

# ESTIMATING THE WILLINGNESS TO PAY FOR RESTORING THE ISAHAYA BAY WETLAND: EVIDENCE FROM CONTINGENT VALUATION METHOD

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This paper presents the first attempt to estimate the environmental value of restoring the eco-system of the Isahaya Bay Wetland by using the Contingent Valuation Method (CVM), in the three cities of Kyushu- Isahaya, Nagasaki and Kitakyushu. Mail survey technique and double bounded dichotomous-choice (DC) format have been used for eliciting willingness-to-pay (WTP). From the results of the study we have found that, the Isahaya Bay Wetland is worth approximately 218 million yen, 1.1 billion yen and 2.7 billion yen to the residents of Isahaya, Nagasaki and Kitakyushu, respectively. The study also revealed that, average willingness to pay of the respondents rises as the distance from the project site increases and gradually settles around a certain average amount.

*Key Words: contingent valuation method (CVM), dichotomous-choice (DC), willingness-to-pay (WTP), wetland eco-system*

## 1. INTRODUCTION

The Isahaya Bay reclamation project (IBRP) undertaken in Nagasaki Prefecture, Japan, to construct sea dikes with the initial objective of land reclamation and flood prevention, attracted a lot of attention lately. The reason for such higher attention is the influence of the project on the eco-system of the Isahaya Bay Wetland (IBW). Local residents and fishermen of different prefectures of the Kyushu Island, namely Nagasaki, Kumamoto, Fukuoka and Saga prefectures caught up themselves into different debates regarding the merits and demerits of the project. On the other hand, the government is also faced with a tough decision in deciding about the continuity of the project.

In the backdrop of such debates, this paper aims

to quantify the value of the Isahaya Bay Wetland, as thought by the people living in different cities of the Kyushu Island. In order to do so, we plan to use contingent valuation method (CVM), to quantify the benefits of restoring the Isahaya Bay Wetland. Termed contingent valuation, the technique draws upon economic theory and the methods of survey research to elicit directly from the consumers the values they place upon public goods<sup>1)</sup>. It should be mentioned here that, this study is a modest attempt to estimate the value of the Isahaya Bay Wetland and not the value of the Isahaya Bay reclamation project and enough care was taken in designing the survey instruments, so that the respondents of the study do not confuse these two interrelated terms.

## 2. ENVIRONMENTAL EVALUATIONS AND CONTINGENT VALUATION METHOD (CVM)

We want our environment to be safer and cleaner. But how clean or safer it should be? How clean we should make the sea or air? Should we build a new dam for flood protection? Or we just tolerate the flood to get rid of the negative impact of the dam on the eco-system? Like these questions- nothing comes for free. If we want to get something, then we got to forgo something. Same with environmental resources, which are entirely public goods and are limited. So before making any decision regarding the use of such public goods, we need to compare the benefits of defending environmental resources compared with the opportunity costs or benefits forgone for alternative uses, i.e., conducting cost-benefit analysis. Accordingly, Contingent Valuation (CV) evolved as a method to quantify the benefits of non-marketed environmental goods attributes so that they could be entered directly into cost-benefit calculations. The CV was seen both as an alternative method of valuation to travel-cost (TC) and hedonic pricing (HP) models and as being able to quantify some types of benefits, such as non-use or passive-use benefits, which lie outside the scope of TC and HP studies<sup>2)</sup>.

In simple terms, contingent valuation is a method of estimating the value that people places on a particular good. It uses survey techniques to elicit people's willingness to pay (WTP) to obtain a particular good or willingness to accept (WTA) to give away the good. It can be applied for goods both which are and are not traded in regular marketplaces. For goods, which are not traded in the marketplace a hypothetical marketplace is created in which respondent's are given the opportunity to buy the good. Contingent valuation method can also be applied for goods which are sold in the current marketplace such as improvement in medical treatment facilities, water quality, national parks etc.

Because the elicited WTP values are contingent upon the particular hypothetical market described to the respondent, this approach came to be called the contingent valuation method<sup>3)</sup>. At different times and in various places the contingent valuation method has been called the survey method, the interview method, the direct interview method, the

direct questioning method, the hypothetical demand curve estimation method, the difference mapping method, and the preference elicitation method<sup>1)</sup>.

