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Willingness to Pay for Conservation of Mangrove Forest in Kuala Perlis, Malaysia

(Kesanggupan Membayar untuk Pemuliharan Hutan Paya Bakau di Kuala Perlis, Malaysia)

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ABSTRACT

Mangrove forest provides ecosystem services for human well-being such as fish and non-fish products, timber and non-timber products, medical plants, and dyes. Despite the important services provided, mangrove forest size in the country is reducing at an alarming rate. The mangrove forest is often overlooked in policy decision makings because the ecosystem services' monetary values are not available in the market. Hence, we undertake this study to value the benefits of Mangrove Forest Ecosystem Services in Kuala Perlis, Perlis. We used the double-bounded Contingent Valuation Method (CVM) to value the ecosystem services provided. We interviewed 256 respondents, asking them whether they are willing to donate to the mangrove conservation program at various bid prices. Besides, we also sought their opinions on issues related to mangrove forest. The results show that the respondents are willing to donate up to MYR18.31 for the mangrove forest conservation program. Considering 75% of Perlis' adult populations are willing to donate, the donation's total collection would be MYR3,453,724 or MYR81,861 per hectare per year. The amount of respondents' donation is found to be positively correlated to the variables of the conservation program. This finding provided an important message to policymakers on managing the fund of mangrove forest conservation.

Keywords: Mangrove forest; ecosystem services; contingent valuation method

ABSTRAK

Pelbagai perkhidmatan disediakan oleh Hutan Paya Bakau kepada manusia, antaranya ikan dan produk bukan ikan, produk kayu dan bukan kayu, tumbuhan perubatan, dan bahan pewarna. Walaupun perkhidmatan seperti ini disediakan, jumlah keluasan hutan ini semakin berkurangan pada kadar yang membimbangkan. Hutan jenis ini sering diabaikan dalam pembuatan polisi kerana perkhidmatan yang disediakannya tidak diukur dalam nilai wang. Oleh itu, kajian ini dijalankan bagi menilai faedah Perkhidmatan Ekosistem Hutan Bakau di Kuala Perlis, Perlis. Teknik Penilaian Kontingen double bounded (CVM) digunakan bagi menilai perkhidmatan ekosistem yang disediakan. Kami telah menemubual 256 responden. Setiap responden perlu membuat keputusan sama ada bersetuju untuk menderma kepada program pemuliharaan Hutan Bakau atau tidak. Pelbagai amoun derma telah ditawarkan kepada responden. Selain itu, kami juga mendapatkan pandangan responden berkenaan dengan isu berkaitan dengan Hutan Paya Bakau. Hasil kajian mendapati responden sangup menderma RM18.31 bagi program pemuliharaan Hutan Bakau. Dengan mengambilkira 75% populasi orang dewasa di Perlis sanggup untuk menderma, jumlah kutipan bagi program pemuliharaan ini ialah RM3,453,724 atau RM81,861 per hektar per tahun. Hasil kajian juga mendapati amoun derma responden berkorelasi positif dengan pemboleh ubah program pemuliharaan hutan. Hasil ini memberi mesej penting kepada pembuat dasar berkenaan dengan pengurusan dana pemuliharaan Hutan Paya Bakau.

Kata kunci: Hutan paya bakau; perkhidmatan ekosistem; teknik penilaian kontingen

INTRODUCTION

Many developing and developed countries are suffering from rapid loss of mangrove forests (Lal 2003). Despite its essential ecosystem services (ES) that provide various benefits to human well-being (Costanza & Folke 1997) including fish and non-fish products, timber and non-timber products, medical plants and dyes (Lal 2003), the areas of mangrove forest are rapidly declining (Hamilton & Casey 2016). A study on the mangrove area and loss among the top 10 mangrove-rich countries revealed that Myanmar ranked first, losing 0.7% of its mangrove area per year between 2000 to 2012 (Hamilton & Casey

2016). Asia ranked top in terms of region, registering 0.28% mangrove area loss per year for the same period.

