence interval of the mean in the spike model is quite tight, while that in the conventional model is not and even include zero. Consequently, we can conclude that the information at zero drastically decreases the standard error of the mean and makes the confidence interval derived by Monte Carlo simulation technique fairly tight in this application. These results strongly support our application of spike model when estimating WTP.

For completeness, we have used equation (12) for the truncated mean in the conventional model. Mean WTP is computed to be about 4,111 won, which is statistically significant from zero at the 1% level. In this case, it appears that there is no significant difference between the truncated mean and the mean in the spike model. The standard errors of the mean are the case. As Hanemann and Kristrom (1995) pointed out, this result can be interpreted as indicating that a conventional analysis with truncation of the integral at zero provides a reasonable approximation to the spike model. It should be stressed, however, that without information at zero it is not clear that we should truncate the integral at this point when computing mean WTP. In addition, the formula of truncated mean has an unclear interpretation and inconsistent logic (Haab and McConnell, 1997). This is why the formula is derived from allowing WTP to be negative, and then integrating over the positive range of the employed distribution. Thus, the spike model is more appropriate.

It is common to test for internal consistency (theoretical validity) in CV studies by estimating the models with covariates. Definitions and sample statistics of variables used in estimating the spike model with covariates are shown in Table 7.

Table 7. Definition and Sample Statistics of Variables

Variable	*Definition*	*Mean*	Standard deviation
KNOWLEDGE	Previous knowledge about tidal wetlands (1=Very little; 2=Average; 3=Very much)	2.082	0.562
IMPORTANCE	Importance level of tidal wetlands compared with other environmental problems (From 1=not important at all to 5= very important)	4.044	0.692
BELIEF	Degree of belief in the proposed conservation program (1=Very little; 2=Little; 3 = Average; 4=Much; 5=Very much)	3.238	0.929
RECREATION	Monthly household expenditure on recreational activities (Unit: 10,000 won)	12.210	3.548
MARRIAGE	Dummy for marriage (0=Single; 1=Married)	1.026	0.159
AGE	Age of the respondent (Number of years)	40.75	9.272
EDUCATION	Education level of the respondent in years (From 0=no education to 18=post graduate)	12.98	6.090
INCOME	Monthly household total income after tax deduction (Unit: 10,000 wona)	211.739	86.760

Table 8 reports the estimation results. Using the Wald statistic, the equation estimated is statistically significantly different from zero

Table 8. Estimation Results of Spike Model with Covariates

Variables[a]	Coefficients
Constant	-4.0670
	(-6.16)**
BID	0.2001
	(23.88)**
KNOWLEDGE	0.4946
	(3.79)**
IMPORTANCE	0.2071
	(2.55)*
BELIEF	0.4548
	(7.12)**
RECREATION	0.0799
	(2.13)*
MARRIAGE	0.9985
	(2.45)*
AGE	-0.0100
	(-1.51)
EDUCATION	0.0166
	(1.36)
INCOME	0.0007
	(1.01)
Number of observations	1,000
Log-likelihood	-1,417.14
Wald statistic:[b]	1,315.38
(*p*-value)	(0.000)

Note: [a] The variables are defined in Table 2. [b] The hypothesis is that all the parameters are jointly zero and the corresponding *p*-values are reported in the parentheses below the statistic. The numbers in parentheses below the coefficient estimates are *t*-statistics, computed from the analytic second derivatives of the log-likelihood. * and ** indicate significance at the 5% and 1% levels, respectively.

at the 1% level. On the whole, respondents accepted the contingent market and were willing to contribute a significant amount, on average, per household. This willingness varies according to individual characteristics and environmental concerns. With the exception of some variables such as AGE, EDUCATION, and INCOME, coefficients of most variables in Table 8 are significant at the 5% level and all estimated relationships are consistent with our expectation.

6.3 WTP Estimates

Table 9 presents the mean and the median estimates of monthly

Table 9. Monthly Willingness-to-Pay Based on the Spike Model

WTP	Model without covariates	Model with covariates
Mean		
WTP (won)	4,093	3,904
95% confidence interval[a]	[3,802−4,403]	[3,618−4,205]
99% confidence interval[a]	[3,750−4,461]	[3,562−4,268]
Wald statistic[b]	512.18	485.47
(*p*-value)	(0.000)	(0.000)
WTP (US$)	3.41	3.25
Median		
WTP (won)	854	847
95% confidence interval[a]	[278−1,419]	[275−1,376]
99% confidence interval[a]	[170−1,525]	[172−1,501]
Wald statistic[b]	6.23	6.47
(*p*-value)	(0.013)	(0.011)
WTP (US$)	0.71	0.71

Note: [a] The confidence intervals are calculated by the use of Monte Carlo simulation technique with 5,000 replications. [b] The null hypothesis is that the WTP estimate is zero and the corresponding *p*-values are reported in the parentheses below the statistic.

WTP per household for the spike models. Those for the spike model with covarites are calculated for the average household, conditional on the mean of covarites in our sample for the equation in Table 8. For the monthly mean value, the models without and with covariates produce 4,093 and 3,904 won, respectively. For the median value, they give 854 won and 847 won, respectively. Thus, the welfare measures are not significantly changed by adding covariates. The confidence intervals around the mean and the median are derived by the use of the Monte Carlo simulation technique with 5,000 replications.

To test whether the mean and the median are statistically different from zero, we also provide the Wald statistics and their p-values. The mean values are statistically greater than zero at the 1% level, while the median values are at the 5% level but not at the 1% level. Moreover, all the confidence intervals do not include zero. From these results, both the mean and the median values are overall significantly different from zero. However, it should be noted that confidence intervals for the mean are tighter than those for the median. Each mean is consistently larger than the corresponding median. The dramatic difference between the mean and the median vividly portrays the asymmetric distribution of conservation value of tidal flats.

6.4 Aggregating Issues on WTP Estimates

This paper estimated the conservation value of tidal flats around Youngsan River as perceived by the households in Seoul. As a final

exercise, we expand the sample values to the population estimates in order to obtain at least a preliminary evaluation of the proposed conservation program for governmental policy options. The appropriateness of the expansion relies on the representativeness of the sample frame. As described earlier, our sample frame is a stratified sample to represent demographic aspects such as geographic regions, sex, etc. Thus, if our sample is broadly representative of the population of the entire national level,[13] the sample values could be expanded to the general population and aggregated benefit estimates should be adjusted to reflect the sample percentage stating a positive WTP amount.

According to the benefit estimates in Table 9, monthly mean WTP based on the spike model with no covariates is 3,904 won per household. The 1995 Census of Population recorded 12,958,181 households in Korea. We considered several factors in calculating the expanded annual mean WTP values, which are presented in Table 10. A low estimate is calculated by multiplying the mean WTP estimate by 28.95% (=0.50 ×0.579) of Seoul's households. The assumption for this low estimate is that the true value should be divided by two in order to correct for the upward bias in hypothetical value statements (Federal Register, 1994)[14] and only

13) For more accurate estimation for WTP at the entire national level, benefit transfer technique should be applied. This paper, however, just try to demonstrate the magnitude of and implication for conservation value compared to use values.

14) Caution is advised to calibrate hypothetical values which overstate 'true' economic values. Balisttreri, et al. (1995) found that hypothetical bids exceed market values by a factor of 1.65, and Federal Register of NOAA (1994)

57.9% of the households will have a positive WTP. This is a very conservative approach. A middle estimate is obtained by adjusting the mean WTP estimate of 3,904 won by NOAA Workshop's recommendation and multiplying it by the total number of households in Korea. A high estimate is the mean WTP estimate of 3,904 won times the total households of Korea. The total annual benefits range from a low of 175,745.3 million won (US$175.75 million)[15] to a high of 607,064.86 million won (US$ 607.06 million).

