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Using Contingent Valuation Method for Estimating the Willingness to Pay for Mangrove Forest: A Study in West Lombok, Indonesia

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Abstract

Mangrove ecosystem provides a range of market and non-marketed goods and services. It serves as a natural protection from storm, flood and abrasion. It also plays an important role in reducing the impact of land pollution to the sea. However, the total value of mangrove products is not easily recognized, thus they often neglected. As a result, mangrove forests often be converted in order to generate directly marketable products, such as aquaculture that might lead to massive economic lost for the surrounding community once natural disaster such as storm happen in the location.

This study estimated the monetary value of mangrove forest. A mangrove ecosystem in West Lombok Indonesia was considered as the case study. Respondent for this study were tourists, local communities and fishermen who were selected using purposive sampling technique. By employing Contingent Valuation Method (CVM), this study estimated respondents' willingness to pay (WTP) for the mangrove forest. This study found that the average WTP of tourist is IDR10, 500 (USD 0.75) per visit. While the local community and fishermen are willing to pay for a monthly contribution of IDR 8,500 (USD 0.61) and IDR 9,500 (USD 0.68) respectively. The WTP for mangrove forest of tourist was influenced by socio demography characteristics, facility, frequency of visit, and travel cost. For local community, the determinants of WTP for mangrove forest were socio demography characteristics, facility and preservation participation. While WTP for mangrove forest of fishermen was influenced by socio demography characteristics and household assets. The estimated WTP is expected to be utilized as useful information for setting up the entrance fee to the mangrove forest as well as for setting up a voluntary contribution of the local communities and fishermen for mangrove conservation.

Keywords: Mangrove forest/ Contingent valuation method/ Willingness to pay/ Ecosystem services/ Dichotomous choice

1. Introduction

1.1 Background of the study

The existence of mangrove ecosystems is beneficial to human life for suppling marketed goods and non-marketed environmental services, including provisioning, regulating, and cultural services (M. Brander, L., J. Wagtendonk, A., S. Hussain, S., McVittie, A., Verburg, P. H., de Groot, R. S., and van der Ploeg, 2012; Mendoza-González, G., Martínez, M. L., Lithgow, D., Pérez-Maqueo, O., and Simonin, 2012). The value of the mangrove

ecosystem is not easily recognized by most people thus it impacts are often neglected (Hamilton, L. S., Dixon, J. A., and Miller, 1989; Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., and Raskin, 1997; Gunawardena, M. and Rowan, 2005). People lack of awareness and will usually realize the presence of mangroves when the mangroves are already extinct and disasters happened in nearby locations (Badola, R., Barthwal, S., and Hussain, 2012; Schwerdtner Máñez, K., Krause, G., Ring, I., and Glaser, 2014).

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This situation might not occur if people value the existence of such environmental services provided by a mangrove forest. The value of mangrove forests might be acknowledged more when it's have been converted into other forms such as aqua culture. The presence of economic valuation methods for environmental goods and services that do not have a market system has given awareness of the importance of mangroves for human life (Spaninks, Frank and van Beukering, 1997). This kind of valuation method can contribute to a more appropriate decision-making process regarding the use of mangrove forests, whether mangrove forests will be conserved or converted into other forms.

In West Lombok Indonesia, a mangrove forest has become one of tourist attractions. With the natural beauty offered by mangrove forests in this place, many domestic and foreign tourists come. In addition, the concept of education tourism was developed where the existence of this forest is used as a laboratory for the development of science. The local community also indirectly get benefit from the mangrove forests in the form of storm protection. In addition, fishermen who live in the surrounding area of mangrove forest also benefited from the variety of fish thanks to the existence of the mangrove forest (Authors' survey, 2018).

Ironically, the condition of this mangrove forest continues to damage. Based on data provided by the Forestry Service of West Nusa Tenggara (NTB) Province, until 2014 there was damage of around 65% of the total area of mangrove forests in this location. Similar conditions also occur in almost all mangrove forests in West Lombok.

Mangrove forest damage that continues to occur needs to be stopped to prevent wider damage that can have a negative impact on the life of people living around the area. Economic valuation methods can contribute to this matter by estimating the mangrove forest value from the perspective of the related stakeholders, including communities, fishermen and tourists. By knowing the value of mangroves, further policy can be formulated to protect the mangrove forests in the long term.