We understood the various benefits provided by ES, but calculating the benefits in monetary terms remains a challenge. The ES benefits are intangible; thus, we usually are unable to capture all their values. Such scenario explains why we always undervalue the estimated ES (Vo et al. 2012) and overlook matters related to ES policy decisions (Sathirathai 2004; Costanza et al. 1998). Lal (2003) recommended considering all costs and benefits of mangroves before deciding to resolve the undervalued estimation. The increasing popularity of the studies of the economic value of Mangrove Forest Ecosystem Services (MFES) partly because of the recommendation. Since then, many researchers have done studies on topics related, including but not limited to, mangrove-fishery benefits (Searya et al. 2020), meta-analysis of mangroves' economic benefits (AlbertoLara-Pulido et al. 2018), economic benefits of biodiversity (Mori et al. 2017), and mangroves' economic benefits (Ashournejad et al. 2019). The result from a search on the topic by Acharya et al. (2019) on two data sets of SCOPUS and ScienceDirect showed that the number of research on this topic has increased exponentially. The authors attributed this increase due to the popularity of academic seminal and global agencies' efforts, such as the Millennium Ecosystem Assessment and The Economics of Ecosystem and Biodiversity (TEEB).

King (1966) and Helliwell (1969) introduced ES valuation studies to the literature. Since then, researchers undertook more valuation research on various topics, including biodiversity (Hogarth, 2007), coastal protection (Verdú et al. 2011; Sathirathai, 2004), and climate change (De Groot et al. 2002). Majority of such studies took place in developed countries such as the United Kingdom, Canada, and Australia, and not many research were done in developing countries like Malaysia. Acharya et al. (2019) attributed this difference due to lack of ES initiatives (e.g., less funding opportunity and limited human resources) in developing countries.

Impacts of lack in ES valuation done on mangrove forest include lack of understanding on mangrove forests' importance, which drives the deforestation of mangrove forests for shrimp production, agriculture, and urban development, as evidenced by the reduction of mangrove forests size. Malaysia has reported a decline in mangrove forests areas from 560,946 hectares in 2007 to 529,424 hectares in 2013 (Malaysia, 2014). Among the top 10 mangrove-rich nations, Malaysia ranked the second biggest country in percentage of mangrove forests loss per year after Myanmar (Hamilton & Casey 2016).

The mangrove valuation studies done in Malaysia is not thorough. There is no study done that calculates the direct and indirect economic benefits of ES for certain mangrove areas This may be the reason why the area of mangrove forests in Malaysia is decreasing on yearly basis. In this paper, we estimate the value of ES benefits of mangroves in Kuala Perlis, Perlis using double-bounded Contingent Valuation Method (DBCVM). We estimate the economic benefits of mangroves conservation area to be MYR3,453,724 or MYR81,861 per hectare per year. If we manage the mangrove sustainably for 200 years, the net present value at a 5% discount rate is MYR69,070,485.54 or MYR1,637,129.31 per hectare.

The following section explains the economic benefits of mangroves and the economic valuation method used. Next, method applied in this study is presented in Section 3. Section 4 presents and discusses on the study results. Finally, section 5 concludes the study.

LITERATURE REVIEW

ECONOMIC VALUATION AND THE MANGROVES BENEFITS

Policymakers need to evaluate and understand the value of mangrove forests in terms of ecosystem services provided. If we believe and understand that there is more benefits gained by conserving mangroves compared to destroying them, a sound policy is important for such endeavor. Measuring the benefits of the mangrove, however, is a challenging task. Ecosystem benefits obtained from mangrove forests are not ordinary services that come with a price-tag. We do not trade such services in the market; therefore, its price is not available in the open market system. Thus, how do we estimate MFES value? Researchers in environmental economics (e.g., Bateman et al. 2002; Mitchell & Carson 1989) always apply an economic valuation approach to value ecosystem services.

Economic valuation is the knowledge to estimate monetary value of goods and services provided by the ecosystem (Costanza & Folke, 1997). Lal (2003) classified three reasons to justify the research done on valuing mangrove ecosystem benefits: advocacy purpose, providing choice between alternative uses, and estimating externality costs. On the first reason, global agencies such as Ramsar Bureau advocated countries to conduct studies on wetlands values by providing research grants to study the subject (Acharya et al. 2019). The South Pacific Regional Environment Programme (SPREP) is an excellent example of an organization devoted to protecting the environment in the Pacific Island region (Lal, 2003). It is vital to quantify the mangrove ecosystem benefits to convey its importance to policymakers.

Second, the providing choice between alternative uses allows economists to pick a project with the highest net economic benefit. Net present value (NPV) and cost-benefit ratio (CBR) are the examples used to determine

the highest net economic benefits. However, this is not always the case. If a project is socially desirable, the government will probably choose projects with lower net economic benefits.

The third justification for studying mangroves' ecosystem benefits is to estimate the externality costs for mangrove forests development. Mangrove forests is an example of public goods where property rights are absent. The third party usually bears any externality costs that occur from a mangrove-land activity. If this continues, the benefits of the ecosystem may diminish in the future. The government can determine such externality costs by undertaking a valuation study and asking the developer to pay for such costs. For example, a polluter pays principle requires a developer who caused the externality to pay the pollution costs.