The household total values can be compared to the cost of conserving the tidal flats around Yongsan Riverto to conduct the CBA on the conservation of the tidal flats. If the conservation program is socially profitable, appropriate conservation policy must be defined and implemented immediately

Table 10. Monthly WTP for Conserving Coastal Wetlands around Youngsan River

(unit : million Korean won)

Scenarios	Annual Mean WTP
Low estimate	175,745.3
Middle estimate	303,532.4
High estimate	607,064.9

Note: For the meaning of "low", "middle" and "high", see the text.

recommends that WTP values derived through CV studies be divided by two in order to correct for the upward bias in hypothetical value statements.

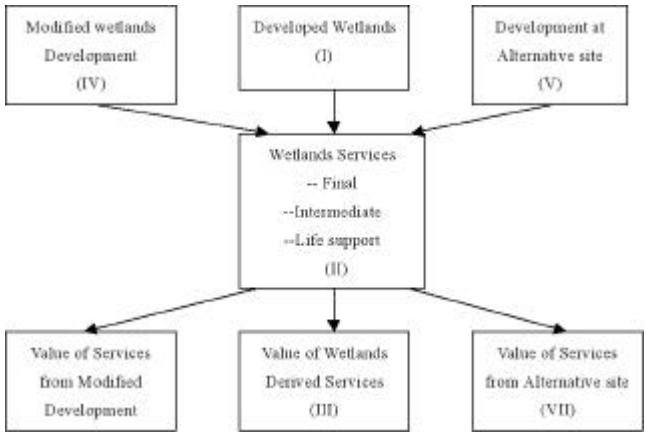
15) Calibrated WTP = [3,904 won per household and month * 12 months * 12,958,181 households * 57.9%(positive respondents for WTP)] / 2(calibrated factor)

7. A CASE STUDY FOR BENEFIT/COST ANALYSIS

7.1 Economic Value of Wetlands

Batie and Shabman (1982) formulated an economic framework for the relationship between determinants of natural wetland value (Figure 3). The basis for the establishment of wetland value is the "with and without" principle. If the value of the wetlands services vector (Box III) is different from that of modified development or development at an alternative site, then the value of wetland development is the difference between the economic surpluses earned with developed wetlands and the economic surpluses earned without the wetlands development.

Figure 3. Determination of Developed Wetlands Value



Note: Intermediate services - hunting, fishing, and birdwatching
Life support services - waste treatment

7.2 Identification of Benefits and Costs

Benefits and costs in wetland development are identified as shown in Table 11. The economic costs incurred by wetland development consist of reclamation cost including construction costs, maintenance costs, commercial fisheries losses, recreational losses, waste treatment costs, and inestimable cost. These costs are described below.

i) Commercial Fisheries Loss: The basic question is how much higher fisheries profits would be or how much better off consumers of fisheries products would be if wetlands were kept in current condition? When wetlands are converted to alternative uses such as farmland and industrial use, commercial fisheries loss can be estimated by the value of consumer surplus plus economic rent. Alternatively net economic rent, which is total revenue minus total cost, can be used as commercial fisheries loss under competitive market conditions (Tihansky and Mead, 1976). In Korean tidal flats, many commercial fisheries activities are taking place in the form of various granted fishing right or fishing license[16] under the limited entry regime.

ii) Recreational Losses: Using contingent valuation method or travel cost method, recreational losses can be estimated. In this project, however, we assume that recreational losses by wetland development were roughly offset by the newly created recreational benefits from the new freshwater reservoirs.

16) Under the fishing right various commercial resources including aquaculture, seaweed, various shellfishes, oyster, shrimp, and lugworm, etc. are produced, and under fishing license various fishes are caught.

iii) Waste Treatment Cost: It is difficult to analyze the significance of life-support system such as processing sewage, cleansing chemicals solely in monetary terms because their functions seldom have a market and the public seldom has information about the role that ecosystems play in support society (Turner *et al*., 1993). When identifying the cost of a wetland substitutes (Box **IV** in Figure 3), consideration should be given to the "least-cost" substitute. This search for the least-cost alternative is necessary since the presumption is that users of wetland services would only be willing to pay an amount equal to the least-cost way of replacing the service if it were lost (Batie and Shabman, 1982). Using the replacement cost method, waste treatment cost can be calculated. This method involves making up artificial wetlands in the project. Its investment cost is about US $84 million and annual maintenance cost US $0.42 milliom, and its carrying capacity of waste treatment is similar to that of sewage treatment plant.[17)]

17) The investment cost for a sewage treatment plant which assimilates 1,000 tons daily is $0.5million, and the wetland's capacity of waste treatment is 20kg per ha and day which is average of Odum(1989)'s estimates, 21.7kg/ha, day and Wellsbury et al.(1996)'s one, 18.3kg/ha, day.

Table 11. Classification of Benefits and Costs in Wetland Development

Benefits	Costs
1. Direct Benefits – Agricultural Production – Industrial Land – Use of Fresh Water 1. Indirect Benefits – Storm Protection – Assimilation of Water and Air Quality	1. Direct Costs – Construction Cost – Maintenance Cost 2. Indirect Costs – Commercial Fisheries Loss – Recreational Losses – Waste Treatment Cost

The economic benefits incurred by wetland development include (i) direct benefits from using agricultural and industrial land, and the uses of freshwater resource; (ii) indirect benefits from water and air pollution assimilation in rice field and rice plant, and cost savings occurred by the improvement of inland transportation, storm protection and flood control.

i) Effect of Agricultural Production: Main direct benefit in wetland development is a created economic surplus from agricultural production in the reclaimed farmland. The effects of agricultural production normally occur after 20 years which are project periods, fifteen years plus five years. Dominant commodities comprise rice for reclamation area, rye and vegetables for hinterland.

ii) Effect of Industrial Land: Developed wetlands may create land

area for industries. Observations of land sales can be used to evaluate the net land value which subtracts build-up costs from the land price.

iii) Uses of Freshwater: Two freshwater reservoirs whose size is 11,870 ha will be newly created, and they can store 570 million tons for mainly agricultural and industrial water.

iv) Storm Protection: Storm protection values focus just on the economic cost savings to the society attributable to the wetlands moderation of flood and storm damages. This project considers the reduced effect for flooding and storm damages of farmlands, which can be measured by using historical data in case of with and without embankment.

v) Water and Air Quality Pollution Assimilation: According to Kim *et al*.(1997), farmlands assimilate waste water approximately by 52.1~66.1% of nitrogen and 26.7~64.9% of phosphoric acid streamed in farmlands. Its cost saving effect obtained by replacing with waste treatment plant is US $5.58 thousand. And they also argued that rice plant has a key role in absorbing about 16.3 million tons of CO_2 from the air and providing 12.278 million tons of oxygen in the air which are converted into US $5.33 thousand per ha and year. Compared to the replacement cost for waste treatment of wetland, $3.75 thousand per ha per year, that of farmland is quite higher while the treatment cost of wetland is more than double that of farmland under the lump sum and present value base.

7.3 Results of Conventional CBA

Table 12 shows a summary of present value of benefits and costs at the discount rate of 10% over 50 years from wetland conversion to agricultural and industrial land, and freshwater reservoir development, not considering the nonuse values. In Table12, according to the replacement cost for waste treatment of wetland, Scenario 1 was calculated based upon the build-up cost of artificial wetland which is relatively quite small compared to replacement cost for waste treatment from wetland, Scenario 2 that of waste treatment plant under 10 kg per ha and day as wetland's capacity of waste treatment, and Scenario 3 under 20kg per ha and day.[18] Benefits come from agricultural production, industrial land, and assimilation of water and air quality. Major portion from the assimilation benefit of water and air quality, a sort of benefits from non-marketed goods and services can be overestimated due to a lack of scientific and agro-ecological data. In the same context, waste treatment cost from lost wetland has an important influence on economic analysis. In contrast, the build-up cost for artificial wetland in Scenario 1 is quite questionable whether or not to be made under its level of cost. The merits of preservation or conversion depend on many factors which are subject to change. As indicated here, for example, the accuracy of assimilation benefit and waste treatment cost can have an important bearing on the outcome. Further researches on method and data are unavoidable.

