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Estimate the conservation value of biodiversity in national heritage site: A case of Forest Research Institute Malaysia

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Abstract

Forest Research Institute Malaysia (FRIM) offers a variety of forest ecosystem services such as biodiversity conservation, recreation, ecotourism and nature-environmental education. These services are limited in supply and may lead to the reduction if resources are not managed and conserved well. Conservation of biodiversity is one of the efforts to ensure sustainability of biodiversity. The study was conducted in 2014 to value willingness to pay (WTP) for conserving biodiversity at FRIM among residents of Selangor. This study found the mean WTP ranges from RM53.24 to RM67.22, which could contribute annual revenue ranged from RM66.3 million to RM83.8 million.

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Keywords: biodiversity conservation; economic valuation, contingent valuation (CVM); willingness to pay (WTP); national heritage site

1. Introduction

Convention on Biological Diversity (CBD) defines biodiversity as the variability among living organism from all sources including terrestrial, marine, other ecosystems and the ecological complexes of which they are parts [12]. According to the World Development Indicator, Malaysia has only 0.2% of the world's land mass, its diversity of flora and fauna species makes it one of the richest countries in the world in terms of biodiversity per unit area.

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The 2001 Global Diversity Outlook recognized Malaysia as one of the 12 mega-diversity countries in the world [15]. The biodiversity contributes to economic, food security, environmental stability, national biological heritage, in science, education, and recreation and ecotourism. Massive human activities contribute to loss of biodiversity, which threaten the ecosystem stability to provide human with its goods and services [18]. At present, people are more concerned in protecting and conserving biodiversity. In 1998 Malaysia's National Policy on Biological Diversity was adopted, with the vision to transform Malaysia into a world center of excellence in conservation, research and utilization of tropical biological diversity by 2020[16]. However, there are still lacks of biodiversity conservation efforts, due to lack of knowledge and experiences. Biodiversity conservation were always been given low priority especially when it comes to land-use policy. Therefore, the trade-off between land-use and conservation must be given attention and highlighted in order to support government conservation efforts [21]. Trousdale and Gregory [23] stated that one of the most important and challenging aspects of biodiversity conservation is identifying priority lands for protection from development or other incompatible uses. FRIM (544.3 ha) is surrounded by Bukit Lagong FR and located 16 km northwest from metropolitan city of Kuala Lumpur. With its rich biodiversity and scenic beauty, today, the institute has become a tourist destination for nature tourism, education and outdoor recreation activities with the tourist arrival of 707, 297 in 2013 [13]. In the urban environment, preserving the biodiversity should become priority, especially in areas with small natural habitat remains and contains relatively high levels of biodiversity [1]. There are 200 species of land mammals all over Malaysia, 58 species (29%) from 16 families were found and recorded in FRIM [8]. In order to manage and conserve biodiversity, information about the economic value of biodiversity conservation must be obtained. Environmental valuation technique provides useful evidence to support and formulate policies by quantifying the economic value associated with the protection of biological resources [7, 14]. Moreover, this information also will contribute to realizing FRIM's aspiration to become a World Heritage site by United Nations Educational, Scientific and Cultural Organization (UNESCO).

2. Methodology

There are several methods to estimate the economic values of non-marketable goods and services. One of methods is Contingent Valuation method. The CVM is the most commonly used method, in which respondents are directly asked on how much they are willing to pay for conserving the environmental goods and services. Well-structured and implemented CVM technique can produce reliable estimated value which is enough to be used in judicial proceedings assessing natural resource damage [4]. Theoretically CVM is the only technique that is capable of capturing all benefits includes use, non-use, even existence value. This clearly showed that biodiversity conservation can be assessed through CVM. Nowadays, in Malaysia CVM is the environmental economics tool to assess the wide range of goods and services like valuing the climate protection, households' willingness to pay for curbside recycling scheme, valuing highland protected forest, cultural heritage, and watershed protection [17, 11,20, 19][6]. There were few studies in Malaysia that applied the double bounded dichotomous choice approaches such as study in marine park, highland and mangrove forest [2, 4, 19]. The advantage of this approach is that one could identify the location of the maximum WTP value from the data derived. The approach is statistically more efficient than the single-bounded dichotomous choice [10]. For the purpose of this study, CVM was used to estimate the economic value of conserving biodiversity of FRIM. The respondents were asked whether they willing to contribute conservation fee annually to conserve biodiversity of FRIM. Sample size can be crucial in determining the accuracy of the CVM estimation. Larger sample sizes imply more enumerators and involve high costs, but at the same time the larger the correctly-selected sample, the greater the accuracy of estimation would be. However, no specific study has been carried out specifically to address the ideal sample size for study using dichotomous choice contingent valuation technique. In general, Roscoe (in Sekaran 1992) proposed the rules of thumb for determining sample size as larger than 30 and less than 500 are appropriate for most research; and for samples that are broken into sub-samples, a minimum sample size of 30 for each category is necessary [22]. As a further guideline, Calia and Strazzera [3] in their study on bias and efficiency of single vs. double bound CVM model, define "small size sample" as sample of 100 or less; categorize sample size of 250 – 400 as "medium size sample"; and more than 1000 as "large sample size". They concluded 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. Given the limited time and budget constraints, we managed to obtain 410 responses from both urban and rural households of Selangor, the most