Economic valuation technique provides a quantitative environmental goods and services value for these kind of goods and services that do not have market price. An economic valuation approach can produce an estimate economic value of these types

of goods and services. Prices that emerge from a natural resource often do not reflect actual costs and benefits, resulting in inaccuracies related to policies for the maintenance of these resources (Panayotou, 1993). The presence of valuation methods has also helped land pricing or also the cost of mitigating the impact of environmental damage as a result of a development process (Loomis, J., Kent, P., Strange, L., Fausch, K., and Covich, 2000).

As the mangrove forest in West Lombok is threatened by deforestation, a scientific study that evaluates the economic value of this forest is needed. This study is important as a reference for the related policy maker about the economic value of this mangrove forest. This present study aims to fill the literature gap by estimating the economic value of the mangrove forest through a contingent valuation method.

2. Methodology

2.1 Study area

This study took place in West Lombok, West Nusa Tenggara Province of Indonesia. The area was selected following a mapping using Geographic Information Systems conducted by (Saptutyningsih, E. and Diswandi (2018). Their study clarifies a decreasing of mangrove area in West Lombok as reported by the forestry agency in this province. The area was selected as the case study site.

2.2 Sampling procedure

The subjects of this study were communities living around the Lembar Mangrove Forest, fishermen and tourists who visited the mangrove forest. The reason for choosing these subjects was because they were well-informed about the mangrove forest so that they could help to elicit information on the value of it. The sample size of the study was determined after consideration had been given to the availability of resources including funds, the number of enumerators that could be recruited and the time it would take to complete the survey. Based on these considerations, it was decided that 300 people consisting of 100 tourists, 100 local communities, and 100 fishermen were selected as samples. The sampling technique used was purposive sampling technique. Among them, 30 people were selected for pilot survey, to find the average respondents' willingness to pay.



2.3 Design of the questionnaire

The questionnaire for this study was set into three sections. Section A collected information on socioeconomic characteristics of respondents including family size, age, and sex. Section B enquired the environmental awareness of the respondents (i.e. mangrove forest conditions, facilities in the mangrove forest, and effort for mangrove conservation). Finally, section C consisted of Contingent Valuation Method (CVM) questions to estimate willingness to pay of respondents for mangrove forest conservation. In this study, respondents were firstly asked whether they would be willing to pay for their experiences regarding the mangrove forest site. Respondents with “yes” answer were asked to give a monetary value for their experiences which is reflecting their willingness to pay for forest conservation.

Data was collected through survey. The respondents were approached by enumerators who firstly introduced him/her-self and the aims of the study. Then, respondents were asked whether they were willing to participate in the survey. If a respondent did not want to participate, then the enumerator approached the next available visitor. There was approximately 14% of visitor who refuse to join the survey. If a visitor was willing to participate in the survey, the questionnaire was given to him or her to fill in. The questionnaire was collected by the surveyor once it was done onsite. Similar onsite survey method has been used in some previous contingent valuation studies such as conducted by Lee (2002), and Togridou, A., Hovardas, T., and Pantis (2006).

2.4 Method of analysis

A Contingent Valuation Method (CVM) was employed to estimate the willingness to pay of the local communities, tourists and fishermen for mangrove forest conservation. CVM is considered as one of the most widely technique that used for conducting ecosystem services valuation (Gunawardena, M. and Rowan, 2005; Gupta, V. and Mythil, 2007; Stone, K., Bhat, M., Bhatta, R. and Mathews, 2008; Yacob, M.R., Radam, A. and Shuib, 2009; Binilkumar, 2010; Ekka, A. and Pandit, 2012). This method is called “contingent” valuation method, due to the technique that ask people about their willingness to pay or willingness

to accept, a certain hypothetical situation of environmental goods and services (Brookshire, D. and Eubanks, 1978).