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18) Scenario 1 is based on KIRI (1998), and Scenario 2&3 are calculated in a view of sensitivity analysis under the basis of Odum(1989) and Wellsbury et al.(1996)'s estimates.

Table 12. A Summary of Present Value over 50 Years from Wetland Development Using Conventional CBA

(unit: thousand dollars)

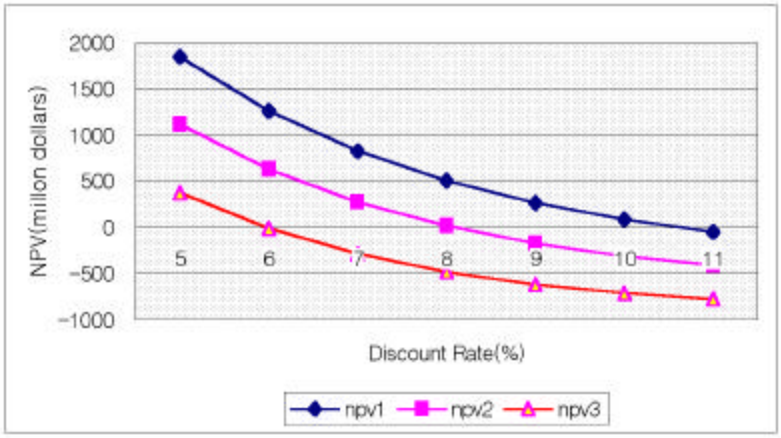
Items		Scenario 1	Scenario 2	Scenario 3
Benefits	Agricultural	424,670	424,670	424,670
	Assimilation	311,488	311,488	311,488
	Industrial use	344,962	344,962	344,962
	Water Use	20,721	20,721	20,721
	Storm Protect	18,276	18,276	18,276
	Inland Transport	102	102	102
Total Benefits		1,190,220	1,190,220	1,190,220
Costs	Construction	565,317	565,317	565,317
	Maintenance	40,851	40,851	40,851
	Artificial wetland or Waste Treatment	4,756	403,460	806,919
	Fishing Right	227,860	227,860	227,860
	Fishing License	83,284	83,284	83,284
	Community Fisheries	85,614	85,614	85,614
	Salt-Pans	28,130	28,130	28,130
	Other	68,908	68,908	68,908
Total Costs		1,104,721	1,503,425	1,906,885
NPV(discount rate=10%)		85,499	-313,205	-716,664
IRR(%)		10.6	8.1	5.9

Note: Benefits and Costs are based on KIRI(1998), but modified because of their theoretical and methodological errors. For example, the costs of fishing right, fishing license, community fisheries, salt-pans, and others are based on Korean regulatory compensation criterion. In an economic view, however, it is seriously distorted. Especially, their compensation costs except fishing right include their net benefits only of 3 years, even though they continue to occur in the future after 3 years. (for more detail, see Pyo and Chang, 1995)

Presumably wetland preservation is preferred to wetland reclamation in economic terms under Scenario 2 and 3 which case are apparently rejected with the results of negative NPVs and IRR of 8.1% and 5.9% respectively, while wetland development project appears to be accepted for economic feasibility with the discount rate of 10%, yielding NPV=$85.5 million and IRR of 10.6%. In addition, Scenario 1 is also rejected due to its negative NPV and IRR of 7.3% if both of assimilation benefit and waste treatment cost are not considered because there has strong assumption on the capacity of air and water quality assimilation from wetlands and farmland.

As shown in Figure 4, the present values of these streams decrease in proportion of the increasing discount rate. An increase in discount rates will offer a motive for wetland development more than wetland preservation.

Figure 4. NPV Curves in Conventional CBA



7.4 Results of Extended CBA

Kopp (1992) argues that nonuse values may be incorporated into CBA on the basis of Samuelsonian neoclassical welfare economics.[19] Over the years, research into CBA has sought to expand the types of benefits that can be measured in monetary terms. As environmental awareness and the perception of environmental threats have increased, much of this research has focused on resource allocation decisions involving natural resources and environmental systems (Goodman, *et al*., 1995). Especially much of the coastal wetlands of Korea has a value of amenity, aesthetic, recreational, ecological or archaeological value which can be measured as major potential costs and benefits in the project. Hence there are risks in using a conventional CBA that is narrowly defined economic appraisal methods to evaluate coastal wetland preservation or development (Parker and Thompson, 1988). An "extended" CBA takes into account the identification and quantification of all impacts including nonuse values.

A strong motivation for wetland development exists since net benefits from wetland development sometimes exceed those from preservation in a conventional economic appraisal which excludes nonuse values. An extended economic appraisal considering the value of environmental resources including preservation value, however,

19) Some economists tend to doubt the significance of values that are derived in the absence of observed behavior. Such issue of existence or nonuse value was debated by Rosenthal and Nelson(1992), arguing that existence values should not be included in CBA, and by Kopp(1992), arguing that they should be included. Another remarkably critical debate on CV method for estimating nonuse values is included in Hausman(1993)

provides more useful means to decide whether wetlands will be preserved in its natural state or be developed

In contrast with conventional CBA of Table 12, Table 13 describes the result of extended CBA adding the nonuse values to conventional CBA under the condition of the same scenarios. The extended CBA reflecting nonuse values for the first five years resulted in an IRR that is about 30% lower than that of conventional CBA, implying CBA can be heavily affected by nonuse values. The results of extended CBA shows that coastal wetland preservation is preferred to its development in economic terms even though these cases assumed to calculate nonuse values only for five years under conservative approach.

Table 13. Estimates of IRR in Extended CBA

(Unit : %)

Payment Periods of Nonuse Values	Scenario 1	Scenario 2	Scenario 3
1 year	9.56	7.40	5.50
5 years	7.32	5.73	4.23
10 years	5.92	4.56	3.23

Note : The aggregated annual nonuse values estimated in the previous section, were reflected by payment periods(1 year, 5 years, and 10 years)

7.5 Goal-Seeking Model for Nonuse Values

This part is to speculate about the impact on CBA of nonuse values by using goal seeking model.[20] In project appraisal it is the

20) Goal seeking method is to seek a desired level of performance by adjusting

standard way of dealing with situations where the magnitude of one of the variables (in this case nonuse values) is unknown. Accordingly, what the analysis tries to do is to switch from positive to negative (i.e. the switching value). In order to seek the minimum level[21] of nonuse values rejecting the project of wetland development at the given rate of social discount and other benefit andcost factors, Table 14 shows various levels of nonuse values at the national

Table 14. Estimating the Magnitude of Nonuse Values for Wetland Preservation

		Discount Rate	Payment Period			
			1 year	5 years	10 years	50 years
Nonuse Values	National Level (million dollar)	5%	1,850.0	427.3	239.5	101.3
		6%	1,262.0	299.6	171.5	80.1
		7%	828.9	202.2	118.0	60.1
		10%	85.5	22.55	13.91	8.62
	Household Level (dollar)	5%	246.6	57.0	31.9	13.5
		6%	168.2	39.9	22.9	10.7
		7%	110.5	27.0	15.7	8.0
		10%	11.4	3.0	1.9	1.1

Note : 1. For example, the figure of $246.6 represents a single payment for nonuse values at the household level, while the figure of $13.5 represents an annual payment of that amount for 50 years (i.e. an annuity) at the discount rate of 5%.

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a special variable, and it can be estimated by software such as EXCEL.