developed state among 13 states in Malaysia for the analysis. The respondents for this study were randomly sampled by Department of Statistic Malaysia. The approach of CVM for this study was the dichotomous choice – double bounded format. The format gives the respondents an opportunity to choose the amount of WTP. Five bids were given to different respondents randomly. The five bids were selected for use: RM4, RM10, RM15, RM20, and RM30. The charges were chosen based on an earlier pilot study. In the pilot study on 37 respondents, we asked (open-ended question) possible payment that respondents might be willing to pay. In the pilot study, the lowest WTP given by respondents was RM4 and the highest WTP was RM30. Therefore, RM4 and RM30 were chosen as the lowest and highest WTP respectively. The same method was used by Hall et al. [9] to determine bid values, based upon results from pre-testing or pilot test. They used open-ended questions which gave them values from USD0 to USD260. They chose to place a bid from USD2 up to USD100.The exploration of whether a person is willing to pay for conservation of FRIM's biodiversity was done using Logistic, Bivariate probit, and Ordinary Least Squares (OLS) model. These models were chosen because of its ability to deal with a dichotomous dependent variable and a well-established theoretical background. The analyses were done in Stata/SE 8.0 and SPSS 16.0.

3. Results and discussion

3.1 Demographic characteristics

The descriptive analysis was run by using frequency analysis (Table 1). Out of 410 respondents, urban areas presented 84.6% of households and balance from rural areas (15.4%). A total number of 196 (47.8%) respondents were males, and 214 (52.2%) were female. The respondents comprised 65% Malays, 22% Chinese, 12% Indians and 1% others. Result also showed 52.7% of respondents were in employment with the overall mean income of RM 3,928 per month, and range between RM 400 to RM 30,000 per month. Analysis also showed the highest frequency (28%) in age group of 31-40 years and lowest (8%) in age group below 21 years old. As high as 97.8% of the respondents had attended formal education and the balance of 2.2% of respondents never attended formal education.

Table 1 Demographic characteristics of head of households by status of urban and rural areas

Demographic Characteristics			Rural (n=63)		Urban (n=347)		Overall (n=410)	
			f	%	f	%	f	%
Gender	Female		27	13	187	87	214	52.2
	Male		36	18	160	82	196	47.8
Race	Malay		50	19	215	81	265	64.6
	Chinese		12	13	78	87	90	22.0
	Indians		0	0	49	100	49	12.0
	Others		1	17	5	83	6	1.5
Occupation	In employment	Government	6	18	28	82	34	8.3
		Private sector	20	11	162	89	182	44.4
	Not in employment	Retiree	9	21	33	79	42	10.2
		Unemployed	19	15	109	85	128	31.2
		Self-employed	9	38	15	63	24	5.9
Income	<RM1500		24	28	62	72	86	21.0
	RM1501-RM3000		22	14	130	86	152	37.1
	RM3001-RM4500		7	13	48	87	55	13.4
	RM4501-RM6000		7	12	53	88	60	14.6
	RM6001-RM7500		0	0	10	100	10	2.4
	RM7501-RM9000		0	0	15	100	15	3.7
	>RM9000		3	9	29	91	32	7.8
Age	<21 years old		8	24	25	76	33	8.0
	21-30 years old		6	10	55	90	61	14.9
	31-40 years old		12	10	103	90	115	28.0
	41-50 years old		16	19	70	81	86	21.0
	50-60 years old		11	19	47	81	58	14.1
	>60 years old		10	18	47	82	57	13.9
Education	No formal education		4	44	5	56	9	2.2
	Primary school		11	22	39	78	50	12.2

