Environmental Valuation of Huis Ten Bosch by Integrating Remote Sensing and CVM

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Abstract: This study aims to estimate, in monetary figures, the environmental value of recreational theme park- Huis Ten Bosch (HTB), located in Nagasaki Prefecture, Japan, through the integration of both contingent valuation method (CVM) and remote sensing. In the analysis, we have estimated the environmental value of HTB through CVM. Then, we have compared this amount with the valuation made by using remote sensing. The results of the study would provide the interest groups some monetary base, to value the worth of environmental restoration activities undertaken by HTB.

Keywords: Remote Sensing, Contingent Valuation Method, Environmental Valuation, Huis Ten Bosch.

1. Introduction

Huis Ten Bosch (HTB), meaning 'House in the Forest' in Dutch, is one of the biggest theme parks in Kyushu, Japan (see **Fig.1**). It is a famous private recreational theme park opened on March 1992 at an approximate cost of ¥ 300 billion, created by transforming industrial wasteland through various environmentally affable mechanisms.

Although Huis Ten Bosch marked a bright start by attracting visitors not only form Japan, but also from neighboring Asian countries, this trend did not continued. HTB started to fall into financial difficulties.

Accordingly, HTB revenues continued shrinking and stood at about ¥35 billion in 2001, down 40 percent from the peak annual revenues of about ¥49.6 billion in 1996, while the liabilities stood at about ¥229 billion, including about ¥180 billion in loans. Eventually on February 2003, operators filed for protection from its creditors under the Corporate Rehabilitation Law and currently efforts are continuing for its revival. For the continuation of the activities of HTB it is very much important to quantify the value of HTB activities in monetary figures. In doing so, we wish to apply both economic potential behavioral techniques CVM on the one hand and land cover mapping by remote sensing on the other. And to compare the value derived under these two methods to see how these two can be integrated to achieve a range of environmental valuation.

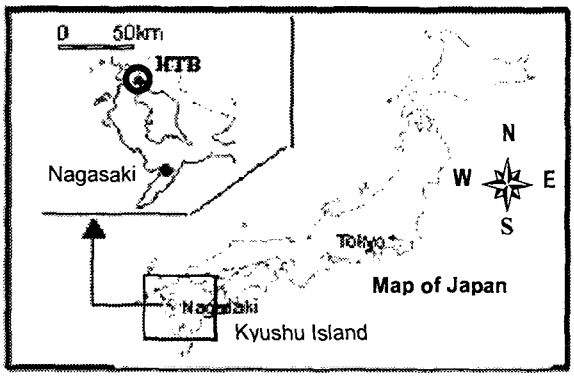


Fig. 1 Location of the HTB

2. Objectives

The objectives of the study are to estimate the environmental value of Huis Ten Bosch (HTB) through the integration of CVM and remote sensing; and to see the difference in valuation of environmental impact by behavioral economic tools based survey and thematic mapping of land cover derived from satellite remote sensing images.

3. Methods

The research methodology followed in this study is explained in **Figs. 2** and **3** and are outlined below:

1) Contingent Valuation Method

Under contingent valuation method, mail survey technique and double bounded dichotomous choice (DC) elicitation method have been used for estimating the willingness to pay (WTP) for preserving the Huis Ten Bosch (HTB). Households were selected randomly from the telephone directory in the two cities of Kyushu Island, Japan: Nagasaki and Sasebo. In deriving the aver-