The CVM in this study was conducted through a survey of selected respondents. The survey asked some questions as mentioned in the previous section, that also consisting of a by-designed hypothetical market condition regarding the mangrove forest to capture the respondents’ WTP (Loomis, Bair and González-Cabán, 2002). Through the CVM, stated preferences of the respondents were collected that reflecting the direct value of the quality of related environmental goods or services. This information was captured by asking the respondents about their willingness to pay (WTP) for an improved condition of mangrove forest.

CVM is an important tool in environmental economics that has been used by some number of studies (Bateman, I.J., Willis, K.G., Garrod, G., Doktor, P. and Turner, 1992; Stevens, T.H., Benin, S. and Larson, 1995; Oglethorp, D.R. and Miliadou, 2000; Wattage, P. and Mardle, 2008). This technique was also used in valuation of wetlands by Binilkumar (2010) and mangroves by Ekka, A. and Pandit (2012). The present study follows and adopts the method employed by Bann, (1999), Lal (2003), Gunawardena, M. and Rowan (2005), Gupta, V. and Mythil (2007), Stone, K., Bhat, M., Bhatta, R. and Mathews (2008), Yacob, M.R., Radam, A. and Shuib (2009) and Sathya and Sekar (2012).

This study also assesses factors influencing the WTP. This is done by using multiple regressions analysis with WTP as the dependent variable and some other related variables as the explanatory variables, including socioeconomic characteristics, neighbourhood characteristics, and environmental awareness.

2.5 Variables and definition

As mentioned above, the dependent variable in this study is willingness to pay for conserving mangrove forest. The WTP is estimated to be influenced by socioeconomic characteristics, neighbourhood characteristics and environmental awareness characteristics. The lognormal WTP function for the *i*th respondent can be written as

$$\log(WTP) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots$$



Y_i is a vector of social demography characteristics; Z is vector of neighbourhood characteristics; X is vector of environmental awareness characteristics and $\varepsilon \sim N(0, \sigma^2)$. If the respondent's true valuation, WTP_i , is known to lie within the interval (t_i, t_i+1) , then $\log(WTP_i)$ will lie between $\log(t_i)$ and $\log(t_i+1)$. Each pair of individual thresholds for $\log(WTP_i)$ can then be standardized to state the probability that respondent i will select t_i as

$$\Pr(t_i) = \Pr(\log(t_i) - \beta'X_i / \sigma < z_i < (\log(t_i+1) - \beta'X_i) / \sigma) \\ = \Phi((\log(t_i+1) - \beta'X_i) / \sigma - z_i) - \Phi((\log(t_i) - \beta'X_i) / \sigma - z_i) \\ \Pr(t_i) = \Pr((\log(t_i) - \beta'X_i) / \sigma < z_i < (\log(t_i+1) - \beta'X_i) / \sigma) \\ = \Phi((\log(t_i+1) - \beta'X_i) / \sigma - z_i) - \Phi((\log(t_i) - \beta'X_i) / \sigma - z_i)$$

where z_i is the standard normal random variable and Φ is the cumulative standard normal density function. With the assumed lognormal distribution of valuations, the median of an individual's conditional WTP distribution was estimated as the anti-log of that individual's predicted $\log(WTP)$ (Cameron, T. A. and Huppert, 1991). The mean of WTP , for each individual, was obtained by scaling the median by $\exp(\sigma^2/2)$. The mean WTP per individual for the mangrove forest conservation was estimated by averaging across all respondents of first survey in the sample.

Table 1. The definition of explanatory variables

Variables		Definitions
Dependent variable		
WTP conservation		Willingness to pay (WTP) for conserving mangrove forest
Independent variables		
Socioeconomic characteristics	AGE	Age of household head
	SEX	Sex of household head (1 if male; 0 if female)
	FAM_SIZE	Family size
	EDUC	Years of schooling
	INCOME	Income per month
Neighbourhood characteristics	DISTANCE	Distance from home to mangrove forest
	ACCESS	Transportation access (=1 if good; =0 if otherwise)
	FACILITIES	Facilities condition (=1 if good; =0 if otherwise)
Environmental awareness characteristics	CONSERVATION	Perception of need for mangrove forest's conservation (=1 if conservation is needed; 0=if otherwise)
	PARTICIPATE	Willingness to participate in the mangrove forest conservation (=1 if willing to participate; 0=if otherwise)

Environmental awareness in this study refers to perception of respondents for a need of mangrove forests conservation and willingness to participate in the conservation. In this case, the environmental awareness reflects people's behaviour related to the value of mangrove forest that can be recorded through CVM. As described in Table 1, the conservation indicator is perception of need for mangrove forest's conservation that measured using a dummy variable. It is valued as 1 if the respondents believe that conservation is needed and valued as 0 if otherwise. The participate variable defined as a value of 1 if respondents are willing to participate in the mangrove forest conservation and 0 if otherwise.