Secondary school	34	15	200	85	234	57.1
Diploma	9	15	51	85	60	14.6
Degree	5	11	42	89	47	11.5
Master/PhD	0	0	10	100	10	2.4

3.2 Contingent valuation method

Variables-variables used in the analysis are as listed below:

Willingness $= \alpha + \beta_1 \text{EXPvisit}_i + \beta_2 \text{KnowFRIM}_i + \beta_3 \text{umurAC}_i + \beta_4 \text{NGOmem}_i + \beta_5 \text{INCOME}_i + \beta_6 \text{StatusBandar}_i + \beta_7 \text{InitialBID}_i + \beta_8 \text{BID2}_i$

Where:

Willingness = Dependant variable with 1 if respondent is willing to pay for the amount asked to them, 0 otherwise

EXPvisit = Number of visits to FRIM (number of visits)

KnowFRIM = if respondents knew FRIM (1 = knew FRIM, 0 = otherwise)

UmurAC = Age of the respondent (years)

NGOmem = involved in NGO (1 = Yes, NGO; 0 = No, non-NGO)

INCOME = income respondents (RM/month)

StatusBandar = City area (1 = urban areas, 0 = rural)

InitialBID = bid price levels set out in the CVM question (Dichotomous choice format)

BID2 = Follow-up bid assigned

3.2.1. The level of willingness to pay (WTP)

Analysis showed that 89% of respondents interviewed were willing to contribute for conserving biodiversity through an annual Fund, while 11% were not willing to contribute. Respondent who are willing to pay felt that the public had a role to play in conservation. Among the minority who were not willing to pay because they felt that conservation effect should be funded by the government and they could not afford to pay any amounts presented. Frequency analysis shows the level of willingness to pay (WTP) for biodiversity conservation fund was between RM1 to RM100 per year. The analysis also showed that the average level of WTP for conservation of biodiversity FRIM was RM27.18. Average WTP rate by rural and urban areas was respectively RM27.41 and RM25.81. Correlation analysis showed, there was a significant relationship between WTP and the amount of the maximum amount of the bid price. The results show that the bid price set by RM4 (close ended), the maximum rate of WTP (open ended) was RM50 and frequency (mode) was RM10. In comparison with the bid price set by RM10, RM60 and maximum WTP was RM10. The bid price was set at RM15, RM20, RM30 and RM100 maximum WTP. Increase in the bid price set provides higher WTP.

3.2.2 Overall analysis (Urban and Rural)

For this analysis, the number of respondents who considered was 367, because 11% of the total respondents who were not willing to contribute (protest bidder) to biodiversity conservation fund. Results for the logistic model show that age (umurAC) of the respondents and bid assigned for conservation fee are negatively related (Table 2). When the age of the respondents increases, the probability of saying 'yes' decreases. When age of respondents increases by 1 year, the probability of saying 'yes' decrease by 0.4%. Results also show that negative relationship for respondents who knew the existence of FRIM (knowFRIM). Respondents who had knowledge or knew FRIM resulted less probability of accepting the bid. This was because, those respondents knew FRIM as a government agency and they felt the conservation effort should be funded by government itself. Besides that, the higher the monthly income (INCOME), the more likely the respondents would accept a given bid. The coefficients for bid offered (InitialBID) are negatively correlated with the probability of acceptance as expected. The negative and statistically significant coefficients on bid suggested that the higher the amount respondents were asked to pay, the less likely they would pay. For bivariate probit model, the results indicate that the age (umurAC) has a statistically significant negative impact on both the respondents' initial and subsequent decision on their contribution towards willingness to pay for preservation the biodiversity in FRIM Campus. Namely, the regression coefficient is -0.022 at the initial response and -0.015 at the follow-up response, which means that the older the less probability that people would accept the proposed willingness to pay or in other words they would be willing to pay less. INCOME is

