Economic Valuation of Nature Area of Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake), Malaysia

Mohd Parid Mamat1*, Mukrimah Abdullah1, Nor Hizami Hassin2 and Faten Naseha Tuan Hussain1

1Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor D.E., Malaysia
2Faculty of Earth Science, Universiti Malaysia Kelantan Kampus Jeli, 17600 Jeli, Kelantan, Malaysia

E-mail: paridms@frim.gov.my

Abstract. The value of protected natural environments is important for policy-making in a world of increasingly scarce natural resources. The natural environment includes protected areas such as forest reserves and lake parks which are also areas with high potential for ecotourism. The increasing demand for tourism has led to the development of infrastructure and facilities, particularly the development for ecotourism. However, the economic benefits of natural ecotourism areas are not readily quantified because of the unavailable market price. This is true for the forest and lake resources where the potential and realised benefits for recreation purposes are not valuated. If valuation is not done, the allocation of the resources cannot be optimised and the natural resources may be converted for other purposes. Quantifying the economic value of natural environment resources can show where goods and services are currently underpriced by the market. It can also indicate whether there is potential to develop new markets, to charge prices for the use of natural resources, or to capture natural resource benefits in financial terms. Other than generating revenue, prices and market measures can provide an effective means of regulating the demand for resources and of providing incentives for sustainable management. The purpose of the study is to estimate the value of Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake), in Malaysia, through non-users' willingness to pay (WTP). In this study, the dichotomous-choice contingent-valuation method (CVM) was employed to estimate the economic value of conserving the park through face-to-face interviews. The WTP was elicited from a total of 268 respondents. The respondents were asked whether they would be willing to contribute a conservation fee to preserve the park as a recreational site. The average WTP for all respondents was estimated to range between RM111.22 and RM293.12 annually, which translates to a contribution of between RM11.22 million and RM29.58 million in aggregate for the year 2019.

1. Introduction
Apart from the conservation of biodiversity, the lake ecosystem has a positive effect on the enjoyment and appreciation of natural resources by the public. Lake ecosystems encourage the development of tourism (including ecotourism), particularly the development of recreational activities. Benefits brought about by lake ecosystems come in the form of contribution to tourism-related income at national or state levels, the generation of direct and indirect employment, and an increase in social and cultural development [1]. Lake ecosystems are often suitable as recreation sites because of their inherent beauty and richness of biodiversity. The vegetation, fish, aesthetic environment, together with
the peaceful and harmonious condition of the site, combine to offer an area for human enjoyment, particularly for those who live in urban areas.

Currently, the demand for recreational activities in lake ecosystems is increasing. However, the economic benefits of recreation, particularly in lake ecosystems, are not readily quantified because of the unavailable market price. This is true for lake resources and their environments where the potential and realised benefits for recreational purposes are not valued. If this is not done, the allocation of lake resources cannot be determined optimally and they may be converted for other purposes. Quantifying the economic value of natural environment resources can show where goods and services are currently under-priced by the market. It can also indicate whether there is potential to develop new markets, to charge prices for the use of natural resources, or to capture natural resource benefits as cash value [2]. Other than generating revenue, prices and market measures can provide an effective means of regulating the demand for resources and of providing incentives for sustainable management. Demonstrating the economic value of recreation in lakes can make a convincing case for the conservation of the ecosystem. Given the apparent benefits obtained from the ecosystem, environmental economists have attempted to place economic value on its conservation efforts [3]. Higgins and Turpie [4], for example, valued South Africa’s mountain fynbos ecosystems in order to argue for increasing funding and protection. Spurgeon [5] showed how valuation can be used to support ecosystem rehabilitation and protection in coastal and marine habitats. Kumari [6,7] calculated the economic value of forest and wetlands in North Selangor to make the case for increased international financing to secure global benefits. Specifically for the case of protected areas, the valuation of economic benefits through willingness to pay (WTP) can be used to defend the gazetting of new locations or to argue against changes in their protected status. Akbar Ali et al. [8] calculated the economic value of Sarawak Cultural Park, and the result shows that the average WTP for an individual is RM45.90. This result shows that visitors are willing to pay high prices in restoring and preserving the beauty of the Sarawak Cultural Park. Emerton et al. [9], for example, calculated the economic value of ecosystem services and livelihood benefits from Nakivubo wetland in Kampala, Uganda, at more than USD1.5 million a year, using the results to make a strong case for it to be protected as part of the city’s green belt.

