MEASURING PUBLIC PREFERENCES ON FOREST CONSERVATION: A CHOICE EXPERIMENT APPROACH

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ABSTRACT

This paper presents an application of a choice experiment (CE) measuring public preferences towards forest conservation specifically at state of Kelantan. Choice experiment is an economic approach in valuing forest ecosystem services. Economic analysis related to public preferences towards forest conservation become increasingly crucial especially in assisting both federal and state Government to conserve and manage forest ecosystem sustainably. Forest conservation at Kelantan is conceptualized with four attributes relating to public preferences: forest function as watershed areas, forest function as flood mitigation, forest as carbon sink and lastly forest landscape as breeding habitat for fauna. The analysis employs a Multinomial Logit Model (MNL) to analyse the public preferences. The results from the CE data indicate that public in Kelantan has the highest preference for forest function as flood mitigation, followed by forest as carbon sink and forest function as watershed areas. However, surprisingly the result also showed public negative preference on attribute forest landscape as breeding habitat for fauna. The results of this research may help to understand the environmental and economic aspects of forest ecosystem services that may influence public preferences towards forest conservation.

Key words: Choice experiment, public preferences, forest conservation.

INTRODUCTION

Malaysia's transition to become a developed and high-income countries, put pressure on biological diversity and the environment. Pressures that threaten Malaysia biodiversity include habitat fragmentation, invasive alien species, pollution, poaching, land interest conflicts and climate change. According to the World Development Indicator, Malaysia has only 0.2% of the world's land mass, but its diversity of flora and fauna species makes it one of the richest countries in the world in terms of biodiversity per unit area. The 2001 Global Diversity Outlook recognized Malaysia as one of the 12 mega-diversity countries in the world (NRE, 2006). Thus, in 2016 the 2nd National Biological Diversity Plan (2016-2025) was formulated to provide direction and a framework for conserving and utilizing biodiversity wisely (NRE, 2016). 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 (Nijkamp et al., 2008).

More than half of the land area in the country remains covered by forests despite rapid development, and the government is committed to continue preserving the forest. At Malaysia, forests largely were Permanent Reserve Forest (PRF) contributed about 55.3 per cent of the land area in Malaysia, or 18.28 million hectares area covered by forests. Forests play an important role especially in watershed benefits as forest cover. Forests act as sponges that absorb heavy rainfall and gradually release water throughout the year to the river, which can reduce the effects of floods and maintain river flows during the dry season (Bosch dan Hewlett, 1982, Wright et al., Clark, 1987; 1990; Bowling et al., 2000; Bruijnzeel, 2004; Van Dijk et al., 2009). A study by Zhang et al (2017) showed that reduction of forest cover areas could lead to an increase in annual runoff rates, due to the reduction of interception and evapotranspiration. Forests also provide habitat and home for a vast array of plants and animals, many of which are still undiscovered.

In order to manage as well as conserve the ecosystems of reserved forest, economic analysis of PRF's ecosystem services must be conducted and documented. Christie (2006) states that the environmental assessment techniques can be useful evidence to support the policy by quantifying the economic value associated with it. The importance of economic analysis and identify potential usefulness is also recognized by the Organization for Economic Co-operation and Development, OECD (2001).With all the

importance as stated above, the objectives of this paper is to investigate how choice experiments (CE) can be used to measure public preferences on forest conservation attributes.

LITERATURE REVIEW

a. Stated-preferences Method

There are several methods to conduct economic analysis of non-marketable goods and services; one of the methods is using Stated-preferences Method. Stated-preferences methods depends on statements by respondents about their willingness-to-pay (WTP) or willingness-to-accept (WTA) the monetary compensation for their loss. These methods are closely related to the individual's behavior in a hypothetical setting. This method is based on "price observed" for the goods to be valued (in this case forest conservation attributes). The value can be obtained through a questionnaire which consists of the amount of unit goods at a given price. The questionnaire must be well-designed to ensure the response and accuracy of respondents during the survey interview.