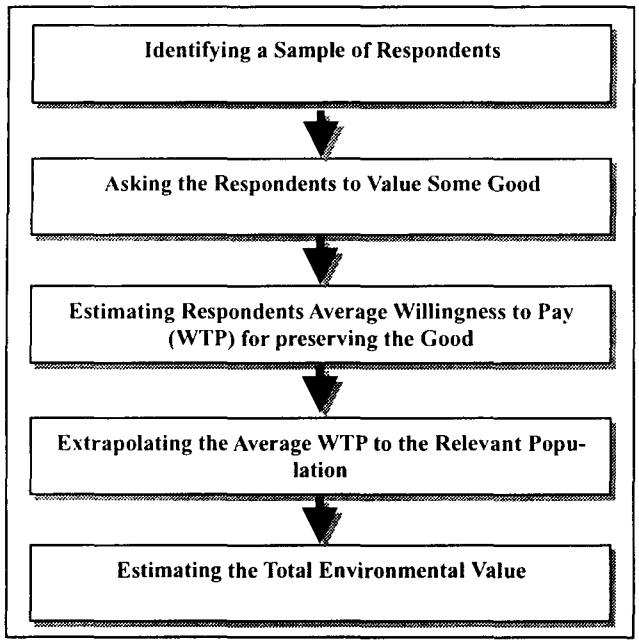


Fig. 2. Steps involved in environmental valuation by applying CVM

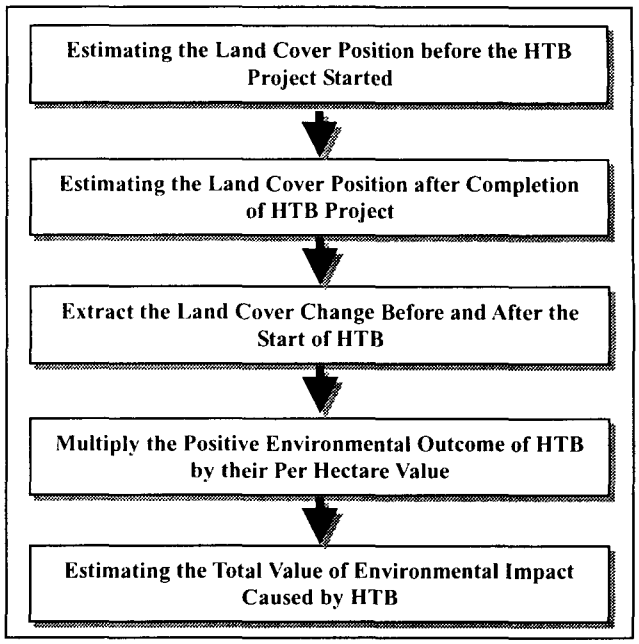


Fig. 3. Steps involved in environmental valuation by remote sensing

age WTP, non-parametric estimation Turnbull method is followed and used the following equation [1].

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

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 ith 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.

Pre-testing studies are conducted before finalizing the questionnaire and the type of the elicitation method to be used in the final part of the study

2) Land Cover Mapping

Land cover mapping by satellite remote sensing images of LANDSAT-5 are used to determine the land cover changes in the Huis Ten Bosch (HTB) before and after the project. Then, we have multiplied the positive environmental outcome of HTB by their per ha value to get the environmental value of HTB.

LANDSAT-5 launched on March, 1984 having ground resolution of 30 meter for all bands, except for band 6 with 120 meter resolution. Thus one pixel is equivalent to 900 m^2 for bands 1- 5 and 7. The selection of the satellite images were done strictly on the following criteria:

Table 1. Total estimated WTP

Description	Number/ Amount
Sample size (complete)	479
Mean WTP (¥/household)	4,000 [a]
Median WTP (¥/household)	2,000
SD of the Mean	238
Range of 95% confidence interval (¥)	± 467
Total Number of Households in Nagasaki Prefecture	542,985 [b]
Estimated Total WTP (Billion yen)	2.17

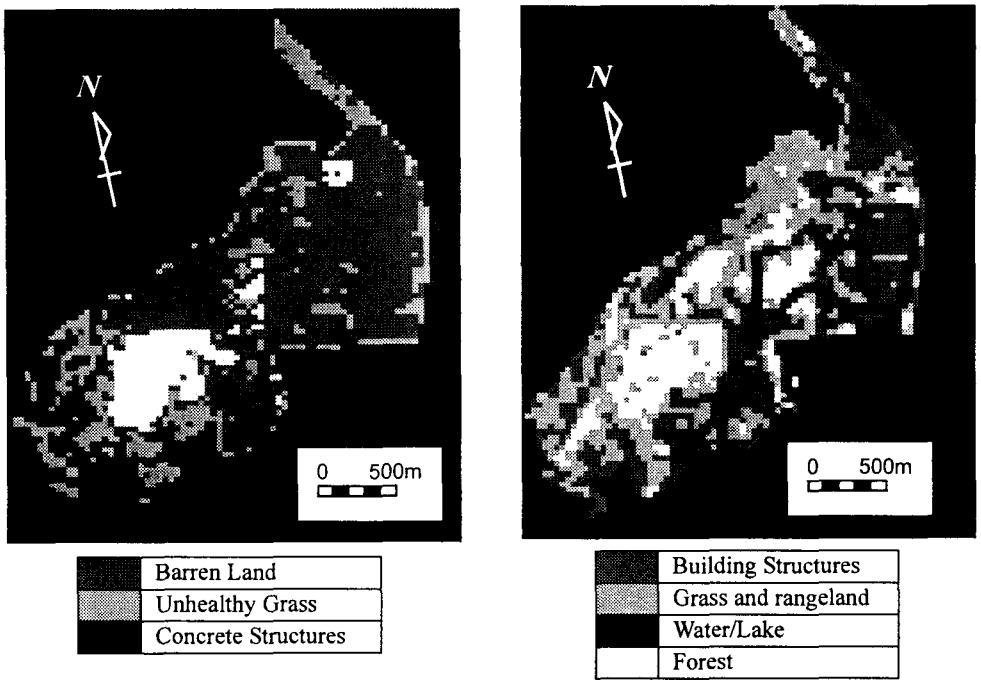
Note : [a] Rounded to nearest 100 yen.
Source: [b] MPHP, 2003 [2].

1. High quality images with minimal or no cloud coverage.
2. Identical time period as far as possible.

4. Environmental Valuation by CVM

1) Contingent Valuation Survey Description

The questionnaires were sent to a random sample of 950 households of Sasebo and Nagasaki Cities. Mail survey technique was used for data collection and households were selected randomly from the registered telephone directory.