The CVM is not also beyond any criticism. It has the shortcomings that survey studies usually have. The way the WTP questions are made may biases value estimates. Also respondent's reply to survey questions about their behavior often differs from what they actually do. Much controversy surrounds the use of CVM when most of the value of the good derives from passive use, as has been typical in litigation over the damages to natural resources and amenities caused by releases of pollutants<sup>4)</sup>.

Despite of these criticisms CVM has been widely used by researchers both in developed and least developed countries.

## 3. METHODOLOGY OF THE STUDY

Contingent Valuation Method (CVM) is used to estimate the willingness to pay (WTP) value, which depends on survey techniques to value a particular commodity. In order to choose from the various survey techniques and elicitation methods, particularly suitable for our study of valuing the Isahaya Bay Wetland, we have conducted pre-testing of questionnaires. And this led us to opt for mail survey technique and dichotomous choice (DC) elicitation method. Both parametric and non-parametric estimate analysis have been conducted.

## 4. RESEARCH DESIGN

### (1) Study region and selection of respondents

A total of 1,800 questionnaires were distributed in the three cities of Kyushu- Isahaya, Nagasaki and Kitakyushu (600 each), by considering the expenditure and time involved in the survey. The reason for selecting these three cities is to examine the WTP in Isahaya city, where the IBRP is located and also in Nagasaki city, the prefecture that includes the Isahaya city. On the other hand, Kitakyushu, the city placed at the topmost part of Kyushu Island is selected to see the change in WTP due to increase in the distance from the IBRP. The locations of the sample cities are shown in Fig. 1. Mail survey technique is used for data collection

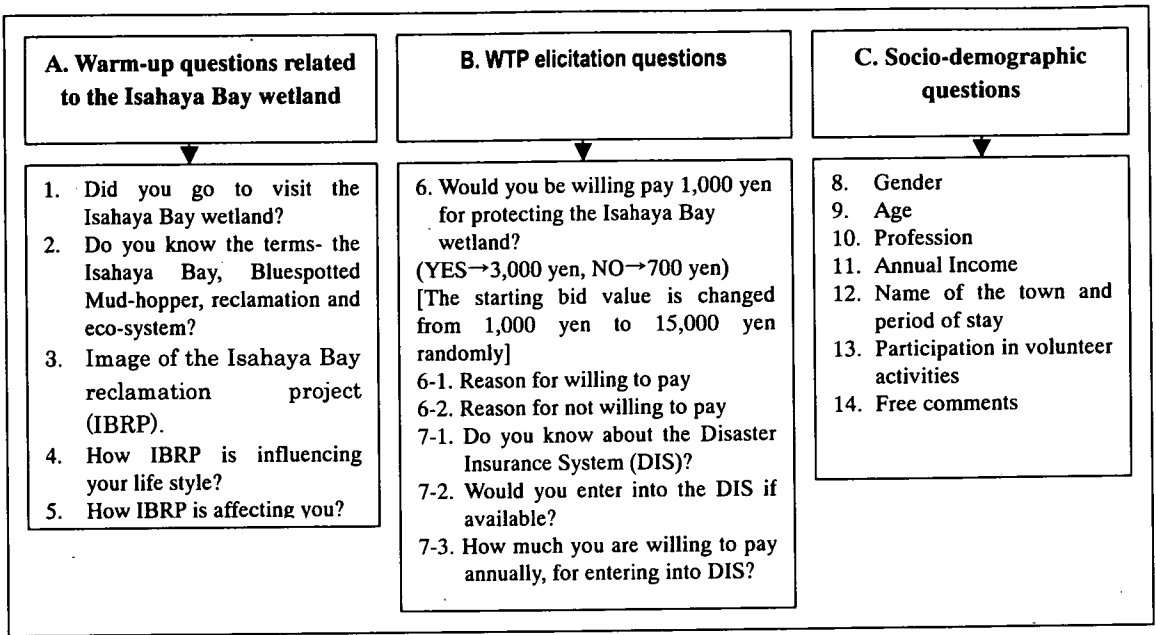


Fig.2 Contents of the questionnaire used in the survey

and households are selected randomly from the registered telephone directory of each targeted city.