21) The minimum level is the level to reach NPV=0, and an annuity, which individual is willing to pay for wetland preservation for n years, can be calculated by the following equation(Brigham, 1980):
annuity = minimum level / $[\{1-(1+k)^{-n}\}/k]$.

and household level.[22)]

For example in Table 14, given the assumption of Scenario 1 with the social discount rate of 5% which is quite low and can be easily accepted in Korea, an aggregate gross WTP for nonuse values should be as high as or more than $1,850 million at one time in order to reject the development project, otherwise it should be annually allocated $427.3 million for 5 years, $239.5 million for 10 years, and $101.3 million for 50 years. In other hand, from a view point of each household, annual tax payment is $246.6, $57.0, $31.9 and $13.5 for each payment period. Given that–quite franklywe have only the very vaguest notion of what the magnitude of nonuse values is, in this or any other situation, it would be unwise to exclude them from any benefit-cost analysis of projects of this kind since other studies have indicated that nonuse values for wetlands are likely to be positive and non-trivial. Moreover, the root of the controversy about wetland conversion should disappear because irreversible loss would result in irrecoverable damage to society. Taking into account average nonuse value as is reviewed in empirical studies of section 2, annual payment level for nonuse value ranging from $1.1 to $13.5 for 50 years seems not to be relatively high or unrealistic.[23)] As Freeman(1993) has pointed out, there is a

22) The total amount of nonuse values at the national level represents the minimum level of aggregated estimates for the nation as a whole to reject the project, and nonuse values at the household level is annual payment per household for preservation. As noted in the previous section, 7,502,786 households(57.9% of total household) of Korea are assumed to state a positive WTP amount for preservation.

23) Bishop and Welsh(1992) argued the issue associated with adding up existence

growing consensus among most economists that people may place positive values on important natural assets they never plan to use, and they would probably not rule out the theoretical possibility of nonuse values for major natural assets.[24] Therefore, nonuse values should be treated as equivalent to use values in assessing preservation or development work with B/C analysis.

8. CONCLUSION

The ecosystem of wetlands is quite complex, and it is very difficult to estimate accurately their economic values. In summary, this study used a double-bounded dichotomous choice (DBDC) format of CVM to estimate the conservation value of Korean

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values across resources which is closely related to the project selection problem. If we added up the existence values of each of them for any given member of society, the sum would become implausibly large. For an example, if the striped shinner is worth $4 to the average Winsconsin taxpayer (the average value per taxpayer used to calculate the $12 million figure for the state as a whole) and there are 100 obscure edndangered species in Winsconsin, then would it follow that there is a value of $400 per taxpayer for all obscure endangerd species? They argued that this does not make existence values wrong or irrelevant, but it does make them more difficult to interpret for policy.

24) Smith(1987) argued that a consistent set of definitions for nonuse benefits is a necessary prerequisite for empirical implementation in B/C analysis. While this does not imply that nonuse values are unimportant, it does seem sufficient to call for caution in aggregating the estimates of option, existence, and use values available in the literature.

coastal wetlands. The conservation values were estimated based on Haneman's model and Kristrom's spike model using the maximum likelihood estimation method. Overall, respondents answered that they would be willing to pay 3,904 Korean won per month per household for conserving the wetlands under study. Provided that our sample is broadly representative of the national population, an estimate of the annual aggregated conservation value of the coastal wetlands for entire Korean households approximates 175,745.3 million won (US$175.75 million). On the other hand, a cost-benefit analysis (CBA) of the wetland development was conducted to identify how much the nonuse value affects the result of CBA. An extended CBA reflecting the estimated nonuse values resulted in an IRR that is about 30% lower than that of conventional CBA. This means CBA can be heavily affected by nonuse values. A goal-seeking model was used to evaluate the economic feasibility of wetland preservation and development, considering the nonuse values. The result shows that a wetland development project can be rejected if the annual nonuse value for the wetland exceeds 3,000 won per Korean household for the first five years. As such, nonuse values for conserving coastal wetlands are likely to be positive and non-trivial.

The results of this study provide important insights for both policy and research. For policy purposes, the results are useful starting points in understanding the possible implications of conserving coastal wetlands. This analysis provides a preliminary indication of the benefits of the conservation policy, which can be used in conventional

CBA. The main preliminary results indicate that concern about coastal wetlands is on the rise, and that people are willing to shoulder the burden to conserve coastal wetlands. There may be evidence that the public is ready to accept significant increases in prices or other costs to which conservation of coastal wetlands will lead. The results can offer a useful framework for organizing information about the consequences of alternative actions for addressing coastal wetlands. Therefore, the more broadly defined economic value of coastal wetlands lead to different policy decisions on wetland development. One strategy for wetland management may be preserve rather than develop the wetland under the current lack of full knowledge unless the expected value of wetland conversion is exceedingly large. This is especially because irreversible loss caused by development results in irrecoverable damage to the society. In order to sufficiently take into account the potential costs and benefits including the value of environmental resources in coastal wetlands, a method for extended economic appraisal needs to be developed together with a useful means to reconcile the conflicts between preservation and development of wetlands.

For research purposes, beyond the intrinsic interests of our results in relation to the proposed conservation policy, this paper has demonstrated the feasibility of extending the use of CV methods to at least the urban areas of a newly industrialized Asian nation. A highly educated population and recently developed skills in standard survey sampling and interviewing techniques provide a sound foundation on which to impose the special requirements of CV studies.

In addition, Kristrom's spike model was expanded from single-bounded dichotomous choice data to DBDC-CV data. This is a major contribution of this study to the empirical research in this field and should be played up since Kristrom's original paper used only a SBDC data.

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APPENDIX 1 : Nonuse values: empirical studies

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Bateman *et al.* (1995)	Norfolk Broads Wetlands, UK	Use, nonuse value	Personal interview, 1991	Total 3,000 OE: 862 No response: 131 DC/IB: 2,070 No response: 240	OE/ DC/ IB	OE: mean=67.19 Median=30 DC:mean=140 IB:mean=74.91
Bennett (1984)	Nadgee Nature Reserve, Southeastern Australia	Existence Value	Personal interview, 1979	Total: 544; 14.2% (77 responses) of the total was invalid. Final:467	Direct Question/ One time lump-sum payment	$0-$750; Mean=$27.08; standard Error= $68.82; Median=$5.21; mode: $0 ($10 if you exclude $0 bids)
Bishop and Boyle (1985)	Illinois Beach State Park and Nature Preserve	Use, option, and existence values	Mail survey; 1985	Total: 571; 37.1%(212 responses) of the total was invalid. Final: 359	Dichotomous choice; Bids ranged from $1-$77/ Annual membership to a private foundation	$1-$77; Weighted average mean: $27.55; Median:$16.44
Bowker and Stoll (1988)	Whooping crane	Existence Value	Mail survey and on-site survey; 1983	Total: 1,031; 28.1%(290 responses) of the total was invalid. Final: 741	Dichotomous choice; Bids ranged from $1-$130/ Annual membership to an independent foundation	$5-$149; Mean WTP=$21-$149, depending upon functional specification; estimated Median; $62-$67

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Boyle (1990)	Preservation of Illinois Beach State Nature Preserve	Total value (includes values for both users and nonusers)	Mail survey ; 1985	Total: 378; 30%(112 responses) of the total invalid. Final: 266	Dichotomous choice/ Contribution to a nonprofit foundation	WTP: $37-$41 (other functional forms give very different estimates)
Boyle and Bishop (1987)	Two endangered species in Wisconsin-the bald eagle and the striped shiner	Use and existence values	Mail survey; 1984	Total: 810. No mention of invalid responses	Dichotomous choice; Bids ranged from $1-$100/ Annual membership to a private foundation	Existence value for the bald eagle: $4.92-$28.38 /yr; striped shiner: $1.00-$5.66/yr, Total value: $6.50-$75.31/yr
Brookshire, Eubanks, and Randall (1983)	Grizzly bear and bighorn sheep in Wyoming	Use, option, and existence values	Mail survey; 1983	Total: 751 for the grizzly bear survey; 785 for the bighorn sheep survey. No mention of invalid responses	Direct question/ Annual purchase of grizzly bear (or bighorn sheep) stamp to ensure its future availability	Option value for the grizzly bear: $10.00-$21.50 /yr, bighorn sheep: $16.65-$22.90/yr. The mean was estimated using all responses
Carson (1991)	Visibility at Grand Canyon National Park	Use, option, and existence values	Personal interviews; 1990	Total: 202; 9.4% (271 responses) of the total was invalid. Final: 183	Direct question/ Higher utility bills to pay for installing scrubbers on specific power plants	$0-$360 for total visibility values; Mean WTP=$$16.15-$27.78, depending upon truncation levels;Median: $10.00