Researchers (e.g., Trung et al. 2020; Owuor et al 2019; De Groot et al. 2002) classified MFES benefits to individuals into two categories: use-value and non-use value. Three types of use-value are available for measurement: direct use value, indirect use-value, and option value. Direct use-value refers to benefits that individuals receive directly from mangroves such as wood products (timber, fuel, and fiber); non-wood products (medicine, food); educational, recreational, and cultural uses; and human habitat. On the other hand, indirect use-value refers to the benefits individuals receive indirectly from the Mangrove forest. The benefits of watershed protection or erosion control that individuals receive from mangrove forests are indirect use-value examples. The option value refers to the direct and indirect values that humans may receive in the future by preserving the mangrove forest. The non-use value is the value that can be obtained by future generations. An example of such values are cultural, biodiversity, and heritage values.

Researchers (e.g., Ramli et al. 2017; Verdú et al. 2011) used either direct or indirect approach to value ecosystem services. The difference between these two approaches reflects how to obtain the information used to inform valuation. The direct approach (or stated preferences) involves asking individuals to respond to hypothetical scenarios related to MFES. In such approach, individuals indicate the amount of money they would be willing to pay (or willing to accept) following the hypothetical scenarios presented. Example of a direct approach is asking individuals how much they are willing to pay for mangroves conservation. By contrast, an indirect approach would infer information about value indirectly from other sources, such as number of visits individuals make to the mangrove site for recreational purposes, such as recreational fishing, hiking, boating, and wildlife-watching (Garrod & Willis 1999). Examples of the indirect environmental valuation methods are Travel Cost Method (TCM), Hedonic Price Method (HPM), Preventive Expenditure Method, and Surrogate Market Method. Meanwhile examples for direct methods include Choice Experiment (CE) and Contingent Valuation Method (CVM).

There is no specific guideline to determine when to choose CE over CVM, and vice versa. However, Adamowicz et al. (1998) asserted that CVM is more appropriate for a study that focuses not on investigating a multidimensional and its trade-off is not the interest. The following paragraphs explain the CVM technique.

CONTINGENT VALUATION METHOD (CVM)

CVM is a technique whereby respondents must state a value for a change in environmental goods (Mitchell & Carson, 1989). Respondents may state the value in terms of their willingness to accept (WTA) or willingness to pay (WTP). WTA is the minimum value of money that people demand to receive as compensation because of losses so that they are indifferent between being paid and bearing the losses. On the contrary, the latter is the maximum sum people are willing to pay to be indifferent between paying and enjoying the gains (Hasan-Basri et al. 2015). The issue is whether to use WTP or WTA. According to Mitchell and Carson (1989), a solution to the case depends on two criteria: who has the ownership of the goods in question and whether consumers have to pay if they want to use the goods. This decision is not easy to make because usually, environmental goods like mangrove forests are held collectively. Every member of the society has the right to access (or potential access) to those goods (Mitchell & Carson, 1989). Willig (1976), however, demonstrated that the difference between WTA and WTP is not apparent.

Different kinds of elicitation formats are available for researchers to elicit the WTP, such as open-ended, payment cards, discrete choice single bounded, and discrete choice multiple bounded formats. Perhaps open-ended is the most convenient and appropriate means of asking respondents to state their WTP for mangroves changes (Mitchell & Carson, 1989). The format is straightforward and very informative for researchers. However, researchers do not prefer to use the format due to the cognitive burden and strategic behavior issues (Mitchell & Carson, 1989).

The next elicitation format, payment cards, is where respondents are provided with cards outlining various payment scenarios to help them decide on their WTP for mangroves in question. Researchers use this format for two reasons: to maintain a direct approach to obtain WTP and to increase response rates (Mitchell & Carson 1989). The drawback of this format is that respondents are more likely to state low WTP values (Blaine et al. 2005).

The discrete choice-single bounded format or also known as referendum CV is where researchers present respondents with the bid value for mangrove scenario and ask them whether they would be willing to pay the bid value for particular changes to be done on the

mangrove forest. This format received support from the National Oceanic Atmospheric Administration (NOAA) panel report as their preferred means of eliciting WTP in CVM (Portney, 1994). Following this report, studies using the CVM technique have often preferred to use the format (Willis, 2002). However, the elicitation formats are statistically less efficient and require a larger sample size to increase their precision level (Hanemann et al. 1991).