In this respect, the purpose of this research is to estimate the value of recreation in a lake ecosystem, the Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake), by using a tool utilised in environmental economics, the dichotomous choice CVM.

2. Material and Methods
This study attempts to measure recreation benefits from a societal perspective (non-use values). The contingent valuation method (CV) is used to derive willingness to pay (WTP) of people. From this value, the aggregate monetary benefits of recreation in Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake) are estimated. In estimating this value, the CV with a close-ended WTP elicitation format was employed. Contingent valuation is defined as ‘any approach to valuation of a commodity that relies upon individual responses to contingent circumstances posited in an artificially structured market’ [10]. In this study, individuals were asked directly to reveal how much they were willing to pay to conserve the Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake) and its ecosystem for recreational activity. The theoretical basis of CV used in this study is the equivalent surplus (ES) measure of welfare, which measures the amount a person is willing to pay or accept, to place him on a better utility or welfare level if changes in quality of goods in question do not occur.

2.1 Questionnaire design
The survey questionnaire is an instrument that sets out a number of questions to elicit the monetary value of a change in a non-market good. Contingent valuation method (CVM) uses survey questions to elicit the society’s preference for public goods by creating a hypothetical market. CVM questionnaires can be designed to elicit willingness to pay (WTP) or willingness to accept (WTA) estimates for a change in the level of provision of a public good [11]. A questionnaire was designed to gather primary
information such as socio-demographic profile, attitude, and peoples’ willingness to pay for recreational activity in Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake) ecosystem. For the purpose of this study, primary data from respondent households were collected through face-to-face interview. The dichotomous choice – double bounded format was used as an approach of CVM for this study. The format gives the respondent an opportunity to choose the amount of WTP. Through this format, the response ‘yes’ or ‘no’ was needed for the WTP questions. Six different bids were given to different respondents randomly. Each respondent only has to say ‘yes’ or ‘no’ to the bid posed to them. Six bids were selected for use: RM10, RM30, RM50, RM100, RM150, and RM200. The charges are chosen based on a pilot study.

This study focused on the non-users’ for a number of reasons. Households instead of individual visitors were chosen as respondents for interview. “Visitors” are broadly defined as those who use the park and participate in the activities provided. However, at the time of writing, the park area is no longer open to the public. Therefore, households were chosen for the interviews. In terms of the sample size, Roscoe (in Sekaran [12], proposes the rule of thumb that for most research, a sample size that is larger than 30 and less than 500 is appropriate; and for samples that are broken into sub-samples, a minimum sample size of 30 for each category is necessary. As a further guideline, Calia and Strazzera [13] in their study on bias and efficiency of single vs. double bound CVM model, define “small size sample” as a sample of 100 or less; 250 – 400 as a “medium size sample”; and more than 1000 as a “large sample size”. They conclude that even for a medium sample size, both single and double bound CVM perform well in giving point estimates for the parameters and of the mean WTP.

The survey design was determined by the Department of Statistics (DOS) Malaysia, using random sampling. The parameters used in the sample determination were based on the strata or status of the area, whether urban or rural. The interview survey was conducted on 16 Enumeration Blocks (EB) provided by the DOS representing two Districts, namely, Kota Bharu and Tanah Merah/Jeli. The DOS also issued a map for every EB to facilitate the process of collecting data for this study. Given the limited time and budget constraints, we managed to obtain 268 responses for the analysis. The survey was undertaken in October 2019. The analyses were done using Statistical Package for Social Science (SPSS) and Stata/SE 16.0.

