

Determinants of Households' Willingness to Pay for Watershed Protective Services in Langat Basin, Malaysia

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ABSTRACT

The monetary value of watershed protection services has often been overlooked and underestimated in land-use decisions aimed at sustainable management. Payment for Ecosystem Services (PES) is emerging as a viable tool for protecting and conserving ecosystems by providing financial incentives. PES highlights the potential of watershed services as an economic instrument that supports sustainable land management and financing conservation efforts, involving households at the national level to protect watershed ecosystems. This study examines eliciting households' willingness to pay (WTP) for watershed ecosystem services for sustainable watershed management through a conservation fund added to a monthly water bill. The total sample in the Langat Basin area was 540 covering 12 districts in Selangor state of Malaysia. Primary data were collected from the households Langat Basin using a structured questionnaire through face-to-face interviews. The study outcomes demonstrated that the mean and median willingness to pay by the respondents in Langat catchment area is RM31.05 and RM25.30 for binominal probit model and mean and median WTP is RM 32.25 and RM26.90 for binary logit model. This analysis was conducted based on the willingness to pay 540 households of the Langat watershed. Found that occupation, certainty, PES program, importance of protecting ES, reason for PES program and bid are statistically significant towards willingness to pay for watershed protective services in Langat Basin. PES for watershed ecosystem services in Langat Basin may offer an additional source of income for the state governments.

1. Introduction

Payments for ecosystem services (PES) are a swiftly rising mechanism for incentivizing ecosystem services management that is progressively being adopted worldwide to boost sustainability. Payments for ecosystem services programs were initiated in the early 1990s at different spatial scales in Costa Rica in 1997 for carbon storage, hydrological services, and the protection of biodiversity and landscapes (Pagiola et al., 2004). There is an extensive recognition that PES are an increasingly vital environmental policy tool to compensate beneficiaries as they don't continuously exploit ecosystem services (ES). Indeed, PES has expanded around the world including Malaysia. Wunder (2005) define PES as a voluntary transaction where a buyer (usually a government, NGO, or private sector entity) provides compensation to a landowner or resource user (the seller) for the provision of a well-defined ecosystem service that benefits the buyer and is additional to what would have occurred without the payment. Wunder's work often stresses that PES should ensure ecosystem outcomes that go beyond what would have occurred without the payment (i.e., "additionality"), and these transactions should involve clear, measurable outcomes for both parties involved. Watershed ecosystem services play critical roles not only in human's livelihood, but also towards flora and fauna. Forest ecosystem services provide watershed protection, biodiversity conservation, landscape beauty, and carbon sequestration service. Although many successful PES have been stated, the efficiency of PES as a conservation policy tool still remains questionable. Almost 60% of extant ecosystem services, including freshwater and fisheries activities, have deteriorated or were utilized irresponsibly. The monetary value and utility of watershed protection services have been overlooked and undervalued in land-use decisions for sustainable management. It is reprehensible that land development activities seem to be endangering Malaysia's existing ecological services. In order to prevent these hazards from deteriorating, PES has been suggested as one tool to maintain and improve the quality of natural

environments as supported by Konu et al., 2024. The Langat River's upstream is considerably cleaner than the mid-downstream of the Langat River, mostly due to human activities such as oil palm cultivation, discharges of industrial effluents, and dumping of household waste (Ahmed et al., 2022). In comparison to developed nations, Malaysia is still in the beginning phases of PES development. As a result, the initial stage of PES in Malaysia can be implemented by developing realistic micro-level plans among relevant government entities through workshops and pilot studies, with the primary goal of understanding the usefulness of the PES scheme. Recognizing the relevance of PES as a key component in safeguarding watershed ecosystem services, this study investigates gender willingness to pay for watershed protective functions in the Langat Basin.