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Carson *et al.* (1992)	Injuries to Prince William Sound, Alaska, caused by *Exxon Valdez* spill	Total value (substantial portion is nonuse)	In-person interviews, 1991	Total: 1,043; 26% (271 responses) of the total was invalid. Final: 772	Double-bounded dichotomous choice using yes, no, and not sure/ One-time federal tax payment	Median WTP=$31, with 95% confidence level of $27-$36; Mean WTP=$94 with 95% confidence level of $83-$105. Eliminating protest bids (26% of sample) increases median WTP to $41
Desvousges *et al.* (1992a)	Migratory waterfowl protection in the Central Flyway and reducing the effects of oil spills	Total value (substantial portion is nonuse)	Mall intercept with a self administered questionnaire; 1991	Migratory waterfowl version: Total: 1,205;29%(350 responses) of total was invalid. Final: 855. Oil spills version (direct question format): Total: 817; 32% (260 responses) was invalid. Final: 557. Oil spills version (dichotomous choice format) : Total 790; 2%(16 responses) was invalid. Final: 774	Migratory waterfowl: direct question. Oil spills: direct and dichotomous-choice versions. Bids for dichotomous choice format ranged from $10-$1,000 also, allowed $0 bid. Higher prices each year	Migratory waterfowl version: Mean=$59-$71; Standard error =$11. Oil spills, direct question version: Mean=$81-$129; Standard Error=$9-$15. Oil spills, dichotomous-choice version: Mean=$240-$354: Standard Error=$85-$126.

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Diamond *et al.* (1993)	Protection of wilderness areas in Colorado, Idaho, Montana, and Wyoming from timber harvesting	Total value (substantial portion is nonuse)	Telephone survey, 1991	Total: 1,400; 15% (210 responses) of the total was invalid. Final: 1.190	Direct Question/ Federal income tax surcharge each year	Administered seven versions of questionnaire; Means=$29-$66 ;Standard Error=$4.40-$30.60;Median: $2.00-$10; Percentage of WTP=0:39%-45%
Duffield and Patterson (1992)	Instream flow resources to protect fisheries in Montana	Total value (existence value is significant portion)	Mail survey; 1990	Total: 1787. No mention of invalid responses	Payment card/ Trust fund	Average contribution: Residents: $2.24-$4.64 Nonresidents: $12.60-$17.36
Edwards (1988)	Potable supply of ground water in Cape Cod, MA	Use and bequest values	Mail survey; 1987	Total: 785, 25% (200 responses) of the total invalid. Final: 585	Dichotomous choice; bids ranged from $10-$2,000/ A bond with annual payments	Option prices ranged $0-$1,623 depending on probability of future supply. Bequest values increase option prices from $248-$975 probability of future supply 1.0

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Goodman *et al.* (1998)	Natural Coastal Environment, UK	Nonuse values, 1995	Personal interview	Total: 806 40 responses were invalid Final: 766; 69% (528 responses): positive WTP	OE/ one time lump-sum payment	Mean=£48.36 Median=£25 High conservation quality=£17.87
Greenlay, Walsh, and Young (1981)	Water quality for recreational use in the South Platte River Basin, CO	Use, option, existence, and bequest values	Personal interview; 1976	Total: 202. No mention of invalid responses	Bidding game: the sales tax starting point was one-half cent per dollar of expenditure; the water, sewer fee starting point was fifty cents per month/ 1. Sales tax, 2. Water/ Sewer fee	Total values for nonusers: $42/yr; Existence value: $25/yr, Bequest value: $17/yr: Total nonuse value for present users; $67/yr, Existence value: $34/yr, Bequest value:$33/yr
Halstead, Luloff, and Stevens (1992)	Wildlife preservation and protection of bald eagles, coyotes, and wild turkeys in New England	Total value (significant portion is existence value)	Mail survey; 1989	Total: 305; 32% (98 responses) of the total sample was invalid. Final: 284	Modified dichotomous choice format; Bids ranged from $5-$150/ Private trust fund	Average bid: $14.46 (with protest zero bids excluded)

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Hoehn and Loomis (1993)	Enhancing wetlands and habitat in the San Joaquin Valley in California	Total value (substantial portion is nonuse)	Mail survey; 1989	Total: 272; 8% (21 responses) of the total sample was invalid. Final: 251	Dichotomous-choice in a referendum format. Bids ranged from $25-$500 for single-program agendas, from $50-$900 for two- and three-program agendas/Taxes	Single-program values:$96.40-$184; Two-program agenda values: $178-$251; Three-program agenda values: $224-$268
Hoevengel and Linden (1993)	A clean environment around the year 2015	Total value (substantial portion is nonuse)	Mail survey, 1989	Total: 982; 9% (89 responses) of the total was invalid. Final: 893	Bidding game consisting of 6 questions. Final question was open-ended. Bids from $5.50-$55/Mandatory monthly contribution.	Mean WTP= $16.62-$29.02; Standard Error =$1.96-$4.94; Variance = $574-$1,567
Holmes and Kramer (1993)	Protection of the boreal montane forest ecosystem in Appalachian mountains	Total value (substantial portion is nonuse)	Mail survey; 1991	Total: 486	Payment card for half of the sample and dichotomous-choice for the other half	Payment card format: Avg. median WTP=$4.21; Avg. mean WTP=$22.86; Dichotomous-choice format: Median WTP =$40.36

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Imber, Stevenson, and Wilks (1991)	Kakadu Conservation Zone and National Park, Australia	Use, option, existence, and bequest values	Personal interview, 1990	Total: 2,561;10% (25 responses) was invalid. Final: 2536	Dichotomous choice; Bids ranged from $2-$250/A reduction in take-home pay or other income	$2-$250. This study uses median values for WTP estimates. Major impact scenario: Median: $123.80-$143.20/yr; Minor impact scenario: Median: $52.80-$80.30/yr
Johansson and Kristrom (1988)	Elimination of sulfur emissions, which cause acid rain, in Sweden	Total value (substantial portion is nonuse)	Self-administered questionnaire 1987	Total: approximately 700. No mention of invalid responses	Dichotomous choice in both subsamples. Sample 1: bids $15-$640 per annum/mandatory payment per annum. Sample 2: bids $550-$290,000 jobs/ shortrun loss of jobs in the industry	Sample 1: Mean value = 4,500 SEK/yr. (about 4% of the avg. disposable household income in Sweden) Sample 2: Mean value = 150,000 jobs (about 3-4% of total no. of jobs in Sweden)

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Kahneman and Knetsch (1992)	Improved rescue operation for disasters	Total value	Telephone, 1989	Total: 218. Total was split into three subsamples: N=66, N=78, and N=74. Invalid responses on the last WTP question reduced sample size to N=74 for Group 2	Direct question/ Higher taxes, prices or user fees that would go into a fund	Environmental services: Mean=$135.91; Median=$50. Improve disaster preparedness: Mean=$29.06-$151.60; Mean=$29.06-$151.60; Median=%10-$50. Improved rescue personnel: Mean=$14.12-$122.64; Median=$1-$25
Kaoru (1993)	Coastal Pond Water Quality Improvements on the island of Marthas vineyard property, Massachusetts, USA	Use, option, and existence values	Mail survey, 1989	Total: 559 274 returned 200 complete information 25 no answer for WTP 30 zero value	OE	Mean values Use=$33.69 Option=$19.41 Existence= $77.59
Kay, Brown, and Alee (1987)	Atlantic salmon restoration in New England rivers	Use, option, and existence values	Mail survey; 1986	Total: 677	Users: direct question. Nonusers: dichotomous choice; either 12 cents/ k Wh or 9 cents/k Wh/ increased taxes or electric bills	Mean WTP: Use: $31.93, in addition to cost of the fishing license; Option values: $10.81; Existence values: $27.45