The discrete choice double-bounded format is an extension of the single-bounded format. The format requires respondents to state their WTP for more than one bid value, where the subsequent bid values are subject to respondents' reactions to the initial bid value. If respondents agree to the initial bid value, the following bids must be higher than the initial bid value. Otherwise, the subsequent bids must be lower than the initial bid value. Analysis of the format is quite complicated because the second question depends on the response to the first question (Haab & McConnell, 2003). The double-bounded format estimate seems to have improved compared with the single-bounded format estimate (Hanemann et al. 1991).

A response for CVM's discrete choice question of yes or no is analyzed using a random utility model (RUM) as discussed in Haab & McConnell (2003) and Bateman et al. (2002). Equation (1) presents the utility function of respondent *j*:

$$U_{ij} = U_i\left(y_j, z_j, \varepsilon_{ij}\right) \tag{1}$$

where *i* refers to the studied scenario. *i* takes 0 value for status quo scenario (i.e., no mangroves preservation done), and 1 if there is preservation done in the future While *y* is the household income, *z* is the vector of respondents' characteristics, and ε is the unobservable factors. Respondents are willing to pay if their utility on mangroves preservation in the future is higher than their utility on the status quo scenario. Technically, equation (2) presents the probability of saying yes.

$$Prob\left(Yes_j\right) = Prob\left(U_1\left(y_j - d_j, z_j, \varepsilon_{1j}\right) > U_0\left(y_j, z_j, \varepsilon_{0j}\right)\right) \tag{2}$$

METHODS

STUDY SITE

We conducted this study in the mangrove area in Kuala Perlis, Perlis. Perlis is the smallest state in Malaysia and lies at the northern part of the west coast of Peninsular Malaysia. This state share borders with Satun and Songkhla provinces of Thailand on the north and state of Kedah on the south. The main port and ferry terminal are located at the small village of Kuala Perlis, linking the local people and tourists to Langkawi Island. Perlis has the smallest area of mangroves in Peninsular Malaysia, with only 94.02 hectare (ha) in total. Individually, the mangrove areas in the state include 42.19 ha in Kuala Perlis (Hamdan et al. 2010) and 51.82 ha in Seriap. The main mangrove species are *Rhizophora apiculata* and *R. mucronata,* as well as several *Sonneratia* spp. In Kuala Perlis, the mangrove is used for conservation purposes, whereas the land around the area is used for housing, business, agriculture, and small industries purposes. Fishing activities are carried out by fishermen who live along Sungai Perlis.

Despite its small size, mangrove forests in Kuala Perlis are important due to their role in protecting the coastal lines. In 2004, Perlis only suffers minor impacts from a tsunami incident partly due to the mangrove forests in Kuala Perlis. The mangroves area is also a place for people seeking additional income. Due to such contributions, the corporate division of Tenaga Nasional Berhad (TNB) together with 200 volunteers from Malaysia Nature Society, students of local universities (i.e., UiTM and UniMAP), and residents from nearby villages organized the Mangrove Tree Planting Program. A total of 1000 trees from various mangrove species were planted during that program (Aswad 2019).

FIGURE 1. Location of the study area

Apart from that, Perlis coastal lines are also being threatened with marine litter problem. As pointed out by Odli et al. (2020), about 80% of the marine litter in Kuala Perlis came from land-based resources such as urban populations and agricultural, industrial, and manufacturing activities. The remaining 20% of marine litter came from sea-based resources. Another study

carried out by researchers from Universiti Malaysia Perlis (Ahmad Zubir & Mohd Saad, 2018) found that heavy metals have polluted this area. Until now, there is no effort done to estimate in monetary terms on benefits and impacts provided by Kuala Perlis mangrove forests to the public and in helping to combat pollution

QUESTIONNAIRE

The questionnaire that we used in the study consists of five sections. The first section assessed respondents' perception on forest matters, including their feedback on forest preservation, ecotourism programs on television, importance of managing and conserving mangroves, and the use of tax either for conserving mangroves or other purposes like national defense. The second section focused on mangrove forests, including general questions on mangroves to measure respondents' awareness of the issue. The next section elicited information on possible reasons why the government must preserve the mangroves in Kuala Perlis. We presented ten reasons to be rated by respondents using five-point Likert scale format with extreme points of very unimportant and very important on each side of the spectrum.