2. Methodology

A. Method

This study focused primarily on the outcomes of the quantitative findings retrieved from a total of 540 households in the Langat Basin. The National Oceanic Atmospheric Administration (NOAA) guidelines were adhered to as guidance in conducting personal interviews by using structured questionnaires. Personal interview sessions were carried out for data collection, whereby decreased nonresponse, increased response rate, and high data value had been ensured (Lavrakas, 2008). Trained enumerators were deployed to conduct the survey exercises among the respondents aged 18 years and above. The stratified random sampling method was applied to ensure that the selected sample group represented the population, apart from enhancing efficiency with greater control over the sample composition. The probability approach was adopted in this study to minimize sampling error. Figure 1 illustrates the research framework that summarizes the overview of steps undertaken in this study.

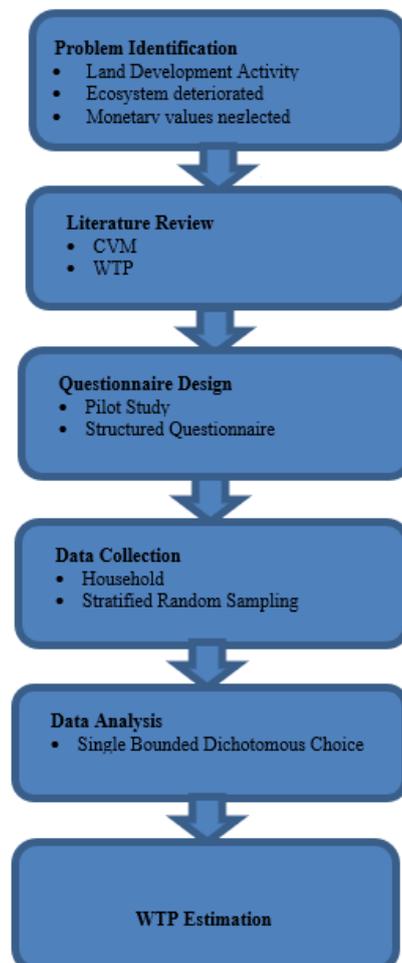


Figure 1: Research Framework

B. Single Bounded Dichotomous Choice (SBDC)

The single bounded modelling offers respondents a choice from two options, whereby the respondents may choose either ‘Yes’ to accept or ‘No’ to decline the presented offer. Turning to this study, the probability of saying “Yes” or “No” is denoted as follows:

$$\text{Prob (no)} = \pi_n = G(\text{BID}; \theta) \tag{2}$$

$$\text{Prob (yes)} = \pi_y = 1 - G(\text{BID}; \theta), \tag{3}$$

where $G(\text{BID}; \theta)$ refers to the numerical scattering equation of the individuals’ WTP, along with parameter vector θ . The Utility Maximisation signifies that the respondents may either accept the bid by selecting “Yes” if the offered bid is lower or equal to the maximum WTP or decline the bid price and choose “No” if the offered bid exceeds the bid price. Predicted probability of ‘yes’ and ‘no’ responses for logistic regression can be simplified as;

$$P_y = \frac{1}{(1+e^{-2})} \tag{4}$$

Cameroon (1988) applied this formula to assess the mean WTP. This equation has also been applied to measure WTP for watershed security benefits in Langat river basin vicinity (Krishnan et al., 2018).

C. Site Description

The Langat Basin refers to a macro-sized catchment area that provides water sources and other significant amenities for 1.2 million households. The total area of the Langat Basin is 2938 km² with 200 km of mainstream length that ends at the Straits of Malacca. Langat River Basin is an important river basin among the four main basins of Selangor, and it is divided by the Selangor state (78.14%), Negeri Sembilan state (19.64%), and the federal territories of Putrajaya (1.90%) and Kuala Lumpur (0.33%) (Ahmed et al., 2022). The Langat catchment area offers ample ecosystem services to humans, such as catchment area security service, biodiversity conservation, natural landscape, and carbon sequestration. Unfortunately, the listed ecosystem services appear to face serious threats from land development activities. The threats have deteriorated its water quality, hence the classification of this catchment area as partially contaminated. Apparently, overexploitation of natural resources is a result of the failure of the current market in accurately computing the true price of ecosystem services within the market-based decision-making process. Figure 2 illustrates geographical locality of Langat Basin.