Stated-preferences methods consist of contingent valuation (CVM) and choice modeling (CM) methods. The CVM is the most commonly approach used, where respondents are directly asked on how much they are willing to pay for the environmental goods and services, especially in forest ecosystem services. However, respondents must be well-informed to make value judgment on the environmental goods during the survey. Respondents might not understand or unfamiliar with certain terms of goods and services, therefore all these elements must be emphasized to respondents during the survey. While, the CM is quite different from CVM where, CM is based on the attributes and level of the goods and services, while CVM is directly based on respondents statements on the WTP. This CM method requires respondents to state their preferences on the sets of attributes and level related to the goods and services.

At the global level, the CM is widely used all around the world by researchers, academicians and private sectors for certain purposes and sectors such as ecotourism, marine parks and waste disposal management (Wan Norhidayah, 2013; Mohd Rusli, 2006; Özge Can, 2012; Sara Kaffashi et al, 2012 and Jamal Othman, 2007). CM also was applied as evidence to conceptualization of payments for ecosystem services (PES) and also assess biodiversity conservation (Matthew C. and Susana M., 2014; and Huynh VK & Mitsuyasu Y, 2014).

b. Choice model (CM)

CM is a one of the stated preferences methods in the non-market economic valuation study, which is also a survey-based method which values the environmental goods and also services and used to estimate for a wide range of goods and services which are not traded in market. CM is a series of multiple choices; each management option proposes differs according to the choice sets, each choice set comprised three management options (Hanley N *et.al*,2006). This method requires respondents to state their preferences on the sets of attributes and level related to the forest conservation attributes. According to Bakti Hasan *et.al* (2013) attributes and their levels are considered to be one of the most important issues in the design of CM.

There are four main CM alternatives which can be used to design the CM questions which are choice experiment, contingent ranking, contingent rating and paired comparison (Pearce et al, 2006). For the purpose of this study, the approach of CM was used the choice experiment (CE). According to Bateman *et al.* (2000), CE is a required respondent to choose the most preferred alternative from a series of alternatives presented to them. These alternatives refer to the various hypothetical scenarios that might influences respondent preferences on the forest conservation attributes. According to Lancaster's approach consumers derive utility from a bundle of attributes rather than the good itself as it can maximize consumer satisfaction (Birol E & Koundouri P,2004). While, Hanley *et al* (2006) state a marginal utility estimates can be converted into willingness-to-pay estimates for changes in attribute levels, and welfare estimates obtained for combinations of attribute changes by making one of these attributes a price or cost term.

The CE is an application of Lancaster's characteristics theory of value combined with random utility theory (Hanley *et al.*, (2006). This methodology consists of several choice sets from various alternative option and one status quo options, where respondents are asked to choose their preferred one. The utility function of the respondents is presented in equation (1).

$$U_{ij} = V(Z_j) + e(Z_j) \quad (1)$$

For any respondents i, each alternative j corresponds to a given utility U which is not directly observed. The utility gained from the good depends on the attributes (X) proposed in choice set. It is assumed that the relationship between attributes and utility is linear and that the error terms are identically and independently distributed (Noor Aini, 2011). Therefore, the conditional indirect utility (V) function can be estimated as equation (2) in which $ß_i$ are vector coefficients corresponding to each attribute X_i considered in the choice set.

$$V_{ij} = ß_1X_1 + ß_2X_2 + ... + ß_nX_n \quad (2)$$

Indirect utility function allows us to provide information about the trade-off between the different attributes (marginal rates of substitution, MRS). According to Mohd Rusli et al (2008), the ratio corresponds to the change in implicit price of the attributes relative to the status quo situation. The formula indicates the WTP between monetary attributes and non-monetary attributes in the CE as equation (3).

$$\text{Implicit price} = - \frac{ß_{\text{non-monetary attributes}}}{ß_{\text{monetary attributes}}} \quad (3)$$