The fourth section asked questions related to CVM technique – whether the respondents are willing to pay for mangrove preservation program in Kuala Perlis. We presented the current scenario of mangroves in the area to them before they state their willingness to pay. Short notes on mangroves were shown, including its functions including in providing provisioning services, regulating services, and cultural services (De Groot et al. 2002). Other information provided include current development activities in the area, possible threats, and the mangrove area's size. Besides, a series of mangroves pictures in Kuala Perlis was also shown to respondents to improve their understanding on the current mangroves' scenario in the area.

This study applied a donation to the conservation fund as a CVM payment vehicle, where the Director of Perlis Forest Department will manage the fund. This study used a double-bounded format with six starting bid prices: MYR1.00, MYR5.00, MYR10.00, MYR15.00, MYR20.00, and MYR25.00. The same six starting bid values were used in a mangroves study at Matang Mangrove Forest Reserve in Perak by Ramli, Samdin and Abd Ghani (2017). Another similar study also used similar bid price range (i.e., between MYR1.00 to MYR30.00). Mukrimah et al. (2015) used five bid prices starting from MYR4.00 to MYR30.00 in their study on biodiversity values at Forest Research Institute Malaysia.

There are four probability of responses -- yes/yes, yes/no, no/yes, and no/no, where:

NN (No, No) shows that $WTP \leq b^L$
NY (No, Yes) shows that $b^L \leq WTP \leq b$

TABLE 1. Profiles of Respondents

Characteristics	Mean	Standard Deviation
Age	48.57	14.51
Education (in years)	8.44	3.18
Monthly household income	1018	788.96
No of household	5	2.07
	Percentage	
Gender		
Male	84.36	
Marital Status		
Married	91	
Age		
17- 20 year-old	2.3	
21- 30 year-old	11.72	
31- 40 year-old	17.19	
41- 50 year-old	17.97	
51- 60 year-old	29.30	
61 -70 year-old	16.02	
60 year-old and above	5.47	
Highest Education Level		
No formal school	5.08	
Primary school	35.55	
Lower secondary school	19.92	
Higher secondary school	35.16	
College/ Institute	2.73	
University	1.56	
Types of Occupation		
Government sector	0.4	
Private sector	1.1	
Self-employed	2.73	
Farmer	0.39	
Fishermen	82	
Others (fish-cage workers)	12.9	
Monthly household income (MYR)		
Less 500	7.81	
501-1000	53.13	
1001-1500	18.36	
1501-2000	10.94	
2001-2500	3.13	
2501-3000	3.52	
3001-4000	0.78	
4001 and above	2.34	

YN (Yes, No) shows that $b \leq WTP \leq b^U$
YY (Yes, Yes) shows that $WTP \geq b^U$

b is the initial bid price, b^L is the lower bid price of the initial bid, and b^U is the upper bid price of the initial bid.

$$lnL = \sum_{i=1}^{n} \left[d_i^{NN} P_i^{NN} + d_i^{NY} P_i^{NY} + d_i^{YN} P_i^{YN} + d_i^{YY} P_i^{YY} \right] \quad (3)$$

d_i is the dichotomous variable on respondents answer (either NN, NY, YN, or YY), P_i is the initial bid price. Maximizing the log-likelihood function of equation (3) will estimate the parameter of β. The section ends with an open-ended WTP question. Finally, the last part of the questionnaire is to gather respondents' socioeconomic characteristics such as gender, age, highest education level, and ethnic group.

RESULTS

We conducted face-to-face interviews using structured questionnaires in April 2018 in several villages in Kuala Perlis and surrounding areas. We interviewed 256 household heads selected using convenient random sampling. Calia and Strazzera (2000) suggested that the estimates and mean WTP of CVM are practical if the sample size is at least 250. Table 1 presents the profile of the respondents. Majority of the respondents (91%) are married. Most of the respondents or 64% are between 31 and 60 years old, 21% are over 60 years old, 11.7% are between 21 to 30 years old and lastly, 2.3% are less than 20 years old, with the mean age of 48 years old. In terms of education, majority of respondents attained primary and secondary education (35%), while 4% only obtained tertiary level of education (colleges and universities), with average year of formal education of 8.4 years.