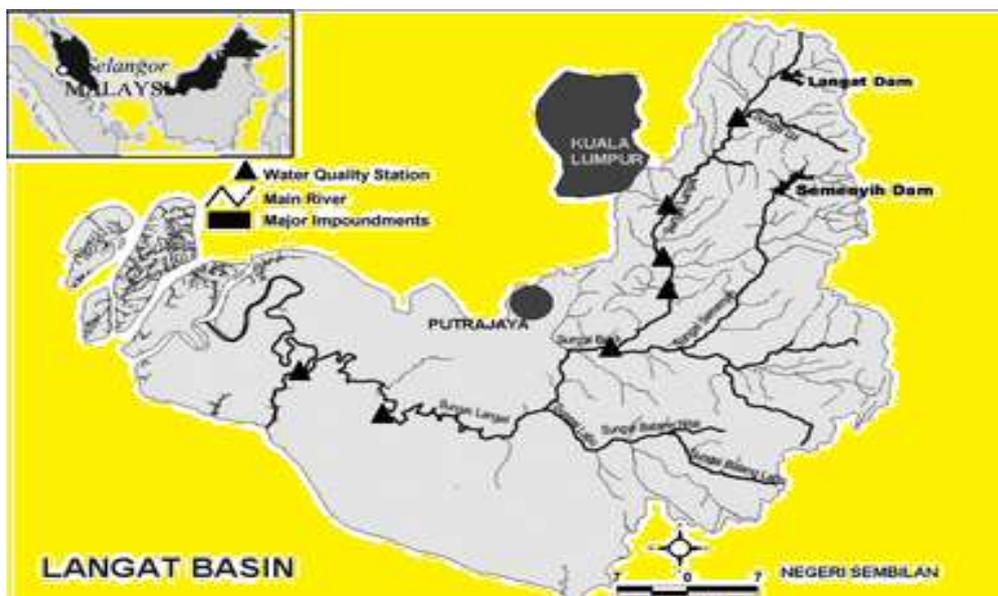


Figure 2: Geographical locality of Langat Basin

The PES system has been reckoned as an imminent tool to establish a viable and systematic process that protects the Langat catchment area. The Contingent Valuation Method (CVM) was adopted to analyse the involvement of the households to the catchment area protection services in the Langat Basin, Selangor. The CVM method has been widely implemented in various areas, including preservation of biodiversity and ecosystem services (Martínez-Espiñeira & Rodríguez, 2020), watershed protection and improved water quality (Zhou et al., 2021), air quality improvement (Zhao et al., 2022), water quality and sanitation (Liu et al., 2021), nature-based tourism (Liu & Zhang, 2023) and carbon reduction policies (Gao et al., 2022). Respondents aged 18 years and above were selected in this study to engage in a survey based on a prepared questionnaire. A pilot test was executed by embedding six bid pricing; RM5, RM10, RM15, RM20, RM25, and RM30. As an extension from the survey, households from Langat Basin were personally interviewed as well to identify their perceptions pertaining to the rising environmental issues of conserving the Langat River Basin. A similar approach was implemented to assess the WTP for coastal ecosystem services (Guerreiro et al., 2023), environmental conservation among urban and rural (Martínez-Espiñeira et al., 2022), and COVID-19 vaccination programs (Terry et al., 2021).

D. Willingness to Pay (WTP)

This study assessed the monetary cost of catchment area protection services via the lens of households. The CVM was implemented to evaluate the WTP of households in the Langat Basin area with the goal of maintaining the catchment ecology. The WTP was calculated by estimating the price of ecosystem services in the absence of a market for products, in addition to simulating the value of linked goods. Zhang et al. (2022) employed the contingent valuation technique (CVM) in conjunction with probit and logistic regression models to investigate the factors that influence WTP for ecological services. Key findings demonstrated that education level, age, and acquaintance with eco-compensation mechanisms were identified as key drivers of WTP, with older individuals and those with more education demonstrating a larger willingness to pay. Otieno and Muchiri (2022) assessed household WTP for wetland ecosystem services and discovered that income levels, environmental awareness, and perceived benefits from ecosystem services all had a significant influence on WTP. Higher-income households were more likely to pay, and environmental awareness played an important role in shaping individuals' willingness to contribute. Based on the literature, a WTP equation (see Equation 1) has been formulated using variables that are deemed to be essential for WTP.