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Kealy and Turner (1993)	Preventing additional damages to the Adirondack region aquatic system from acidic deposition	Total value (a portion is nonuse)	Self-administered questionnaire (all student sample), 1985	Total: 158; 25% (40 responses) of the total was invalid. Final : 118	Both dichotomous-choice and direct question formats. Bids in the dichotomous-choice format:$0.10-$38/Donation	Open-ended: Median=$12.79 ; standard Error=$1.71; Dichotomous-choice: Median=$18; Standard Error=$1.66
Langford *et al.* (1998)	Preservation of Mediterranean monkseal, Aegean area Greece	Use, option, and existence values	Personal interview, 1995	The number of responses (not individual): 193: 348: 608	Direct question/ different components of WTP for preservation.	Mean per person:use=162 Option=838 Existence= 2,321 (unit= drachmas)
Loomis (1989)	Preservation of Mono Lake, California	Total value (option and existence values represent the majority of total value)	Two types: Mail and on-site intercept with mail return, 1986; Mail retests of both samples, 1987	Mail survey: Total: 217; 13% (29 responses) of the total was invalid. Final: 188; Retest: Final: 88; On-site intercept survey: Total: 128; Retest: total=96	Direct question/ Higher water bills and special water fee	WTP Question No. 1 Original test; Mean = $4.72-$11.42; Standard Error =$0.63-$2.45; Retest: Mean=$5.51-$9.97;Standard Error=$0.93-$2.25; WTP Question No. 2 Original test: Mean= $4.12-$12.15; Standard Error=$1.06-$1.77;Estimates vary by type of survey

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Loomis and Larson (1994)	Gray Whale, California, USA	Total value including nonuse values	Visitor: personal interview Household: mail survey	Visitor: Total: 1,402 Response rate: 71.3% (1,003 responses) valid responses: 672 Household: Total: 1,642 Response rate: 54% (890) Valid responses: 519	OE/ one time lump-sum payment	Visitor:Mean: $25-29.73 S.E: 1.16-1.39 Household: Mean: $16.18-18.14 S.E: 1.07-1.16 Household sample dominated by pure nonusers
Loomis, Lockwood, and DeLacy (1993)	Protection of different geographic areas of forest in southeastern Australia	Total value (includes recreation , option, existence, bequest, and `good cause values)	Mail survey, 1991	Total: 895; 23% (210 responses) of the total was invalid. Final: 685	Both direct question and dichotomous-choice / Annual payment into a trust fund managed by the Australian Heritage Commission	Open-ended: Means: $100 (all of S.E Australia); $72-$103 (E.Gippsland portion of S.E Australia);$39-$57 (Errinundra Plateau of E. Gippsland)
Majid, Sinden, and Randall (1983)	Two addition parks in an existing park system in Australia	Use, option and existence values	Personal interview, 1983	Total: 140. No mention of invalid responses	Iterative bidding. No mention of starting point or iterative amount/ An annual contribution to the two additional parks	Park 1: $3.80/yr; Standard Error: $5.20/yr; Park 2: $5.30/yr; Standard Error: $10/yr

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
McClelland *et al.* (1992)	Variations of groundwater cleanup	Use and nonuse (includes bequest, existence and altruistic values)	Mail survey, 1991	Total: 2,874; 31% (891 responses) of the total was invalid. Final: 1,983	Payment card with values ranging from $0 to more than $500/ increase in monthly water bill every month for next 10 years	Nonuse values: Mean: $2.81-$3.54; Standard Error: $3.11-$5.86; Estimates vary by approach
Mitchell and Carson (1984)	Water quality for all rivers and lakes in the US	Use, option, and existence values. Separated nonuse from use	Personal interview, 1981	Total: 813; 30.6% (249 responses) of the total was invalid. Final: 564.	Anchored payment cards based on five income categories. Anchor amounts varied according to the tax and spending rates of the respective group/ Higher prices and taxes	$93 for boatable water, $70 for fishable water; $78 for swimmable water. Mean total willingness to pay: $242
Rowe *et al.* (1991)	Damages caused by the Netstucca oil spill off coast of Washington and British Columbia	Use, option, existence, and bequest values	Mail survey; 1990	Total: 2515; Washington state: 1,291, British Columbia: 1,224; 26% (654 responses) of the total was invalid. Final: 1,861	Payment card with values ranging from $0-$5,000/ Higher prices to pay for programs that prevent one spill over the next five years	Moderate scenario: Washington Mean WTP= $65-$175 (U.S.dollars); British Columbia MeanWTP= $45-$175(Canadian dollars)

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Schulze *et al.* (1983)	The Grand Canyon and other national parklands in the southwest	Existence and use values	Personal interviews; 1980	Total: 614. No mention of invalid responses	Direct question and bidding game/ Higher electric power bills for nonusers and higher entrance fees for users	Electric bills: Grand Canyon only: $3.72-$5.14/mo; entire S.W. Parklands region: $6.61-$9.64/mo; Entrance fees: $3.16-$4.93/ visit
Schulze *et al.* (1993)	Upper Clark Fork River in Montana	Total value	Mail, 1993	Total: 933; 17% (159 responses) of the total was invalid. Final: 774	Payment card/ Respondents selected from list of six payment vehicles	Complete cleanup: $49; Partial cleanup: $36
Seip and Strand (1992)	Membership in Norges Naturvern-forbund (or the Norweigian Association for the Protection of Nature)	Total value	Several parts: Personal interview (Oct.-Nov. 1989);Mail membership drive(Dec. 1989-Jan. 1990); Telephone (Feb. 1990)	Part 1: Total: 101. No mention of invalid responses Part 2: Total: 64 Part 3: Total: 25	Payment card/ Annual membership fee	Part 1: Avg. maximum WTP=180-233 NOK. Part 2: 6 persons or 9% of sample voluntarily signed up for membership to the NVV. Part 3: 68% would revise their WTP downward; 32% would maintain it.

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Shechter et al (1998)	A unique National Park, Carmel National Park, Israel	Lost passive use values	Telephone survey, 1993	Donor sample: 721 General population sample: 200 for OE; 500 for DC	OE & DC	Donor sample: mean WTP of passive users versus user group:55 vs. 46.5. general population: 41.5 vs. 30 (unit=Nis)
Silberman, Gerlowski, and Williams (1992)	Preservation of New Jersey beaches	Use and nonuse (specifically, recreation and existence values)	Personal interview (also conducted telephone survey but did not use data), 1985	Total: 1,931; 35% (673 responses) of the total was invalid. Final: 1258.	Iterative bid format. Starting bids (recreation use): $2, $4, or $6. Starting bids (existence value): $10, $20, $30/ One time contribution to a nonprofit foundation	Mean user bid: $15.10; Mean nonuser bid: $9.26
Smith and Desvousges (1986)	Water quality in the Monongahela River Basin, PA	Option price, option, use, and existence values	Personal interview, 1982	Total: 303; 29.7% (90 responses) of the total was invalid. Final: 213	Direct question, payment card, and iterative bidding. Two starting points for the bids: $25 and $125/ Higher taxes and prices for products	$21-$58 for users; $14-$53 for nonusers; $27-$95 option price for users