The survey results in Table 1 revealed fisheries as the primary employment sector, with 82% of respondents work as fishermen and 12.9% work fish-cage workers. Other employment types comprised of

TABLE 2. Country's Expenditure Priority (value in %)

	1	2	3	4	5	6
Health Expenditure	**120 (46.8)**	77 (30.88)	30 (11.72)	18 (7.03)	6 (2.34)	5 (1.95)
Education Expenditure	51 (19.92)	**71 (27.73)**	34 (13.28)	32 (12.5)	33 (12.89)	35 (13.67)
Mangroves Conservation Expenditure	24 (9.38)	42 (16.41)	**65 (25.39)**	45 (17.58)	51 (19.92)	29 (11.3)
National Defense Expenditure	52 (20.31)	34 (13.28)	34 (13.28)	**68 (26.56)**	41 (16.02)	27 (10.55)
Agricultural Expenditure	2 (0.78)	22 (8.59)	46 (17.97)	56 (21.88)	**71 (27.73)**	59 (23.05)
Tourism Expenditure	7 (2.73)	14 (5.47)	44 (17.19)	36 (14.06)	55 (21.48)	**100 (39.06)**

TABLE 3. Mangroves Management and Conservation Priority (value in %)

Option	1	2	3	4
Plantation of mangroves	**134 (52.34)**	59 (23.05)	22 (8.59)	41 (16.02)
Restoration of mangroves	60 (23.44)	**95 (37.11)**	73 (28.52)	28 (10.94)
Preservation of mangroves for tourism purpose	22 (8.59)	58 (22.6)	**97 (37.89)**	79 (30.86)
River protection against pollution	40 (15.63)	44 (17.19)	64 (25)	**108 (42.19)**

TABLE 4. Motive for Restoring Mangroves (value in %)

Motive	1	2	3	4	5
Green Area			26 (10.16)	165 (64.45)	65 (25.39)
Water Quality Protection			17 (6.64)	181 (70.7)	58 (22.6)
Wildlife Habitats			35 (13.67)	174 (67.97)	47 (18.36)
Education and Scientific Research Area		1 (0.39)	28 (10.94)	180 (70.31)	47 (18.36)
Preserve Nature Beauty			13 (15.08)	172 (67.19)	**71 (27.73)**
Habitats of Plants and Animals		1 (0.39)	17 (16.64)	164 (64.06)	**74 (28.91)**
Recreation and Tourism		1 (0.39)	22 (8.59)	175 (68.36)	58 (22.6)
Environmental Education			19 (7.42)	178 (69.53)	59 (23.05)
For future generation		1 (0.39)	19 (7.42)	169 (66.02)	67 (26.17)
Support Local People Livelihood			13 (5.08)	171 (66.8)	**72 (28.13)**

self-employed (2.73%) and farmers (0.39%). The high rate of employment recorded by the fisheries sector (i.e., fishermen and fish-cage workers) clearly shows that residents in the area are highly dependent on the sector as their primary income source. The survey found that total household income of more than half of the respondents (53.81%) is between MYR501 and MYR1000 a month, while 7.8% respondents earn less than MYR500 a month, with average monthly income of MYR1081. The average number of households in this study is 5 people.

Table 2 reports the respondents' views on where the government should spend the country's revenue. We ask respondents to rate six expenditure options which include health, education, mangroves conservation, national defense, agriculture, and tourism. The result shows that health expenditure obtained the highest vote (46.8%), followed by education expenditure (27.3%), mangroves conservation expenditure (25.39%), and others (national defense, agricultural, and tourism expenditures).

Table 3 reports the respondents' forest management and conservation priority scores. We provided four options to be chosen from: a) plantation of mangroves, b) restoration of mangroves, c) preservation of mangroves for tourism activities, and d) river protection against pollution. We asked them to rate each option using four-point Likert scale, where 1 indicates the highest priority and 4 indicates the lowest priority. More than half of the respondents (52.34%) stated that their preferred option is mangroves planting, followed by restoration of the maritime forest (37.11%), preservation for tourism purposes (37.89%), and finally, the lowest priority is to protect the river against pollution (42.19%).

Table 4 reports the important motives for restoration of mangroves forest. On a scale of 1 (i.e., not at all important) to 5 (i.e., very important), the respondents stated that the main motive for the restoration of mangrove forests is for plant and animal habitat (28.91%), followed by sustainable use by the locals (28.13%), and preserving nature's beauty (27.73%).