2.2 Econometric models

2.2.1 Logistic model

The exploration of whether a person is willing to pay for conservation of the park was done using Logistic model. This model was chosen because of its ability to deal with a dichotomous dependent variable and a well-established theoretical background. The model is specified as follows:

\[ P_i = \frac{e^{\beta_0 + \beta_\sum X_i}}{1 + e^{\beta_0 + \beta_\sum X_i}} \]  

(Eq. 1)

where \( P_i \) = the probability that \( Y = 1 \), \( X_i \) is a set of independent variables explained above and \( \beta \) are coefficients to be estimated corresponding to logistic distribution. Taking a natural logarithm of Eq. (1) we obtain

\[ L_i = \ln \{ P_i / (1 - P_i) \} = \beta_0 + \beta_\sum X_i + e_i \]  

(Eq.2)

where \( L_i \), which is called logit, is the log of the odd ratios and is linear in both independent variables and parameters. The estimation method used was the maximum likelihood estimator (MLE).

2.2.2 Bivariate probit model

Following this, another nonlinear model using bivariate probit was employed to estimate the values with a binary dependent variable, the “yes” and “no” responses to the WTP question. For this model, the estimation of mean and median WTP was done by using the estimated coefficients which is given
by Cameron and Quiggin [14]. The estimation of the coefficients using bivariate probit model include two related models, which can be expressed as:

\[ Y^*1 = \alpha_1 + \beta_1 B1 + \sum \beta_i x_i + \epsilon_1 \]  
(Eq.3)

\[ Y^*2 = \alpha_2 + \beta_1 B2 + \sum \beta_j x_j + \epsilon_2 \]  
(Eq.4)

\[ \text{corr} [\epsilon_1, \epsilon_2] = \rho \]

Where Y1 and Y2 are the binary responses to the WTP questions; B1 and B2 are the bids in the first and second bid question; Xi represents socio-demographic variables and \( \alpha \)'s and \( \beta \)'s are the coefficients to be estimated.

2.2.3 Linear model (OLS)

A linear model using OLS method was also employed in order to determine the variables governing the amount of money an individual is willing to pay for recreation of the area of study using maximum WTP figures as a dependent variable against other independent variables, which can be expressed as;

\[ WTP_i = \alpha + \beta X_i + \epsilon_i \]  
(Eq.5)

where, \( X_i \) is a vector of independent variables, and \( \epsilon_i \) is a random error, assumed to be normally distributed with mean zero and common variance \( \sigma^2 \), i.e. \( \epsilon_i \sim iid \ N(0, \sigma^2) \). The estimated regression model is:

\[ \hat{WTP}_i = \hat{\alpha} + \hat{\beta} X_i \]  
(Eq.6)

3. Results and discussion

3.1 Demographic profile

The 268 respondents are mostly female (at 63%). By ethnic composition, all the respondents (100%) are Malay. In terms of marital status, most respondents were married (89%) while the rest (11%) were single. By educational attainment, except for a minority of respondents who did not go through any education (9%), the rest had attained primary education (12%), lower secondary (19%), upper secondary (47%), diploma/certificate (11%) and tertiary education (2%). The majority (81%) of the respondents were between 21 and 60 years old while there were 4% who were below 21 years old and 15% above 60 years old. In general, the respondents were not involved with NGOs. Less than 1% of the 268 respondents were members of forestry and environmental NGOs. Among the 268 respondents, slightly more than half (68%) were in employment, either as employees in the public and private sectors or self-employed (such as farmers, rubber smallholders, oil palm smallholders and small traders). The rest of the 32% respondents not in employment were housewives, retirees, students and the unemployed. In 2019, 40% of the 268 households interviewed received a monthly income of less than RM1,500. Those receiving monthly income of RM1500–RM3,500 made up 41% of the total respondent households. Nine percent of the households were part of the third group (RM3,501-5,500) and the fourth group (RM5,501-7,500) stood at 6%. It was noted that 4% of the households received income of more than RM7,500 a month.
Lake area/ecosystem in general is not entirely new to the community in Kota Bharu and Tanah Merah/Jeli district. From the 268 respondents, 26% respondents had visited or conducted activities related to lakes before. This suggests that local people are interested to engage in lake-related activities, therefore relevant authorities such as the district office and the Forest Department can work closely to increase local involvement in activities related to the forest and lake such as tree planting and other conservation-related activities. Out of the 268 households, 178 (66%) were aware of the existence of the Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake). Only 42 respondents (16%) have visited Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake) with an average of 1.9 visits per lifetime.