STUDY DESIGN

a. Sampling

The households of Kelantan state were chosen as respondents for face-to-face interview. According to the National Oceanic and Atmospheric Administration (NOAA) panel report, the most suitable approach to collecting information from respondents in any stated preference approach is through face to face interviews (Portney, 1994). By using this approach, goods and services can be defined and explained thoroughly to respondents and the non-response can be minimized (Garrod and Willis, 1999). According to Louviere et al. (2000) two common sampling techniques applied in CE are simple random samples and stratified random samples. This study implies Stratified sampling which involves division of the sampling frame into distinct subpopulations, or strata, and then separate samples are randomly selected from each stratum. Sampling was conducted with the Department of Statistics Malaysia, while the Enumeration Block (BP) map was prepared by the Kelantan State Statistics Department to help streamline the data collection process for this study. Other than that, the parameters used in the sample determination are based on the region and strata or status of the area, whether urban or rural. A total of 50 BPs and 20 houses per BP were selected for sampling. **Table 1** shows the summary of BPs.

Table 1. Summary of Enumeration Blocks (BP)

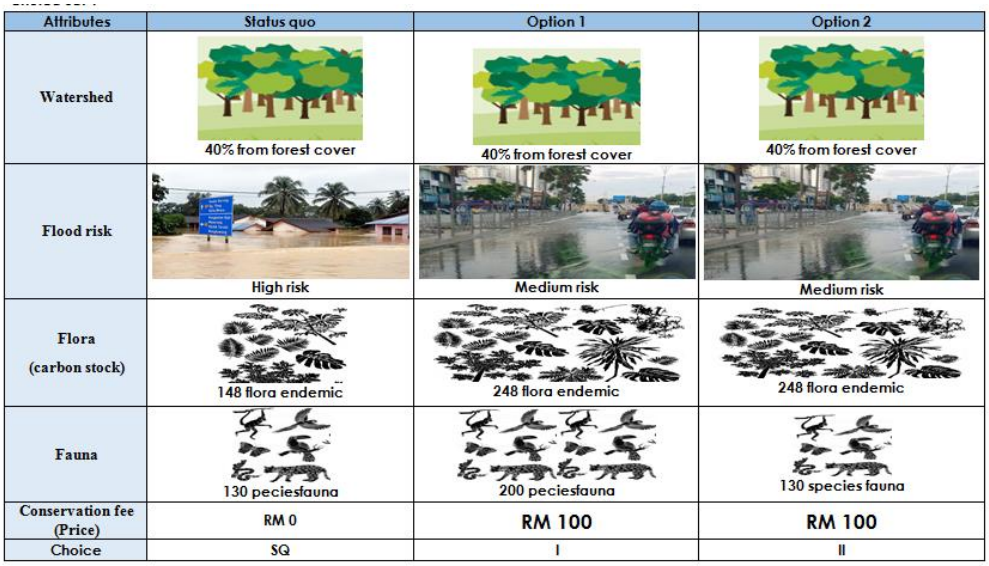
No.	District	No. Of BP	Frequency, (f)	Percentage,(%)
1	Bachok	5	106	10.16
2	Gua Musang	3	60	5.75
3	Jeli	1	20	1.92
4	Kota Bharu	9	191	18.31
5	Kuala Krai	6	122	11.70
6	Machang	4	82	7.86
7	Pasir mas	7	144	13.81
8	Pasir Puteh	5	100	9.59
9	Tanah Merah	5	108	10.35
10	Tumpat	5	110	10.55
Total		**50**	**1043**	**100**

b. Choice Experiments

To measure the application if CE on respondent's preferences on attributes of forest conservation in Kelatan, samples were taken from residents whom lives in state of Kelantan. A total of 1043 Kelantan's residents were interviewed face-to-face. In this study, four attributes were chosen namely (i) forest cover provide ecological function of forest reserved as watershed areas, (ii) forest function as flood mitigation, (iii) forest as carbon sink and lastly (iv) forest landscape as breeding habitat for fauna. While, in terms of attribute levels, Bennett and Adamowicz (2001) suggested that CE design should take into account the types of measurement in levels either qualitative or quantitative. Therefore, this study taken into account both type of the measurements. This study also has applied fractional factorial design (orthogonal design) where, the variations of the attributes of the alternatives are uncorrelated in all choice set and fewer choice sets for respondents to evaluate. Where according to Blamey el al. (2001), fractional factorial designs are usually preferred due to a trade-off between completeness and complexity of CE tasks. Orthogonal design in statistical package was used to generate the possible combination.