TABLE 6. Logit Coefficients for double-bounded CVM

Variable	Basic Model	Restricted Model	Full Model
Constant	17.8909***	13.2741***	19.3800***
	(0.7991)	(3.6052)	(7.3083)
d_{con}	-	8.6087***	8.2747***
	-	(1.9912)	(2.0071)
d_{male}	-	-	5.2395
	-	-	(3.2997)
Hhs	-	-0.9291**	-0.8431**
	-	(0.4131)	(0.4153)
d_{fish}	-	-	-4.4270
	-	-	(3.0376)
Inc	-	0.0054***	0.0050**
	-	(0.0020)	(0.0020)
Age	-	-	-0.0713
	-	-	(0.0695)
Edu	-	-0.3651	-0.5179*
	-	(0.2451)	(0.2778)
Sigma	10.2884***	9.7257***	9.6111***
	(0.7037)	(0.7260)	(7.3083)
Min WTP	17.89	18.31	18.25
[Lower Limit, Upper Limit	[16.32,19.46]	[16.64,19.98]	[16.48, 20.03]
CI/ Min	0.18	0.18	0.19
Number of Respondents	256	229	229
Log likelihood	-323.2587	-260.1440	-257.3789
Wald Chi-Sqd	Na	31.58 (4)	36.03 (8)

Standard Errors are in the bracket
***, ** and * refers to 1%, 5% and 10% significant level
CI= (Upper Limit-Lower Limit)

Table 5 presents the tabulation of respondents' responses to the double-bounded CVM questions. The double-bounded process is a two-round process where we show the respondents the initial bid price in the first round. If respondents agree to pay the initial bid price, then the second round bid price would be higher than the initial bid price. Otherwise, the second round bid price would be lower than the initial price. For example, 7.42% bids MYR15 (column YN), indicating the percentage of respondents willing to pay MYR15 in the first round but refused to pay MYR20 in the following round. The results show that the rate of respondents saying Yes-Yes (YY) decrease from 13.6% to 1.95% when the initial bid price was increased. On the contrary, the No-No (NN) percentage rose from 0.39% to 3.52% when the initial bid price was increased.

TABLE 5. The percentage of yes and no on the first and second bid prices – double-bounded CVM

Bid Price (MYR)	NN (%)	NY (%)	YN (%)	YY (%)
1	0.39	0.00	9.77	13.67
5	0.39	1.56	4.30	10.16
10	0.78	0.78	7.03	10.94
15	1.56	0.78	7.42	9.77
20	2.73	0.78	3.52	1.95
25	3.52	0.00	6.25	1.95
Total	9.38	3.91	38.28	48.44

Table 6 shows the coefficients of the double-bounded CVM. Three types of logit models were estimated: the Full Model, Restricted Model, and Basic Model. The difference of these models are as follows. In the Full Model, the dependent WTP was regressed on all variables, whereas the Restricted Model only includes the Full Model regression's significant variables. Lastly, for the basic model, the WTP was regressed on the intercept. Equation (4) presents the Full Model WTP function.

$$WTP = f\left(d_{con}, d_{male}, hhs, d_{fish}, inc, age, edu, d_{married}\right) \quad (4)$$

where d_{con} is a dummy variable with 1 representing respondents who are confident with the conservation program, while d_{male} is a dummy variable with 1 representing male respondents, *hhs* is the respondents' household size, d_{fish} is a dummy variable where 1 representing fisherman job category and *inc* is the monthly income. *Age* indicates the age of the respondents, *edu* refers to respondents' total education period in years and $d_{married}$ is a dummy variable with 1 representing married respondents.

Overall, the Wald Chi-Sqd statistics values for the Restricted and Full Models exceeded the critical value. The results indicate at least one coefficient which value is not equal to zero if it is estimated jointly with other coefficients. The coefficients for constant and sigma were significant at 1% significant level for all three models.

The Full Model results show that the respondents who are confident with mangroves conservation programs have a higher willingness to pay than their counterparts. The results also indicate that respondents with larger family are willing to pay less compared to respondents with smaller family. Large families need to focus on supporting their family and do not have much money left to provide to forest conservation programs. In terms of education, the *edu* variable is negative, which means respondents with longer education duration is willing to pay less than those with shorter education duration. The results show that respondents' willingness to pay increases as their income levels increases. Other variables such as the respondents' gender, age, and job category, were found to be not significant.

Table 6 also presents coefficients for the Restricted and Basic Models. Interpretation of the coefficients for the models is similar to the Full Model. All significant variables in the Full Model were also found to be significant in the Restricted Model except for education variable.

WILLINGNESS TO PAY

Table 6 also reports the value of consumer willingness to pay for all three models. We used the *nlcom* command of Stata to calculate the WTP values. The regression results revealed that the estimated value of the Restricted Model is higher (MYR18.31) compared to Full Model (MYR18.25), as well as Basic Model (MYR17.89). We adopted Monte Carlo simulations from Krinsky and Rob (1986) for willingness to pay intervals. The results show that the "width" confidence interval recorded in the Full Model (3.55) is higher than Restricted Model (3.34) and Basic Model (3.14).