3. Result and Discussion

Before the survey, interviews with 35 respondents for each group of respondents (tourists, local communities, and fishermen) were conducted to find an average value of the WTP in each group. The respondents were asked for their maximum WTP for conserving the mangrove forest, with a bidding game technique. This technique produced an average of maximum amount of money that the respondents were willing to pay for conserving the mangrove forest, which was IDR 10,500 for tourist, IDR 8,000 for local communities, and IDR 9,500 for fishermen. This amount of money was then used as a value of WTP to define whether the respondents



were willing to contribute or not. This question was asked through the questionnaire to the rest of respondents. The survey result indicates that 70%; 71%; and 77% of tourists, local communities, and

fishermen, respectively implied that they were willing to pay for the mangrove forest conservation (see Table 2.).

Table 2. Willingness to pay for adapting climate change

WTP	Tourist		Local Communities		Fishermen	
	Yes	No	Yes	No	Yes	No
Amount (person)	70	30	71	29	77	23
Percentage (%)	70%	30%	71%	29%	77%	23%

Among variables that categorized as socioeconomic characteristic, age has positive and significant influence in the local communities' WTP for mangrove forest conservation at significant level of 90%, but it is not significantly influence the WTP of tourists and fishermen. Male has higher WTP than female in the local communities at significant level of 95%. Married people in the local communities also has higher WTP than unmarried people at significant level of 99%. This was expected given that married people would think about their future generation. Meanwhile, people who has longer years of schooling has greater WTP than those who has shorter years of schooling at significant level of 99%, 95% and 90% for tourist, local communities, and fishermen respectively. An economic variable, income, has positive and significant influence to WTP of tourist only.

Regarding the neighbourhood characteristics, the transportation access and facilities condition has positive and significant influence on the WTP of tourists and communities at significant level of 99% and 95% respectively.

This study indicates that among the environmental awareness characteristics, only willingness to participate in the mangrove forest has a positive and significant influence on the WTP at significant level of 90%, 95% and 99% for tourist, local communities, and fishermen respectively. Meanwhile, this study found that the perception of need for mangrove forest's conservation is not significantly influence the WTP. Most respondents perceive that mangrove forest's conservation is needed. Detail of the regression result is presented in Table 3.

Table 3. Regression results

Variables		Odd ratio		
		Tourist	Local communities	Fishermen
Constant		.104 (2.941)	0.000 (2.692)	0.000 (4.292)
Age of respondent	(AGE)	-	1.057* (.031)	1.125** (.049)
Sex of respondent	(SEX)	-	.208** (.682)	-
Marriage status	(MARRIAGE)	1.204 (.655)	7.986*** (.729)	30.937*** (1.228)
Years of schooling	(EDUC)	.595*** (.178)	1.350** (.137)	1.766* (.304)
Income per month	(INCOME)	1.000** (.000)	1.000 (.000)	-
Distance to mangrove forest	(DISTANCE)	1.004 (.054)	.947 (.428)	-
Transportation access	(ACCESS)	5.869*** (.633)	1.481 (.473)	.720 (.530)



Table 3. Regression results (Cont.)

Variables		Odd ratio		
		Tourist	Local communities	Fishermen
Facilities condition	(FACILITIES)	2.571 (.671)	2.143** (.369)	1.300 (.791)
Perception of need for mangrove forest's conservation	(CONSERVATION)	-	-	-
Willingness to participate in the mangrove forest conservation	(PARTICIPATE)	2.724* (.577)	5.061** (.670)	15.922*** (.801)
Nagelkerke R Square		.382	.488	.688

Dependent variable: WTP for conserving mangrove forest
Number in bracket () shows standard error.