A series of focus group discussions was held to test the appropriateness of the attributes and their levels. This was important because the attributes in the survey needed to be seen as policy-relevant (Blamey et al., 2002). Participants involves were forest managers from Forest Department of Peninsular Malaysia, academician from University Putra Malaysia and researchers from Forest Research Institute Malaysia. Other than that, pretesting survey was conducted earlier to gather responses to the CE questions. To assist respondents answering the CE questions, there attributes were presented in a pictograph format (**Figure 1**) as employed by Bakti Hasan *et.al* (2013) and Rolfe and Bennett (2008). This format may encounter respondents from becoming bored and it was easier for them to understand as well.

Figure 1. Pictograph format of choice card



RESULTS AND DISCUSSION

a. Descriptive analysis

The analysis of the respondent's profile is based on a survey conducted on 1042 household representatives sampled by the Department of Statistics Malaysia. Out of 1042 respondents, more than half (60%) were females, the remaining 39.2% were male. Analysis shows the average mean age of the respondents was 47.9 years. In terms of education, majority of respondents received education up to the secondary school level with a percentage of 43.1%. There were also 15.3% of the respondents received education until university levels. There are three (3) categories of respondents' profession that implies in this study namely self-employed (39.4%), salary earners (17.8%) and unemployed (42.8%). The average monthly gross income of respondents was RM2, 163 per month with majority below RM3, 500 per month (84%).

b. Econometric analysis

A total of 1042 respondents and 6252 choice observations were taken into the Multinomial Logit Model (MNL) analysis. The result for CE analysis begins with the theoretical expectations about the attributes' sign and the MNL results. For forest conservation attributes, the expectation for all attributes should be positive except for the conservation fee (Price). While, the variables used in the MNL are presented in **Table 2**.

Table 2. The variables used in the MNL

Variables	Attributes level	Policy implication
Watershed	SQ: 40% forest cover Cov2: 20% forest cover Cov3: 60% forest cover	Ecological function of forest reserved as watershed areas. The increase in the percentage of forest coverage is expected to have a positive impact on the utility.
Flood risk	SQ: High risk Risk2: Medium risk Risk3: Low risk	Forest function as flood mitigation. Lower flood risk can have a positive impact on respondents, so it is expected that these attributes will have a positive impact on utility.
Flora (carbon stock)	SQ: 148 flora endemic Flora2: 48 flora endemic Flora3: 248 flora endemic	Forest as carbon sinks. The higher the number of biodiversity flora, the higher the utility rate of respondents.
Fauna	SQ: 130 species of fauna Fauna2: species of fauna Fauna3: 200 species of fauna	Forest landscape as breeding habitat for fauna. Increasing number of biodiversity fauna is expected to be positively related to utility.

Conservation fee (Price)	RM0 RM50 RM100 RM150 RM200 RM250	Increased conservation costs are expected to negatively impact utility and WTP respondents. Usually, people prefer to use higher utility but are not willing to pay more.

The model specification employed the MNL and implicit prices for forest conservation attributes. Thus, **Table 3** presents the results for the simple ML model. The econometric function for MNL model written as follows:

$$U = ß_1Cov2 + ß_2Cov3 + ß_3Risk2 + ß_4Risk3 + ß_5Flora2 + ß_6Flora3 + ß_7Fauna2 + ß_8\ Fauna3 + Ɛ$$

The variables used for this analysis were watershed (Cov), flood risk (Risk), Flora-carbon stock (Flora) and fauna (Fauna). These present the significance of the choice attributes in explaining the preferences of the respondents for the forest conservation attributes between the different alternative options. The results show the explanatory power for this model is considered good with their adjusted psuedo-R^2 of 0.36 or 36%. According to Louviere et al. (2000) and Rusli et al. (2008), in MNL or conditional logit pseudo R^2 models ranging from 0.2 - 0.4 are considered good models and comparable to values of 0.7 - 0.9 in linear equations.