Study	Natural Resource	Type of Value Measured	Type of survey &Year	Sample Size	Question Format/ Payment Vehicle	Range of Estimates
Stevens *et al.* (1991)	Preservation of Atlantic salmon, bald eagles, wild turkeys, and coyotes	Total value (mainly existence value)	Two mail surveys	Total: 508	Modified dichotomous-choice format allowing for open-ended responses (given bid ranges: $5-$150)/ Donation to preservation fund	Mean WTP: $19.28(eagle); $11.86 (turkey); $4.20 (coyote control); $5.35 (coyote preservation); $7.93 (salmon)
Sutherland and Walsh (1985)	Water quality in the Flathead Lake and River drainage system, MT	Use, option, existence, and bequest values	Mail survey; 1981	Total: 280; 39% (109 responses) of the total was invalid. Final: 171	Direct question/ Annual fee to be placed in special fund	Recreation use value: $7.37; Nonuse value: $56.79 (option value: $10.71, Existence value: $19.88, bequest value: $26.37)
Walsh, Loomis, and Gillman (1984)	Wilderness areas in Colorado	Use, option, existence, and bequest values	Mail survey, 1980	Total: 218; 11% (23 responses) of the total was invalid. Final: 195	Direct question/ Annual fee to be placed in special fund	Recreation use: $14; Nonuse value: $13.92 (composed of option value: $4.04; existence value: $4.87; bequest value: $5.01); Mean: $32
Whitehead and Blomquist (1991)	Preservation of clear Creek wetlands in Kentucky	Total value (substantial portion is existence value)	Mail survey, 1989	Total: 215. No mention of invalid responses	Dichotomous-choice format /Donations to a hypothetical `Wetland Preservation Fund	WTP estimates range from $5-$17, depending on the version of the survey

APPENDIX 2 : Questionnaire

The Survey on Conservation Value of the Tidal Wetland

[A]

ID			

Hello?

You have been chosen to participate in a survey to determine the importance of tidal wetland to the people of Seoul. This survey is conducted by Korea Ministry of Maritime Affairs & Fisheries and Korea Maritime Institute. The goal of this study is to include public opinions in decisions to conserve the tidal wetland. There is no right or wrong answer to any of the questions. Just think deliberately and give your thought. Tell us anything questionable.

Your views will help us to establish the policy of conserving the marine environment and to give our descendents beautiful tidal wetlands. The information that you provide will be kept strictly confidential and only used for statistical analysis. The results of this survey will also be classified. Though these questions bother you, please make sincere answer to reveal your real opinions.

Thank you for your help with this survey!

- Korea Maritime Institute
- Hee Dong Pyo, Senior Researcher

※ **This survey is for the people who lives in Seoul and ages 20-65, please give this sheet back to us if you are not in the condition**

After interview, report!

Interviewee's name: _____ Tel.: _____

Address: ____City ____Gu ____Dong ____Ho(_____ APT ____Dong ____Ho)

Interview time : To ___hour __minute form __minute(__minutes), ___, Aug. 1999

Interviewer's name : _____ Tel.: _____

S/V name : _____

A. General Information about Tidal Wetlands

※ *Interviewer explains the tidal wetland: Please show and read the visual card including information on tidal wetland to interviewee.*

First, we would like to ask a few questions about your experience with tidal wetland areas. Please circle the appropriate answer.

A1. Before you received this questionnaire how much did you know about tidal wetland?

(1) Well
(2) A little
(3) Not at all

A2. During the last 2 to 3 years, have you or your family ever been to a tidal wetland?

(1) Yes (___times) (2) No → **[If you answered NO, please go to question A5]**

A3. Then, what makes you have been to tidal wetlands?

(1) Tidal wetland is a residential site or a living way itself
(2) For sightseeing or leisures such as sea bathing, etc.
(3) Others (Please specify: _____)

A4. (Show the distribution chart of domestic tidal wetlands) Choose one area where you or your family had been most often.

(1) Kyunggido coast

(2) Chungcheong coast
(3) Cheonbuk coast
(4) Western Cheonnam coast
(5) Southern Cheonnam coast
(6) Southern Kyungnam coast
(7) Not sure

A5. Compared with other environmental problems such as air pollution, water pollution or waste problems, how important is it for you that tidal wetlands will be conserved?

(1) Not at all important
(2) Somewhat not important
(3) Average
(4) Somewhat important
(5) Very important

A6. Do you remember ever watching or reading news related to tidal wetland through television, radio, newspaper during the recent three years?

(1) Yes (Please specify: _____times) (2) No

B. The Conservation Value of Tidal Wetlands

※ ***Interviewer explains the tidal wetland: Please read the card, and remind interviewee of tidal wetland***

Q) Please choose the response that best describes your attitudes towards tidal wetlands for each statement below.

	Strongly Agree	Moderately Agree	Average	Moderately Disagree	Strongly Disagree
B1. Tidal wetlands are important for fishermen to get a living such as fishery.					
B2. Tidal wetlands are necessary for people to enjoy recreations or leisure such as fishing, sea bathing, digging clams, playing tidal wetland, bird watching and so on.					
B3. Tidal wetlands play an important role in assimilating pollution from land.					
B4. Tidal wetlands are necess ary for people to mollify a natural disaster such as a flood or a typhoon.					
B5. Tidal wetlands are necessary for me and my family to enjoy leisures in the future.					
B6. Tidal wetlands are necessary for my children and my descendants to enjoy leisures.					
B7. Tidal wetlands are necessary for others' fishery and leisures.					
B8. Tidal wetlands are important resources that include endangered wildlife such as migratory birds etc.					
B9. Even if no one visits a tidal wetland, the existence of itself is important.					
B10. Tidal wetlands are scarce and invaluable environmenta resources that cannot be restored once destroyed.					

Counterplan against Tidal Wetlands Impairment

※ ***Read the card 「Counterplan against tidal wetlands impairment」 to interviewee***

Conserving tidal wetlands are so expensive and product prices and taxes will increase in order for the conservation to be guaranteed. If most people would not pay, the plan for conservation of tidal wetland could not come into effect. Otherwise if most people would agree to pay the cost, tidal wetland could be conserved.

Now, we would like to know how much additionally your household is willing to pay your taxes, such as a tax laid on various products usually purchased, an income tax or fund of conservation of tidal wetland. So in consideration of your household income and expenditure, please answer the next questions sincerely.

♠ ***Interviewer must tell interviewee the fact every household will be charged for once a month if it would agree to pay the cost.***

B11. Would your household be willing to pay additionally _____ Korean won a month in order to conserve tidal wetland of our country by indirect tax, an income tax, or founding tidal wetland conservation fund? If you would not pay, it is difficult to conserve our tidal wetland.

(1) Yes ↓ (2) No ——— **[Go to B13]**

B12. Then, would your household be willing to pay _____ Korean won every month in order to conserve tidal wetland of our country? If you would not pay, it is difficult to conserve our tidal wetland.

(1) Yes → **[Go to B17]**

(2) No

B13. Then, would your household be willing to pay _____ Korean won every month? If you would not pay, it is difficult to conserve our tidal wetland.

(1) Yes ——► **[Go to B17]**

(2) No

B14. Then, should not your household be willing to pay only 1 Korean won?

(1) Yes, I should

(2) No, I shouldn't ——► **[Go to B16]**

B15. Then, what is the maximum amount that your household would be willing to pay every month for the conservation of tidal wetland?

_____ **Korean won** ► **[Go to B17]**

B16. What is the most important reason why your household would not be willing to pay?

(01) The cost is too high for my household to afford.

(02) Polluters should pay.

(03) I don't trust new policy of government.

(04) I'm already paying enough in taxes.

(05) The tidal wetland is well-conserved enough.

(06) I don't like these hypothetical questions

(07) Developing tidal wetlands for multiple purposes is more beneficial than conserving them

(08) The environment of tidal wetlands will not be well-conserved even if development of them would be banned.

(09) I don't think that the conservation program is effective.

(10) I don't think that it is valuable to ban the development of tidal wetlands to conserve it.

(11) Others (Please specify : _____)

——► **[Go to B21]**

B17. What are the first-most and the second-most important reasons why your household would be willing to pay?

First: _____ **Second:** _____

(1) For the production and living area of marine products provided by tidal wetland.
(2) For purifying pollution.
(3) For recreations.
(4) For preventing natural disaster or supplying oxygen.
(5) For habitat of sea birds.
(6) For future visits and uses.
(7) For future generations.
(8) I'm satisfied with protecting wildlifes, such as migratory birds, in the risk of extermination.