$$\text{Willingness to Pay (WTP)} = \alpha + \beta_1\text{Gender} + \beta_2\text{Occupation} + \beta_3\text{Howcertain} + \beta_4\text{Income} + \beta_5\text{Whyimportant} + \beta_6\text{PES} + \beta_7\text{WhyPES} + \beta_8\text{Bid} + \varepsilon \quad (1)$$

3. Main Finding

A. Socioeconomic Analysis

Table 1 presents the demographic profile of the 540 households selected from the Langat Basin area. The average age of the respondents is 39.4 years. Among the participants, 44.8% are female, while 55.1% are male. Regarding marital status, 71.1% are married, 23.9% are single, and 4.6% are divorced. The majority of respondents have attained a higher education from the university. In terms of occupation, 20.2% of respondents work as supporting staff in the public sector. The distribution of employed individuals within households shows that 51.3% are female, compared to 48.7% male. In terms of income, 45.3% of respondents earn over RM6,004. Additionally, 74.6% of respondents own their homes, while 22.2% live in rented properties. Only 1.6% of the respondents are members of environmental organizations, such as the European Association of Environmental and Resource Economists (EAERE) or the World Wide Fund for Nature (WWF). These environmental memberships expose participants to conservation activities, providing them with indirect knowledge of environmental protection.

Table 1. Demographic Profile

Variable	No.	%
Mean Age (year)	39.4	
Female	242	44.8
Male	298	55.1
Marital Status		
Single	129	23.9
Married	386	71.5
Divorced	25	4.6
Education		
No Formal Schooling	46	8.5
Primary School	49	9.1
Secondary School	156	28.9
Polytechnic	73	13.5
College	99	18.3
University	177	32.8
Career		
Labor	85	15.7
Public Sector		
Management Staff	40	7.4
Supporting Staff	109	20.2
Private Sector		
Management Staff	64	11.9
Supporting Staff	85	15.7
Own Business	57	10.6
Unemployed	100	18.5
Number of households working		
Total		
Female	277	51.3
Male	263	48.7
Gross Income		
RM >6,004	245	45.3
RM4,503-RM6,003	150	27.8
RM3,002- RM4,502	52	9.6
RM1,501- RM3,001	43	8.0
RM <1,500	50	9.3
Ownership of house		
Owned	403	74.6
Rented	120	22.2
Living with relatives	11	2.04
Arranged by employer	6	1.1
Environmental Membership		
Yes	9	1.6
No	531	98.9

B. Willingness to Pay WTP

For the Binominal Probit Model and Binary Logit Model, gender, occupation, certainty, income, PES program, importance of protecting ES, Reason for PES program and bid1 are measured to calculate WTP. This analysis was conducted based on the willingness to pay 540 households of the Langat watershed. Found that occupation, certainty, PES program, importance of protecting ES, Reason for PES program and bid are statistically significant at the 5% level. Mean and median willingness to pay by the respondents Langat catchment area is RM31.05 and RM25.30 for binominal probit model and mean and median WTP is RM 32.25 and RM26.90 for binary logit model. Table 2 shows results of binominal probit model and table 3 displays results of binary logit model.

Table 2. Binominal Probit Model

Variables	Coefficient	Standard Error	b/St.Er	P[Z >z]	Mean
Constant	0.218952	0.11124459	1.515	0.1297	
Gender	-0.14637813	0.11806636	-1.240	0.2151	0.48703704
Occupation	0.06091017	0.02928237	2.080	0.0375	4.10185185
How_Certain	-0.33299861	0.06888111	-4.834	0.0000	1.65370370
Income	0.04911662	0.06304996	0.779	0.4360	8.35057443
Why_Important	-0.16864452	0.04149664	-4.064	0.0000	2.46666667
PES	1.18702648	0.41742281	2.844	0.0045	0.97222222
Reason_PES	0.07684723	0.03791962	2.027	0.0427	2.68518519
Bid1	-0.02210542	-0.02210542	-3.188	0.0014	17.5000000