To determine whether the Full Model is better than the Restricted Model or not, we used the Likelihood-Ratio (LR) tests. If the LR test is significant, then the Full Model is better than the Restricted Model. For DBCVM, the LR test was insignificant (Prob> Chi-Sqd = 0.1249). Therefore, we conclude that the Restricted Model is better than the Full Model. We estimate that the mangrove conservation's annual total economic value is at MYR3,453,724 or MYR81,861 per hectare per year. We estimate this value based on 75% of Perlis's adult population in 2017 (188,625). If the mangrove is managed sustainably for 200 years, the net present value at a 5% discount rate is MYR69,070,485.54 or MYR1,637,129.31 per hectare.

CONCLUSIONS

We undertake this study to estimate the economic value of mangrove forest ecosystem services in Kuala Perlis, Perlis. Mangrove forest provides ecosystem services to human well-being, via providing us with fish and non-fish products, timber and non-timber products, medical plants, and dyes. Despite its significant provision to human well-being, the conversion of mangroves areas for agriculture and horticulture, residential and commercial purposes occur at an alarming rate. This happens because policymakers are unable to estimate the benefits of mangroves ES in monetary value. Thus, mangroves ES benefits are often undervalued and overlooked in policy decision making process.

In this study, we used the double-bounded CVM approach to estimate the mangrove forest's ES economic value in Kuala Perlis. We estimated the respondents' willingness to pay for conservation of the mangrove area. Besides, we also determined the determinants of respondents' willingness to pay. Three WTP models were estimated, namely, Full Model, Restricted Model, and Basic Model. In the Full Model, we included all determinants, whereas the Restricted Model only consists of the Full Model regression's significant variables. The Basic Model regressed on the intercept. There is only slight difference in WTP values for each model (Full Model = MYR18.25, Restricted Model = MYR18.31, and Basic Model = MYR17.89). The Likelihood Ratio (LR) test revealed that the Restricted Model is better than the Full Model. Considering 75% of Perlis adults in 2017, we estimated that the aggregate WTP value to be MYR3,453,724 or MYR81,861 per hectare per year, and the net present value for 200 years at a 5% discount rate is MYR69,070,485.54 or MYR1,637,129.31 per hectare.

In terms of determinants, this study revealed that variables such as respondents' confidence in mangrove conservation program, household size, and monthly income are significant at the 10% level. The results indicate that respondents who have high confidence with mangrove conservation program, earned high income, and has smaller household number are willing to donate more money to the mangrove conservation fund. For the country's expenditure priority, mangrove forest expenditure ranked third behind health and education expenditures. In a nutshell, most respondents prefer the conservation fund to be spent to plant and restore mangroves for future generation.

In general, the contributions of this study are two-fold. First, this study adds to the literature on mangrove valuation in Malaysia. This study is the first evaluation done on the value of mangrove ES in Kuala Perlis. The CVM technique's suitability in estimating WTP value is in line with other mangroves' valuation studies that have been undertaken in Malaysia. The economic benefits that we measured in WTP values can inform policymakers for future planning in the study area. Second is the contribution of benefit transfer purpose in WTP values. Benefit transfer explains whether we can transfer the WTP value in one study area to another similar site. Since the six bid prices applied in this study are identical to the ones used by Ramli et al. (2017), the transferability of these two WTP values is worth investigating. The finding shows that the WTP values in both studies are very similar, approximately at MYR18.00. Since undertaking a new mangroves study is expensive and time-consuming, the benefit transfer result indicates that we can possibly transfer the WTP's value of one study area to another similar study site.

This study has potential limitations. A limitation that should be highlighted is the anchoring bias effect in CVM technique. Anchoring bias or starting point bias effect is the starting bid value question that influences respondents to respond to the next bid question. CVM researchers argued that sequential bid point estimator like DBCVM is more efficient than a single bound point estimator (Calia & Strazzera, 2000; Hanemann, Loomis, & Kanninen, 1991). However, this method also has its drawbacks. Rather than comparing their original WTP and the list of bids presented, the effect occurs if respondents incorporate the offered bid in their thinking of WTP for the next bid questions. The consequence of this effect is that the point estimation and its standard deviation is biased. Such results eventually lead to inaccurate welfare measures and wrong policy implications. Thus it is suggested for future mangrove forest valuation studies that intend to apply DBCVM to use a model that can consider the anchoring effect bias.

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