### (2) Contents of the questionnaire

The questions contained in the questionnaire of the study can be categorized into three broad headings (see Fig. 2). Before getting into the first part, a description is given regarding the problem in hand: the Isahaya Bay Wetland, the Isahaya Bay Reclamation Project and its effect on the surrounding eco-system, the extent of reclamation and protection; with satellite images showing the changes in the eco-system due to the initiation of the IBRP. Regarding the picture behind the payment, we have stated that the entire Isahaya Bay would be protected by the proposed fund and that the Bay would be restored back to the place as it was before the initiation of the reclamation project. Accordingly, the question asked to elicit the respondent's willingness to pay (WTP) is: *Suppose we are going to create a fund named 'Isahaya Bay Wetland Preservation Fund' to restore the eco-system of the IBW. Would you be willing to contribute \_\_\_\_\_ yen (assigned randomly ranging from 1,000 yen to 15,000 yen) to this fund only once, to protect the IBW?* This was followed by a follow-up question where the amount is increased or decreased, depending on whether the



Fig.1 Location of the sample cities

respondent's initial answer was positive or negative, respectively.

### (3) Versions of the questionnaire

As shown in Table 1, the questionnaires were divided into six versions or groups with different amounts of starting bid value under double-bounded dichotomous-choice elicitation method and are distributed on 13th and 14th September 2001. The number of versions of the questionnaire were increased to six versions as our pre-testing results revealed that relatively higher number of different versions of questionnaire with different bid values reduces error of the estimation<sup>5)</sup>.

### (4) Response rate

The response rates are 20.67 percent in Isahaya,

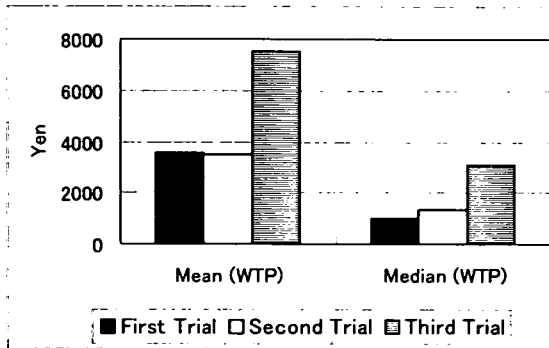


Fig. 3 Mean and median WTP of the pre-testing trials

19.50 percent in Nagasaki and 26.67 percent in Kitakyushu (see Table 2).

### (5) Demographic characteristics

Table 3 illustrates the demographic characteristics of the respondents of the study. From the table we can see that, the samples of the three cities are relatively closer in terms of average age and income. Comparing the sample demographics with actual one, we have found that the sample respondents are slightly older in terms of age and percent male is relatively higher in some of the cities. But these sampling biases are within statistically tolerable range and are not going to impinge on the results of the study.

### (6) Pre-testing results

Pre-testing study was conducted in three trials. A total of 17, 42 and 104 respondents were questioned, in the first, second and third trial respectively, with the same plus some other additional respondents. Only one edition of questionnaire was used in the first trial, with a flat rate of 5000 yen and bidding game elicitation method was used. While in the second and third trial, three editions of the questionnaire were used; with bid values varied between 1000 yen to 10,000 yen and dichotomous-choice elicitation method was used. The results show that the mean WTPs are 3,559 yen, 3,470 yen and 7,561 yen for the first, second and third trial, respectively (see Fig. 3). While the median WTP is very low as compared to the mean WTP, but follows the rising trend through first to third trial. And it was interesting to find that the mean WTP of the third trial gave us a good guess about the final mean WTP of the study. Based on the experience of the pre-testing study, the final

Table 1 Bid values used under double-bounded dichotomous-choice elicitation method

| Versions | Starting Bid Value (Yen) | Second Bid Value |          |
|----------|--------------------------|------------------|----------|
|          |                          | YES (Yen)        | NO (Yen) |
| First    | 1,000                    | 3,000            | 700      |
| Second   | 3,000                    | 5,000            | 1,000    |
| Third    | 5,000                    | 7,000            | 3,000    |
| Fourth   | 7,000                    | 10,000           | 5,000    |
| Fifth    | 10,000                   | 15,000           | 7,000    |
| Sixth    | 15,000                   | 20,000           | 10,000   |