3.2 Wilingness To Pay (WTP) estimation

For this study, our estimations are made using both single and double-bounded dichotomous choice models. For our single-bounded dichotomous choice model, we estimated the WTP using Logistic model, while for the double-bounded dichotomous choice analysis we used a bivariate probit model. The explanatory variables we used are listed below. These variables were included into the models partly because they were believed to be important determinants of WTP.

\[
Willingness = \alpha + \beta_1 \text{percepECO} + \beta_2 \text{POLICYinpo} + \beta_3 \text{INCOME} \beta_4 \text{BUDGETrank} + \beta_5 \text{FAMILIRenv} + \beta_6 \text{BID1} + \beta_7 \text{BID2}
\]

Where:
- **WILLINGNESS** Dependent variable with 1 if respondent is willing to pay for for the amount asked, 0 otherwise
- **percepECO** Perceptions of the use of the Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake) by priority
- **POLICYinpo** Importance of policies on environmental conservation
- **INCOME** Monthly gross income (RM/month)
- **BUDGETrank** Government allocation/budget for forest and lake environment management
- **FAMILIRenv** Familiarity and sensitivity to environmental issues
- **BID1** Dichotomous choice bid assigned. There are 6 sets of bids; RM10, RM30, RM50, RM100, RM150 & RM200
- **BID2** Follow-up bid assigned

The results for the logistic model shows that percepECO (perceptions of the use of the Sultan Ismail Petra Ecosystem Protection Park by priority), POLICYinpo, BUDGETrank (Government budget) and BID are among demographic variables with significant impact on WTP for the conservation of the lake ecosystem (Pergau Lake) for recreation and ecotouristic activity (Table 1). When the respondents believed that the lake area (Pergau lake) is important for ecotourism, the probability of saying “yes” increases. For the perception that the government should allocate a budget for the purpose of preserving the forest and lake environment, a positive perception resulted in a higher probability of saying ‘yes’ or of accepting the bid. People who were satisfied with the government budget for forest and lake conservation were willing to pay more. However, inconsistency in terms of expected signs still remained for the variable measuring the importance of environmental policy (POLICYinpo). The coefficients for the bid offered (BID) are negatively correlated with the probability of acceptance, as expected. The negative and statistically significant coefficients on the bid suggest that the higher the amount respondents are asked to pay, the less likely they would pay.

For the bivariate probit model, the results indicate that the perceptions of the use of the Sultan Ismail Petra Ecosystem Protection Park by priority (percepECO) and government budget (BUDGETrank) has a statistically significant positive impact on both the respondents’ initial and subsequent decision on their willingness to pay for preservation lake ecosystem (Pergau lake). The regression coefficient is 0.697 at the initial response and 0.425 at the follow-up response for
BUDGETrank, which means that people who are satisfied with the government budget for forest and lake conservation purposes are more probable to pay more.

Household income (INCOME) also gave a statistically significant positive impact on an individual’s willingness to contribute towards the preservation of Pergau lake, for this variable only proved to be a statistically significant determinant in relation to an individual’s follow-up bid on his willingness to pay for the preservation of Pergau lake. The regression coefficient is 0.000089, which means that the higher the monthly income, the more likely agree the individual is willing to pay for preserving the park (Pergau lake). This result is in line with the past studies done by Carson, Wilks and Imber [15], and Radam and Abu Mansor [16] which indicates a positive relationship between income and WTP.

For the linear models estimated using OLS, the results, the variables measuring monthly income (INCOME), Government allocation/budget to forest and lake environment management (BUDGETrank), importance of environmental policy (POLICYinpo) and perceptions of the use of the Sultan Ismail Petra Ecosystem Protection Park by priority (percepECO) are significant. R² is the coefficient of multiple determination which measures the goodness of a general linear model to fit a set of data. The measurement of R² value is between 0 and 1. When the value of R² is closer to 1, the variables are strong; if the value of R² is nearer to 0, the model does not fit the data well. From the analysis, the R² is 0.17 indicating that 17% of the variance in the dependent variable is explained by the independent variables in the model. However, the F statistics test is used to test the significance of the function as a whole in contributing to the variance in the dependent variable.