(a) 1988 (Before HTB project)

(b) 2000 (After HTB project)

Fig. 4. Land cover changes in the HTB area

2) Monetary Valuation by CVM

On the basis of the methodology described above, the mean (WTP) is estimated to be approximately 4,000 yen per household for all the sample respondents of Sasebo and Nagasaki Cities. (See **Table 1**). The median (WTP) is 2,000 yen per household. Next we are going to extrapolate the mean WTP of 4,000 yen to the entire 4,976,000 (MPHP, 2003) private households of Kyushu to estimate the benefits received from various environmental costs incurred by HTB. Accordingly, we found that, the residents of Nagasaki Prefecture are willing to pay approximately ¥2.17 billion to preserve the Huis Ten Bosch.

5. Environmental Valuation by Land Cover Mapping

1) Examining the Land Cover Before and After the HTB Project

In order to see the environmental impact of the HTB project, we have examined the land cover changes by satellite images of LANDSAT-5 before and after the initiation of the project. Although HTB was officially opened for public in 1992, its construction work began in 1988. Hence in this study we have taken the images of April 1988 to see the land cover position of the HTB project area before any development work started. Then we have compared it with that of April 2000 to see the change in the land cover due to various activities of HTB. **Table 2** and **Fig.4** show such land cover changes result by unsupervised classification. From the results of the classification verified with ground truth, it has been revealed that in 1988, the HTB project site was mostly industrial wasteland consisting of about 191 ha of barren land and unhealthy grass, and about 80 ha of demolished concrete structures. Thus the land cover of the area was mostly unproductive industrial wasteland (see **Fig. 4a**). On the other hand, land cover classification in 2000 shows that land cover in the area changed a lot with transformation of lands into water/ lake, forest, grass and rangeland and building structures (see **Fig. 4b**). Thus, both by land cover images and ground truth it has been confirmed that, HTB project contributed positively towards restoring the eco environment in the area.

Table 2. Land cover change in the HTB area

Classification	1988 Area in ha	2000 Area in ha
Water/Lake	-	43
Forest	-	46
Unhealthy Grass	53	-
Grass and rangeland	-	85
Barren Land	138	-
Concrete Structures	80	-
Building Structures	-	93

2) Monetary Valuation by Land Cover Mapping

In this section, we have attempted to convert the positive environmental impact (benefits) resulted from HTB project into monetary figures. In doing so, we need to have the per hectare value of these impacts. Costanza *et al.* (1997) attempted to place a total value on the Earth's ecosystem and estimated the total area covered by 17 biomes classified by Bailey [3]. In valuing each biome, the services provided are identified and given a monetary value based on past research and original calculations. The value placed for water/ lake, forest, grass and rangeland in this study are ¥934 thousand $ha^{-1} yr^{-1}$, ¥106 thousand $ha^{-1} yr^{-1}$ and ¥26 thousand $ha^{-1} yr^{-1}$, respectively (converted by taking $1=¥110) (see **Table 3**).

Based on this, we have calculated the present value of all these three environmental goods in perpetuity by taking 3% as the discount rate, as lower rate is usually preferred for environment friendly public beneficiary projects [4]. The formula for calculating present value of a sum in perpetuity is as follows:

$$PV = \frac{C}{r} \qquad (2)$$

Where, PV is the present value, C is the annual cash value and r is the discount rate. The present values calculated are shown in **Tables 3 and 4** and provide us present value of total environmental benefits provided by HTB as ¥1.58 billion at 3 percent discount rate.

6. Conclusion

By compiling both of the valuation results we can conclude that, the value of preserving HTB is in between 2.17 billion yen to 1.58 billion yen (see **Table 5**). Somewhere near this the true value lies. Finally, the estimation of monetary value of environmental restoration activities initiated by a project is a very difficult and complex task. But it is essential for ensuring the sustainability of projects protecting and improving the surrounding environment. In particular, valuation of HTB is very much timely as presently rehabilitation activities are going on in HTB after financial bankruptcy. This study in this regard is merely a modest attempt to integrate CVM and satellite remote sensing techniques and leaves the ample scope for further studies and discussion.

Table 3. Environmental benefit analysis of HTB

	Area (ha)	Value $ha^{-1} yr^{-1}$ (¥)	Total Value yr^{-1} (Mil. ¥)
Water/Lake	43	934,000	40.16
Forest	46	106,000	4.88
Grass and rangeland	85	26,000	2.21
Total			47.25

Table 4. Present value of environmental benefits

	Discount Rate 3%
Total Value of Env. Benefits $year^{-1}$ (Mil. ¥)	47.25
Present value of Benefits (Mil.¥)	1575
Total estimated present value of Env. Benefits (billion yen)	1.58

Table 5. Summary of environmental valuation estimates

Valuation Method	Value (Billion¥)
CVM	2.17
Land Cover Mapping	1.58

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