Table 2 Questionnaires distributed and response rate

|                            | Isahaya City | Nagasaki City | Kitakyushu City |
|----------------------------|--------------|---------------|-----------------|
| Questionnaires Distributed | 600          | 600           | 600             |
| Questionnaires Returned    | 124          | 117           | 160             |
| Response Rate (%)          | 20.67        | 19.50         | 26.67           |

Table 3 Demographic characteristics

|                                     | Isahaya City    | Nagasaki City   | Kitakyushu City |
|-------------------------------------|-----------------|-----------------|-----------------|
| Age (Year)                          | 51.87           | 51.35           | 47.66           |
| Percent Male                        | 56.00           | 58.00           | 43.00           |
| Annual Income (in ten thousand yen) | Between 400-499 | Between 400-499 | Between 500-599 |

survey questionnaire was modified to some extent and the numbers of bid values were increased to six.

## 5. EMPIRICAL ANALYSIS

In this study double bounded dichotomous-choice (DC) elicitation method has been used for deriving the WTP figures. In pre-testing study of the questionnaire, we have found DC method as more widely used and balanced compared to other elicitation methods. Again under DC method both parametric and non-parametric estimate analysis have been conducted to estimate WTP. We consider the non-parametric estimation of the distribution function  $F$  of a real-valued random variable  $X$ , when the sample data are incomplete due to restricted observation brought about by grouping, censoring and/or truncation<sup>6</sup>. Among non-parametric estimation Turnbull method is followed, which uses equation (1) to calculate the WTP.

$$LL = \sum_{i \in yy} \ln S(T_{hi}) + \sum_{i \in nn} \ln [1 - S(T_{li})] + \sum_{i \in ynoy} \ln [S(T_{li}) - S(T_{hi})] \quad (1)$$

Where,  $LL$  is the maximum likelihood estimate.  $S(T)$  denotes the probability to accept bid value  $T$ ,  $T_{hi}$  is highest bid value and  $T_{li}$  the lowest bid value to the  $i$ th individual. On the other hand,  $yy$  shows the set of respondents who answered yes for both the bid values. Accordingly  $nn$ ,  $yn$ , and  $ny$  represents the set of respondents who responded both time no, first time yes and then no and first time no and then yes, respectively.

Whereas, under Weibull method of parametric estimation, the value of  $\mu$  and  $\sigma$  are fixed to give shape to the cumulative distribution function and determines  $S(T)$  by the following equation:

$$S(T) = \exp \left[ - \exp \left( \frac{\ln T - \mu}{\sigma} \right) \right] \quad (2)$$

Where,  $\exp$  is the exponential operator. After determining the  $S(T)$ , then we go for the estimation of  $LL$ .

Both of these two methods have their relative advantages and disadvantages. Hence we are going to conduct our calculation by using them together and compare the results.

## 6. FINDINGS OF THE STUDY

The findings of the survey and empirical study are summarized through the following points:

### (1) Image of the Isahaya Bay reclamation project (IBRP)

According to the respondents of Nagasaki and Kitakyushu the strongest image of the IBRP is as a symbol of eco-system (Nagasaki 72 percent and Kitakyushu 77 percent), while to the respondents of Isahaya the strongest image is as a symbol of flood protection (50%) (See Fig. 4). Thus to the residents of Isahaya IBRP is regarded more as a protection from flood rather than destruction of natural environment.