The estimated results show that all attributes indicate significance at least at 5% in the MNL model and have the a priori expected signs expect for attribute Fauna. Respondents' preference and chose to reduce the number of fauna and it was significant at the 1% level. This is because respondents felt that increasing the number of fauna in the forest can be dangerous and increase the incidence of conflict between humans and animals, especially for those whom live at the adjacent of forest reserved. Other than that, the price attribute also has a negative sign in line with the theory's expectations. This indicates that with the increase in conservation fees, respondents are less likely to contribute due to declines in utility levels.

The implicit price for each attribute is calculated as the ratio of coefficients for the attribute (or level) with the cost parameter using the Wald procedure (Bakti Hassan et al, 2013). The implicit price measures the respondents' willingness to pay. For instance, the implicit price for attribute Flora3 in MNL model means that respondents are willing to pay an extra of RM1, 039 to obtain an improvement to the attribute from the status quo to higher level. Based on the analysis it was found that respondents were willing to contribute to the forest reserved services as flood control and watershed area for the state of Kelantan ranging from RM271 to RM1286 per year (maximum amount by attributes/variables).

Table 3. The estimated coefficients and implicit prices for MNL

Variables	**Coefficients**	**Implicit price,RM**
Cov2	-0.2423** (0.1053)	-55.17**
Cov3	1.1943*** (0.1568)	271.88***
Risk2	5.6507*** (0.3627)	1286.40***
Risk3	3.9829*** (0.1666)	906.71***
Flora2	-1.1432*** (0.1949)	-260.24***
Flora3	4.5678*** (0.2303)	1039.86***
Fauna2	4.6494*** (0.3617)	1058.44***
Fauna3	1.2794*** (0.0967)	291.25***
Price	-0.0044*** (0.0004)	-
Summary statistics		
Number of observations	6252	
Log-likelihood: L(0)	-2751.5869	
Log-likelihood function	-4308.6434	
Pseudo R^2	0.3614	
Adjusted Pseudo R^2	0.3609	

The high degree of willingness proved and support that each of the attributes mentioned is very important and influenced the respondents, although the value if exceeded the bid price used in the study. In addition, the highest implicit price is variable Risk2 (reduce flood from high to medium risk). These results prove that the respondents is more concerned on forest reserved function as controlling the risk of flooding compared with other attributes such as function of forests as watershed areas and the importance of flora and fauna. This result will support and help policy makers and decision makers on the opinion of the preference over HSK function in Kelantan.

CONCLUSION

Based on the results, some conclusion could be drawn and be proposed to the forest managers especially at state of Kelantan. First, respondents were having high preferences on most of the forest conservation attributes, except for attribute fauna (Forest landscape as breeding habitat for fauna). Where, respondents preferred to reduce the number of fauna and it was significant at the 1% level. According to respondents, fauna could be dangerous and frequently have conflict with humans. That's mean, more awareness program, roadshow or campaign related to human-animal conflicts need to be done not only by forest manager but also other related agencies and NGOs. More activities such as engagement with local communities also could be done to increase the awareness of Kelantan's residents.

Secondly, the highest implicit price is variable Risk2 (reduce flood from high to medium risk) prove that respondents is more concerned and preferred on forest function as controlling the risk of flooding compared with other attributes. This result will serve as an important as a guideline to assist the protected and natural areas manager in decision-making process especially in balancing the importance of natural resources and to meet developmental needs or other economic activities. Lastly, the findings of this study provide useful evidence to support and helps the formulation of policies that leads to forest conservation by quantifying the economic value associated with the protection of forest resources; help the management or stakeholders (government or private sectors) to improve in sustainable forest management and assist the conservation of forest for the benefits of present and future generations

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