Table 1. The estimated parameters of the models for the preservation of the Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake)

| Variables        | Logistic Using initial bid | Bivariate probit WTP | WTP² | OLS     |
|------------------|----------------------------|-----------------------|------|---------|
| Constant         | 3.247                      | 1.964                 | -0.324 | 52.419  |
| INCOME           | (0.679)                    | (0.372)               | (0.320) | (14.46) |
| BUDGETrank       | -0.0000671                 | -0.0000394            | 0.000039 | 0.009   |
| POLICYinpo       | 1.226                      | 0.697                 | 0.425 | 33.901  |
| (0.538)**        | (0.299)**                  | (0.227)**             |      |         |
| FAMILREV         | -1.461                     | -0.859                | 0.0622 | -30.86  |
| (0.638)**        | (0.349)**                  | (0.299)***            |      |         |
| percepECO        | 0.532                      | 0.388                 | -0.076 | 4.62    |
| (0.420)          | (0.238)                    | (0.204)***            |      |         |
| BID 1 (start bid)| -0.021                     | -0.0124               | 0.190 | 29.69   |
| (0.005)***       | (0.0018)***                | (0.10)**              |      |         |
| BID 2            | -0.0035                    | -0.0035               | 0.171 | 8.45    |
| -2 log likelihood| 181.918                    | 223.721               |      |         |
| No. of obs. (n)  | 211                        | 211                   | 211  |    |
| PredR²           | 0.27                       |                      |      |         |
| R²               |                            | 0.171                 |      |         |

Note: Standard errors in parentheses
* denote significance at 10% level
** denote significance at 5% level
*** denote significance at 1% level

3.3 Estimation of mean and median Willingness to Pay
There are three approaches involved in estimating mean and median WTP, namely through logistic, bivariate probit and OLS analyses. The calculated mean and median values are listed according to models estimated using different approaches in Table 2.
Table 2. Mean and median WTP estimated for the sample

| Models          | Mean Willingness to Pay | Median Willingness to Pay |
|-----------------|-------------------------|---------------------------|
| Logistic        | Initial bid             | 214.99                    | 214.47                    |
| Bivariate probit| Initial bid             | 216.82                    | 211.15                    |
|                 | Follow-up bid           | 293.12                    | 167.88                    |
| OLS             |                         | 111.22                    | N.A                       |

Referring to estimates obtained from positive WTP responses, the mean WTP was quite close to the median WTP for the logistic model. The estimation of the mean WTP was RM214.99. From the bivariate probit models, the mean WTP ranges from RM216.82 to RM293.12, slightly higher than the results yielded by the logistic model. On the other hand, the model estimated through OLS provide lower estimates to that of logistic and bivariate probit models, at RM1111.22. The bivariate probit model provides the highest estimate of RM293.12. From the overall results, the mean WTP is found to be slightly higher than the median WTP.

3.4 Aggregation
In order to aggregate the WTP for the preservation of Sultan Ismail Petra Ecosystem Protection Park (Pergau Lake) for recreation and ecotourism, the individual WTP obtained from the analysis was multiplied by the number of households in both district undergoing sampling (Kota Bharu & Tanah Merah/Jeli). The yearly calculated conservation value or benefits for Pergau lake based on the mean willingness to pay computed from respective models for the year 2019 are shown in Table 3.

| Estimated number of households | Logistic model | Bivariate probit model | OLS model |
|--------------------------------|----------------|------------------------|-----------|
| (Kota Bharu & Tanah Merah/Jeli District) | Initial bid WTP=214.99 | Initial bid WTP=216.82 | Follow-up bid WTP=293.12 | WTP=111.22 |
| 100,931                        | 21,699,156     | 21,883,859             | 29,584,895 | 11,225,546 |

4.0 Conclusion
It is important to determine the economic value of protected areas or natural resources, so that we can compare the benefits of different projects or programs and provide a reference to policymakers in deciding the best use of resources. The management of natural resources as well as regulation of activities that affect the resources can also be undertaken more efficiently. Policy-makers should consider the positive and negative impacts of any policy made for Pergau Lake. From the study it is suggested that preserving the lake ecosystem should be the government’s priority, as households are more willing to pay to conserve the resources if the government puts in policies to preserve the whole ecosystem in the park.