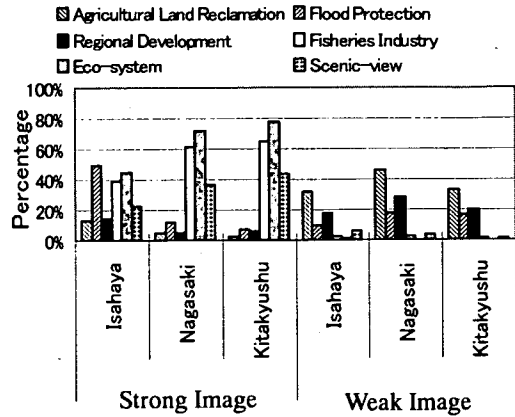


Fig. 4 Image of IBRP

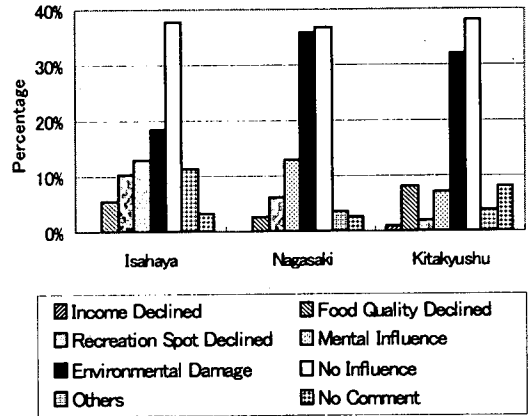


Fig.5 Influence caused by IBRP

### (2) Influence of the project

Regarding the influence of IBRP, 38 percent, 37 percent and 38 percent of the respondents in Isahaya, Nagasaki and Kitakyushu respectively, have reported to have no influence (see Fig. 5). Whereas, the second highest influence was reported to be environmental damage. Thus, respondents of all of these three cities, including Isahaya, have recognized IBRP as detrimental to natural environment.

### (3) Willingness to pay (WTP)

The analysis of data has been conducted by applying both Turnbull and Weibull method. The respondents who had resisted to pay in all of the two bids are considered to have zero WTP, but their opinion regarding refusal to pay are summarized to

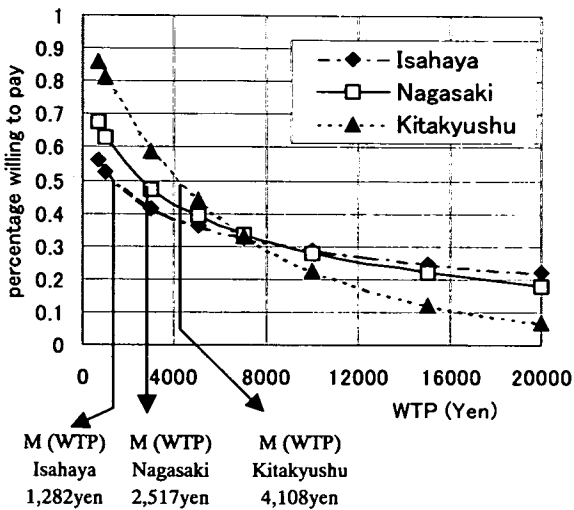


Fig.6 Percentage of respondents WTP

dug out the reasons for not willing to pay. According to the Turnbull method, the mean WTP's are 6,440 yen, 6,560 yen and 6,567 yen for Isahaya, Nagasaki and Kitakyushu respectively (see Table 4). If we multiply these figures by the number of households in each respective cities, then we can find that, Isahaya Bay Wetland is worth approximately 218 million yen, 1.1 billion Yen and 2.7 billion yen to the residents of Isahaya, Nagasaki and Kitakyushu, respectively (see Table 5). This implies the extent of importance of the Isahaya Bay Wetland to the residents of particular city. From the economic point of view, it can be said that the utility function of the residents of the each city would increase by this amount of total WTP, if the IBW were restored back to the position as it was before the initiation of the project. The WTP figures under Weibull method are plotted in Fig. 6, which shows that the median WTP's of Isahaya, Nagasaki and Kitakyushu as 1,282 yen, 2,517 yen and 4,108 yen respectively (see Table 6).