Table 3. Binary Logit Model

Variables	Coefficient	Standard Error	b/St.Er	P[Z >z]	Mean
Constant	0.218952	0.11124459	1.515	0.1297	
Gender	-0.25373796	0.19623551	-1.293	0.1960	0.48703704
Occupation	0.11559076	0.04831057	2.393	0.0167	4.10185185
How_Certain	-0.51700526	0.11356977	-4.552	0.0000	1.65370370
Income	-0.02412141	0.09070324	-0.266	0.7903	8.35057443
Why_Important	-0.27646938	0.06949537	-3.978	0.0001	2.46666667
PES	2.31414013	0.74112639	3.122	0.0018	0.97222222
Reason_PES	0.14093385	0.06275714	2.246	0.0247	2.68518519
Bid1	-0.03642602	0.01159417	-3.142	0.0017	17.5000000

4. Results and Discussion

The willingness to pay (WTP) analysis was conducted using both Binomial Probit and Binary Logit Models to evaluate the factors influencing the WTP for watershed protection in the Langat catchment area. Data were collected from 540 households in the region, with the primary focus on the following variables: gender, occupation, certainty of payment, income, PES program, importance of protecting ecosystem services (ES), reason for the PES program, and the bid amount. Households' occupation types were found to influence their WTP, with individuals engaged in occupations related to environmental or resource management showing a higher likelihood of paying for watershed protection. Furthermore, respondents who were more certain about their ability to pay or who had a higher perceived sense of responsibility toward watershed protection exhibited a stronger willingness to pay. Households that were aware of or involved in the PES program showed higher WTP. This

indicates that prior exposure to or participation in such programs enhances individuals' willingness to contribute financially. The relatively close values across both models suggest a robust consistency in the results, though the logit model suggests a slightly higher WTP. Lindhjem et al. (2010) found similar results in their study on WTP for ecosystem services in Norway, where income, occupation, and perceptions of ecosystem importance were statistically significant factors influencing WTP. In a study conducted in the Philippines, Amponin et al., (2007) noted that factors such as income and awareness of environmental issues were significant in determining WTP for catchment area protection, which is consistent with your findings related to income and importance of protecting ES. Key findings of the research observed that the bid amount had a significant effect on WTP, as reflected by the median and mean amounts from the Probit and Logit models. This is consistent with the findings of other studies where bid amounts play a key role in shaping respondents' willingness to pay. For example, in the study by Sattout et al., (2011) on WTP for watershed conservation in Lebanon, the researchers observed that higher bid amounts led to lower WTP values, similar to your finding that bid amounts are a statistically significant factor in the models. The fact that PES program participation and the importance of protecting ecosystem services were found to be significant in your study is in line with previous findings that highlight the role of environmental awareness and policy instruments like PES in influencing WTP. Kline et al., (2000) conducted a study on the WTP for water quality improvements in the United States and found that individuals who were more aware of the importance of ecosystem services (e.g., clean water) were more likely to express higher WTP for these services. The study found that respondents who regarded the protection of ecosystem services as essential were more inclined to support watershed conservation financially. The motivations behind the implementation of the PES program, such as improving water quality or sustaining biodiversity, were found to influence households' WTP. People who perceived clear, direct benefits from the program exhibited greater WTP. The amount proposed in the bid significantly impacted the WTP, which is consistent with standard economic theory, higher proposed amounts typically result in a lower probability of acceptance. These findings suggest that, on average, households in the Langat watershed are willing to pay a moderate amount for watershed protection, with slight differences observed between the binominal probit and binary logit models in the mean and median values.

5. Conclusion

This study sheds light on the factors that influence households' willingness to pay for watershed protection services in the Langat catchment area. The findings underscore the importance of occupation, certainty of payment, PES program awareness, and the importance of ecosystem services in shaping WTP. The slightly higher mean WTP values from the binary logit model suggest consistency with economic theory, and both models effectively highlight the significant roles that socio-economic and environmental awareness factors play in determining WTP. The study provides valuable insights for enhancing the design and implementation of PES programs aimed at protecting ecosystem services.

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