B18. People value the protection of tidal wetland for several purposes. Read the entire question first, then answer each of four parts. Please rank four of the following from the most important to the least important from your point of view, among the purposes that your household would be willing to pay an amount of money to conserve tidal wetland. Then, what proportion of the highest dollar value you reported above would you assign to each of the following purposes? Please supply weights the ordered purposes, beginning with an arbitrary 100 for your most important. Please remember that these do not need to add up to any particular number, but could equally well be 100, 98, 96, ..., 90 and 100, 10, 9,..., 6 or any other decreasing but non-negative pattern.

Purposes	Rank	Weight
For fisherman to get a living action such as fishery, to enjoy recreations or leisure such as sea fishing, sea bathing, digging clams, playing tidal wetland or to control flood and filtering pollutants		
For our next generations to inherit our benefits of tidal wetlands		
Even though I will not plan to visit or use wetlands on the spot, there is possibility of doing so. Therefore, I will pay a kind of insured amount		
Though it is not possible for me to visit or use wetlands, I like conserving wetlands and protecting wildlifes of tidal wetlands		

B19. At what point did it become difficult to assign weights?

B20. Which of the following areas, do you focus on in answering the above questions?

(1) Kyunggido sea area
(2) Chungcheong sea area
(3) Cheonbuk sea area
(4) Western part of Cheonnam sea area
(5) Southern part of Cheonnam sea area
(6) Southern part of Kyungnam sea area
(7) Most of tidal wetlands

B21. How much do you believe that the implementation of the tidal wetland conservation program could contribute to conservation of tidal wetland?

(1) Very much
(2) Much

(3) Average
(4) A little
(5) Not at all

B22. What type of activity do you want to participate in during your visit to the tidal wetland, if the tidal wetland is conserved?

(1) Sightseeing migratory birds
(2) Leisures such as seabathing, taking a walk, digging clams and so on
(3) Seafishing
(4) Fishery (gathering clams, crabs, sea products etc.)
(5) Other(Please specify: _____)

B23. Considering both negative and positive aspects of developing wetlands by reclamation, do you agree to wetlands development?

(1) Yes ⟶ **[Go to B24]** (2) No ⟶ **[Go to B25]**

B24. Consider that preservation of tidal wetlands involves giving up other benefits. Tidal wetlands can be converted to support farming, fresh-water lake, housing and loads, and commercial buildings. If wetlands would not be developed, import of cereal and water shortage, etc. would be inevitable. With these points in mind, do you object to developing tidal wetlands?

(1) No (2) Yes

B25. Do you think your household can benefit from developing tidal wetlands?

(1) Yes (2) No

C. Value trade-off of tidal wetland

To preserve tidal wetlands we have, new actions are needed. Since it is very expensive to fix all the problems related to tidal wetland, difficult choices must be made. The next five cards show how different actions will change conditions. The following programs are hypothetical. We are trying to learn which resources are most important to you and how much you would pay to protect them.

♠ ***Interviewer explains the tidal wetland: Please read the visual card to remind interviewee of tidal wetlands.***

♠ ***Interviewer shows and reads example card including information on the tidal wetland of Youngsangang.***

C1. Before you received this questionnaire, did you know that there was a debate over conservation and development of tidal wetlands?

(1) Yes (2) No

C2. (Interviewer provides interviewee with five cards) Please put the cards in a decreasing order of subjective preference.

C3. At what point did ranking among five cards become difficult for you?

C4. Please assign a grade (best=10; worst=1) per each for the ordered cards in a decreasing pattern (circle one that applies)

C5. At what point did assign a garde among five cards become difficult for you?

[Answers]

Rank	1st	2st	3st	4st	5st
C2. Card No					
C4. Grade	**Best** -+- 10 -+- 9 -+- 8 -+- 7 -+- 6 -+- 5 -+- 4 -+- 3 -+- 2 -+- 1 **Worst**	**Best** -+- 10 -+- 9 -+- 8 -+- 7 -+- 6 -+- 5 -+- 4 -+- 3 -+- 2 -+- 1 **Worst**	**Best** -+- 10 -+- 9 -+- 8 -+- 7 -+- 6 -+- 5 -+- 4 -+- 3 -+- 2 -+- 1 **Worst**	**Best** -+- 10 -+- 9 -+- 8 -+- 7 -+- 6 -+- 5 -+- 4 -+- 3 -+- 2 -+- 1 **Worst**	**Best** -+- 10 -+- 9 -+- 8 -+- 7 -+- 6 -+- 5 -+- 4 -+- 3 -+- 2 -+- 1 **Worst**

C6. The next eight questions show how different actions will change conditions. The following programs are hypothetical. We are trying to learn which resources are most important to you and how much you would pay to protect them. Consider each question separately. Do not add them up.

If you had to choose one of the three options below, which would you choose. Circle one please.

D. Household Information

(Q) We would like to ask a dew questions about your household. These questions are necessary because they help us understand how people feel about these issues. Your answers to these questions will be kept in absolutely confidence and will never be related to your name. We need the answers only for statistical reasons.

D1. What is your sex?

(1) Male (2) Female

D2. Are you married or unmarried?

(1) Married (2) Unmarried

D3. How old are you?

_____years

D4. Are you home-owner?

(1) Yes (2) No

D5. How long have you lived in Seoul?

_____years _____months

D6. Including yourself, how many people live in your household?

_____persons

D7. How many peoples under the age of 18 live in your household?

_____persons

D8. Are you employed or unemployed?

(1) Employed (2) Unemployed

D9. Is your occupation a blue-collar or white-collar?

(1) Blue-collar (2) White-collar

D10. Do you belong to any environmental organization?

(1) Yes (2) No

D11. Please check the highest level of school that you have completed.

(1) No school (0)
(2) Elementary school (grade 1-6)
(3) Middle school (grade 7-9)
(4) High school (grade 10-12)
(5) Junior college (grade 13-14)
(6) College graduate (grade 15-16)
(7) Postgraduate (grade 17-18)

D12. What is the monthly combined income your household received after taxes in last year? Include wages, salaries, income from your business, pensions, dividends, interest, and any other income after taxes.

_____ (10,000 won)

D13. If you don't want to respond with your exact household income, could you tell me the number that best describes your monthly household income?

(01) under 500,000 won
(02) 500,000 won - 1,000,000 won
(03) 1,000,000 won - 1,500,000 won
(04) 1,500,000 won - 2,000,000 won
(05) 2,000,000 won - 2,050,000 won
(06) 2,500,000 won - 3,000,000 won
(07) 3,000,000 won - 3,500,000 won
(08) 3,500,000 won - 4,000,000 won
(09) 4,000,000 won - 4,050,000 won
(10) 5,000,000 won - 6,000,000 won
(11) 6,000,000 won or more

D14. How much money does your household spend on recreation activities (such as travels, leisures)?

(1) under 10,000 won
(2) 10,000 won - 50,000 won
(3) 50,000 won -100,000 won
(4) 100,000 won - 150,000 won
(5) 150,000 won - 200,000 won

(6) 200,000 won - 250,000 won
(7) 250,000 won or more

D15. Did this survey contribute to your knowledge about wetlands?

(1) Absolutely yes
(2) Yes
(3) Moderately
(4) No
(5) Absolutely no

D16. Which of the following statements best describes your concern about environment?

(1) Technology can solve all the environment problems. We should rely on economic growth
(2) If minimum level of environmental quality could be guaranteed, ceaseless exploitation of environmental resources will be no problem.
(3) Environment is a basic requirement for human life, thus economic growth should be environment-friendlily adjusted.
(4) Environment has a privilege not to be destroyed irrespective of human's use. The only way is radical change in our life-style

D17. Thank you for your participation in this survey! If you have any concerns or opinions you would like to share concerning the questionnaire or tidal wetlands conservation, please use the space provided below.

Your time and effort is appreciated.

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