**(4) Area- wise willingness to pay**

More specific willingness to pay analysis is also conducted in each city. This has lead to some interesting results. For this purpose we have divided each cities into three parts. The particular dichotomous choice (DC) elicitation method used in the study, for each bid value used in the analysis a sample of n=30 or so are needed for statistical significance<sup>7)</sup>. This was satisfied while making calculation for Figs. 7-9. Accordingly we have

Table 4 WTP according to Turnbull Method

|                                      | Isahaya City | Nagasaki City | Kitakyushu City |
|--------------------------------------|--------------|---------------|-----------------|
| Sample Size (complete)               | 121          | 115           | 160             |
| Mean WTP (¥/household)               | 6,440        | 6,560         | 6,567           |
| Median WTP (¥/household)             | 850          | 4,000         | 4,000           |
| SD of the Mean                       | 782.81       | 0             | 584.46          |
| Range of 95% confidence interval (¥) | ± 1,534.28   | -             | ± 1,145.51      |

Table 5 Total estimated WTP

|  | Isahaya City | Nagasaki City | Kitakyushu City |
|--|--------------|---------------|-----------------|
| Mean WTP (¥/household)                             | 6,440        | 6,560         | 6,567           |
| Total Number of Households (in thousand)           | 34           | 168           | 412             |
| Estimated Total WTP (in million yen) <sup>1)</sup> | 218          | 1100          | 2706            |

<sup>1)</sup> Estimated Total WTP is calculated by multiplying Mean (WTP) per household by number of household in the respective cities.

Table 6 WTP according to Weibull Method

|                          | Isahaya City | Nagasaki City | Kitakyushu City |
|--------------------------|--------------|---------------|-----------------|
| Mean WTP (¥/household)   | 6,388        | 6,524         | 6,172           |
| Median WTP (¥/household) | 1,282        | 2,517         | 4,108           |

found that, in Isahaya the lowest mean WTP is reported from the respondents living near the reclamation project sea dikes, which is 3,419 yen (see Fig. 7).

Whereas, in central and northern part of the city, the mean WTP is almost doubled to 7,124 yen and 6,377 yen respectively.

On the other hand, the mean WTP is 7,501 yen, 7,713 yen and 5,702 yen in southern, central and northern part of the Nagasaki City respectively, which shows an almost uniform trend (see Fig. 8). Finally, in Kitakyushu the same mean WTP is calculated as 6,467 yen at the Yahatanishi ward, 7,280 yen at the Yahatahigashi ward and 5,946 yen