A significant policy implication of this study concerns the revenue mechanism for Pergau Lake. From the mean WTP that was found, the management should consider increasing the conservation fee or other charges in order to generate revenue for Pergau Lake. This study found the mean WTP to range between RM111.22 and RM293.12, which could contribute revenue of between RM11 million and RM29.6 million in aggregate (based on the number of households in 2019). The revenue collected would be useful in improving the management and maintenance of recreational site in Pergau Lake. Quantifying the economic value of protected areas, in this case Pergau Lake, can show where goods and services are currently under-priced and can also capture benefits for the protected areas as cash...
value or monetary value as well as generating revenue. Prices and market measures can provide an effective means of regulating the demand for resources and incentives for sustainable management.

The other policy implication based on the findings of this study is that the respondents were only willing to pay if the collection was to be channeled back to improve the management of the lake ecosystem of Pergau Lake. This means that the conservation charge collected needs to be used for the development of ecotourism and recreational activities in Pergau Lake and its surrounding ecosystems only.

References
[1] Mohd Rusli Y, Ahmad S, Mohd Parid M. and Alias R (2007). International Journal of Economics and Management, 1(3):363-384.
[2] Kamri T, Ali JK & Harun NF. (2017). Jurnal Manajemen dan Kewirausahaan 19: 16–21.https://doi.org/10.9744/jmk.19.1.16–21
[3] Adhikari S, Baral H, Nitschke Cr and Baral H. (2018) Environments 5: 53.
[4] Higgins, S.I. & Turpie, J. (1997). Ecological Economics 22 (2): 155–169
[5] Spurgeon, J.P.G.(1998). Marine Pollution Bulletin 37 (8–12): 373–382
[6] Kumari, K. 1995. An environmental and economic assessment of forest management option: A case study in Malaysia. Washington, D.C., Environment Department Papers No. 026, Environmental Economics Series, World Bank.
[7] Kumari, K. 1996. An application of the incremental cost framework to biodiversity conservation: A wetland case study in Malaysia. London, Working Paper GEC 95-15, Centre for Social and Economic Research on the Global Environment.
[8] Akbar Ali, A.K. and Lee, M.H. (2009). Contingent Valuation on Restoration and Preservation of Sarawak Cultural Park. Prosiding PERKEM IV, Jilid 1 577-593 ISSN: 2231-962X
[9] Emerton, L., Iyango, L., Luwum, P. & Malinga, A. 1999. The economic value of Nakivubo Urban wetland, Uganda. IUCN – The World Conservation Union, Eastern Africa Regional Office, Nairobi.
[10] Seller, C., Stoll, J.R. & Chavas, J-P. (1985). Land Economics. 61(2): 156-174.
[11] Mitchell, R. C. and R. T. Carson (1989). Using Surveys to Value Public Goods: The Contingent Valuation Method, Resource for the Future, Washington D. C.
[12] Sekaran, Uma. (1992). Research Methods for Business: A Skill Building Approach. (2nd Ed.). Singapore: John Wiley & Sons, Inc.
[13] Calia, Pinuccia and Strazzera, Elisabetta. (1998). “Bias and Efficiency of Single vs. Double Bounded Models for Contingent Valuation Studies: A Monte Carlo Analysis”. Working Paper. CRENoS: Universita’ degli Studi di Cagliari, (http://veprints.unica.it/331/)
[14] Cameron, T.A. and Quiggin, J. (1994). Journal of Environmental and Economic Management. 27 (3): 218-234
[15] Carson, R. T., Wilks, and Imber, D. (1994). Oxford Economic Papers, 46, 727-749.
[16] Radam, A. and Abu Mansor, S., (2000). “Use of Dichotomous Choice Contingent Valuation Method to Value the Manukan Island Sabah”. Paper presented in First Conference of Resource and Environmental Economists, Malacca, organized by Promin Committee of Malaysian Association for Resource and Environmental Economics (MAREE) on 29 – 31 July