significant at the 10% level of significance in initial response and 5% level of significance at follow-up response and both in a positive sign indicating that the higher the monthly income, the more likely to pay for preserving biodiversity of FRIM Campus. This result is in line with the past studies done by Carson, Wilks and Imber (1994) which indicated a positive relationship between income and WTP [4]. For the linear model (OLS), the results indicated that the respondents from the older group (as indicated by umurAC) would be willing to pay less. Besides that, the increase in monthly income would also lead to the support of the contingent valuation scenario with higher WTP. Results of the analysis also showed a positive relationship for the respondent involvement as a member of the NGO's (NGOmem) and is significant at the one percent significance level. Respondents who were NGO members and familiar with the issues related to the environment would be willing to pay more.

Table 2 Estimated parameters of the models for conservation of biological diversity in FRIM Campus

Variables	Coefficient of the models			
	Logistic	Bivariate probit		
	Initial bid	WTP[1]	WTP[2]	OLS
Constant	5.752	3.1268	1.3479	27.0549
	(1.177)	(0.5868)	(0.3257)	(4.1248)
EXPvisit	0.572	0.2940	0.4963	0.9509
	(0.66)	(0.3317)	(0.2160)**	(3.0676)
KnowFRIM	-0.911	-0.3545	0.0008	3.0412
	(0.525)*	(0.2588)	(0.1648)	(2.4606)
umurAC	-0.043	-0.0224	-0.0155	-0.1461
	(0.016)***	(0.0077)***	(0.0048)***	(0.0705)**
NGOmem	-1.047	-0.4723	5.6435	23.9552
	(1.279)	(0.7243)	(1067.953)	(7.4503)***
INCOME	0.000237	0.0001	0.00005	0.0011
	(0.00013)*	(0.00006)*	(0.00003)**	(0.0003)***
StatusBandar	-0.353	-0.2844	-0.0490	0.1279
	(0.68)	(0.3537)	(0.1989)	(2.9324)
InitialBID	-0.056	-0.0289	-	-
	(0.028)**	(0.0135)**	-	-
BID2	-	-	-0.0296	-
	-	-	(0.0068)***	-
-2 log likelihood	138.606	-292.620		-
No.of obs. (n)	367	367		367

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

3.1.3 Estimates of the mean and median WTP and the net economic benefits of biodiversity conservation campus

Referring to estimates obtained from positive WTP responses, the mean WTP was quite close to the median WTP for logistic model (Table 3). The estimation of the mean WTP was RM56.62. From the bivariate probit models, the mean WTP ranges from RM66.38 to RM67.22 slightly higher than logistic. On the other hand, models estimated through OLS provided lower estimates to that of logistic and bivariate probit model, of RM53.24. The bivariate probit model (follow-up bid) gave the highest estimate of RM66.38. From the overall results, the mean WTP is found to be slightly higher than median WTP. In order to aggregate the WTP for the conservation of biological diversity of FRIM campus, the individual WTP obtained from the analysis multiplied by the number of households in the state of Selangor for the year 2010 which amounted to 1,246,437. The yearly calculated conservation value or benefits of FRIM's biodiversity conservation based on the mean willingness to pay computed from respected models for the year 2014 ranged from RM66.3 million to RM83.8 million. If there is a proposal to charge (e.g. in the form of tax) to contribute to biodiversity conservation fund, the maximum amount found in this study was RM67.22. This value can be used by the authorities to determine the fees conservation / appropriate

conservation.

Table 3 Mean and median WTP estimated for the sample

Models		Mean Willingness to Pay	Median Willingness to Pay
Logistic	Initial bid	RM 56.62	RM 55.86
Bivariate probit	Initial bid	RM 66.38	RM 60.88
	Follow-up bid	RM 67.22	RM 62.25
Ordinary Least Squares (OLS)		RM 53.24	NA

4. Conclusion

Determination of economic values for natural resources particularly biodiversity conservation as a guide to policy-makers in deciding the best alternative use of the resources and its management. The management of resources as well as the regulation of other activities that affect the resources can be undertaken more efficiently. The policy-makers should really consider the impact of any policy made in order to conserve biodiversity. From the study it is proven that conserving biodiversity of FRIM should be the government's priority. This can be seen from the willingness to pay by Selangor's households, for preserving the FRIM ecosystem.

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