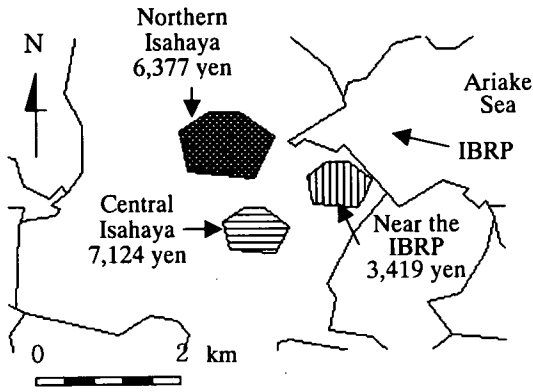


Fig.7 Area wise WTP variation in Isahaya

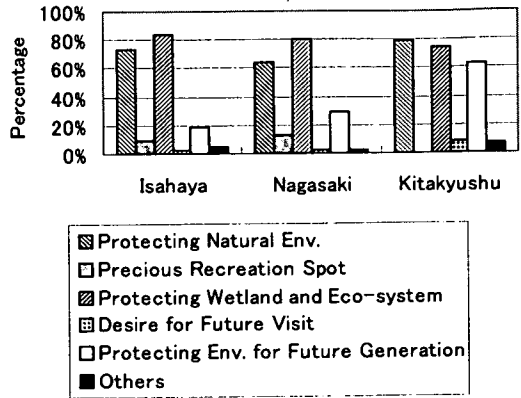


Fig. 10 Reasons for willing to pay

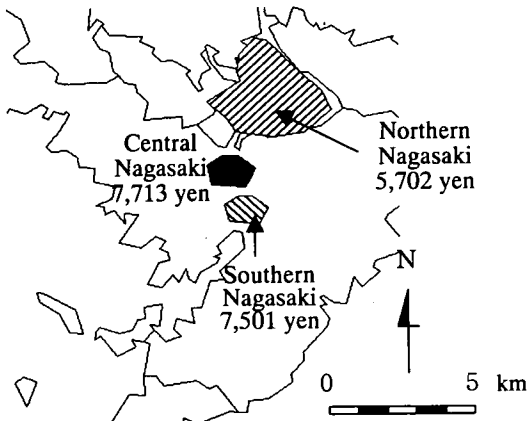


Fig.8 Area wise WTP variation in Nagasaki

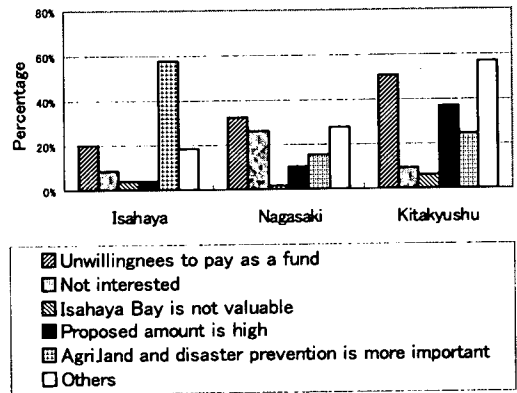


Fig. 11 Reasons for not willing to pay

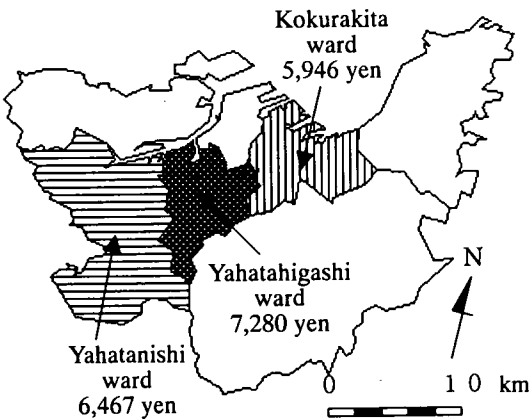


Fig.9 Area wise WTP variation in Kitakyushu

at the Kokurakita ward (see Fig. 9).

**(5) Reasons for willing to pay**

Figure 10 presents the reasons why the respondents are willing to pay to restore the Isahaya

Bay Wetland. From the figure we can see that, protecting wetland and the eco-system is the more common reason cited by the respondents, as the reason for payment (83 percent, 80 percent and 74 percent in Isahaya, Nagasaki and Kitakyushu respectively). On the other hand, only 10 percent, 13 percent and none in Isahaya, Nagasaki and Kitakyushu respectively mentioned reason to pay, by considering the Isahaya Bay Wetland as a recreation spot.

**(6) Reasons for not willing to pay**

Among the reasons for not willing to pay, 58 percent of the respondents of Isahaya City cited that, agricultural land reclamation and disaster prevention is more important than protecting environment (see Fig. 11). On the other hand, 31 percent and 51 percent of the respondents in Nagasaki and Kitakyushu respectively, quoted unwillingness to pay as a fund. In Kitakyushu, we

have found that 37 percent of the respondents reported that the proposed amount is high. This means that, although they cannot afford to pay, but they took the commitment in the survey seriously.

Finally, while considering the results of the study we should bear in mind that, respondents showed unwillingness to pay for reasons like: *unwillingness to pay as a fund, agriculture and disaster prevention is more important* etc., also had some willingness to pay if for example *the payment method is changed or the advantage of the disaster prevention* was not associated with IBRP and so on. Thus, by considering their willingness to pay as zero, according to the typical methodology of DC elicitation method, there remains the possibility of underestimating WTP. Hence, the results reported by this study should be regarded as conservative estimate.

#### (7) Robustness of the results

Diagnostic tests were run on the analysis to rule out extreme values and ensure the reliability of the results. However, as CVM studies are based on survey data, this study also contains the limitations that survey based studies usually have.

## 7. OBSERVATIONS FROM THE FINDINGS

We have conducted a comprehensive study for determining the value of the Isahaya Bay Wetland in three cities of Kyushu Island, Japan (Isahaya, Nagasaki and Kitakyushu), by applying contingent valuation method. The results lead to the following observations:

- 1) From the findings it might appear that the eco-system of the Isahaya Bay Wetland is more valuable to the residents of Nagasaki and Kitakyushu than Isahaya (see **Table 5**). But we should take care in interpreting this result and take the following points into account:
  - a) The number of households is smaller in Isahaya as compared to Nagasaki and Kitakyushu, which gives a lower total WTP in spite of approximately same average WTP as other cities (see **Table 5**).
  - b) To the residents of Isahaya protection from flood disaster is more important than the value of wetland, which was also reflected

into the image survey question where 50% of the respondents of Isahaya strongly viewed the IBRP as a symbol of flood protection (see **Fig. 4**).

- 2) The gradual rising trend in median WTP, as shown in **Fig. 6** indicates that, as we go more further from the IBRP, more the median WTP increases. Thus, it can be concluded that, in case of the particular commodity like the Isahaya Bay Wetland, where sea dikes are constructed having both positive (flood control) and negative (environmental damage) impact, the further we go from the location of the project, more the median WTP increases.
- 3) From the **Figs. 7, 8 and 9** we have seen the area-wise variation in mean WTP for the three cities. And especially in the Isahaya city this value is significantly lower as reported by the respondents living near the reclamation project. But interestingly this value increases by two-fold in the areas a little far from the project in the same Isahaya city, such as central or northern Isahaya. This supports the second observation made above and leads us the conclusion that, the mean WTP also increases as we go far from the location of the project and after a reasonable distance the amount become steady gradually.
- 4) There is a sizeable gap between median WTP and mean WTP, a difference that has large implication on policy makers concerning the appropriateness of continuing the IBRP.
- 5) Although the respondents of Isahaya city view IBRP more as protection from flood (50 percent) than damaging eco-system (44 percent), but their mean WTP is very close to those of Nagasaki and Kitakyushu (see **Table 5**). This implies that, they are supporting the project for protecting them from flood disaster; at the same time they also acknowledge the destruction of eco-system caused by the project.
- 6) The results of the study has several implication for the society and policymakers as follows:
  - a) Firstly, the total WTP calculated can be treated as a proxy value of the amount of damages caused to the residents by the IBRP (see **Table 5** for the Total WTP).
  - b) Secondly, these WTP values calculated by using the contingent valuation method can provide a base for paying compensation to the



potential affected interested groups by the concerned authorities.

c) Finally, recognition of socio-environmental costs of the public works project can be done in such a way, by using CVM as one of the alternatives. This would enable the citizens and the concerned public bodies to decide on the viability of the project before initiating it and reduce unwanted debates.

## 8. CONCLUSIONS

This study is the first attempt to quantify the environmental value of the eco-system of the Isahaya Bay Wetland. It has drawn attention to the contrasting views that are often involved in environmental issues, where we need to choose between environmental preservation versus protection from natural calamity. The results of this study would provide the residents and researchers a quantitative estimate to base their discussion about the much-debated Isahaya Bay Wetland.

Regarding the IBRP it can be concluded that, undertaking construction works to protect from natural disaster is definitely important, but careful long-term viability study should must be conducted to make sure that it does not eventually destroy the invaluable and non-restorable eco-system. This area leaves the scope for further studies.

**ACKNOWLEDGEMENT:** The authors would like to express their gratitude to the respondents of the Isahaya, Nagasaki and Kitakyushu cities for their

cooperation and commitment to the survey study.

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(Received June 24, 2002)

## 仮想評価法(CVM)を用いた諫早干拓の環境修復価値の推定

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本論は、諫早干拓の環境の修復に関する価値について、九州の諫早市、長崎市、北九州市を対象として仮想評価法(CVM)により評価を行ったものである。対象とした3市の住民に郵送方式でアンケート用紙を配布し、また、その際の支払い意思額(WTP)の回答方法として、一般的に用いられている二肢選択法(DC)を用いた。その結果、諫早干拓の環境修復の価値として、諫早市では市全体で約2億円、長崎市では約11億円、北九州市では約27億円の価値を認めていることが分かった。また、個人(世帯)の支払い意思額は、諫早干拓地からの距離が大きくなるにしたがって増加する傾向にあることが分かった。市内部での支払い意思額のばらつきは、諫早市で最も大きく、距離が離れるほど小さくなっていった。