*significant at α 10%; **significant at α 5%; ***significant at α 1%

This study confirms the finding of some previous studies concerning the link between socioeconomic characteristics and WTP for improving environmental quality. This study suggests that income has a positive and significant effect on the WTP of mangrove forest conservation. This implies that respondents with higher income will be willing to pay more for the conservation of mangrove forests than those with lower income. Some contingent valuation studies have similar results to this study. For instance, (Boyle, K. and Bishop, 1987) suggest that there is a positive effect of income on WTP on the conservation of endangered species.

Similarly, (Carson, R. T., Flores, N. E., Martin, K. M., and Wright, 1996) found that some individuals are less willing to pay to preserve quasi-public goods as income increases. (Loomis, J. and Larson, 1994) also found that individual WTP to increase the number of environmental goods is associated with socioeconomic factors including income. Whereas (Hadker, N, Sharma, S, David, A and Muraleedharan, 1997) in his study found that individuals with higher incomes tend to have a willingness to do conservation than those with lower incomes. This study also supports (Verbic, M. and Slabe-Erker, 2009) who employed the classical contingent valuation method for assessing the economic valuation of the landscape development and protection area in Slovenia. The respondents' WTP for improving that area was positively affected by income.

Regarding the years of schooling, this study suggests that there is a positive and significant effect on WTP for conserving mangrove forest. This

finding confirms (Hema, 2013) who found that the education level (years of schooling) was positively related to WTP of the residents to offer labour for replanting efforts and conservation of the existing mangrove stand. A positive sign of the coefficient of education indicates that the probability of saying "yes" to WTP questions increases with the increase in the year of schooling. This is understandable because the longer the time for schooling, the more one's knowledge about social, political, economic and environmental issues. Also, education will help a person to understand the issue of the environmental effects of economic development and also, on the other hand, the effect of environmental conservation on the economy. This study suggests a similar finding with several studies related to contingent valuation that found a relationship between education level and WTP for mangrove forest conservation. For example, (Whitehead, 1992) has found that education levels are positively related to WTP. Likewise, research by (Pate J and Loomis, 1997) illustrates a positive relationship between education and WTP conservation of wetland and salmon in California. Higher education provides better awareness about the necessity of the mangrove conservation for their well-being. Better education may also facilitate better jobs and higher income. Hence, the importance of mangrove conservation and the economic value attached to mangroves by fishermen are highly influenced by their income from the major livelihood activity. The studies by (Hadker, N, Sharma, S, David, A and Muraleedharan, 1997), (Binilkumar, 2010) and (Ekka, A. and Pandit, 2012) also have reported similar results.



Another important variable that influences people's WTP is age. Age is positively influencing people's WTP for the conservation of mangrove forests. This implies that older people tend to say "yes" to WTP questions than those who are younger. An older person would have more experience than the youth so that they would consider the need for mangrove forest conservation due to a bequest motivation for their future generations.

4. Conclusions

This study assessed people's willingness to pay for mangrove forest conservation. For this purpose, surveys of tourists, local communities and fishermen in Lembar mangrove forest area in West Lombok was conducted.

This study found that the average WTP of tourist was IDR 10,500 (USD 0.75) per visit. While the local community and fishermen were willing to pay for a monthly contribution of IDR 8,500 (USD 0.61); IDR 9,500 (USD 0.68) respectively. The amount of WTP is influenced by socioeconomic characteristics, neighbourhood characteristics, and environmental awareness characteristics. This influence slightly differs among the type of respondents. For local communities, the WTP for conserving mangrove forest was influenced by sex, age, marriage status, years of schooling, facilities condition and willingness to participate in mangrove forest conservation. The WTP of tourist was determined by years of schooling, income, transportation access and willingness to participate in mangrove forest conservation. Meanwhile, for fishermen, their WTP was influenced by age, marriage status, years of schooling and willingness to participate in mangrove forest conservation.

This study has several limitations that need to be solved through further studies. Since this study is only conducted in one district, the result might not be applicable in other location with different socioeconomic, neighbourhood, and environmental awareness characteristics. Another study with broader location and variety characteristics is necessary to produce a more general result, to provide evidence that those characteristics can determine an individual's WTP for conserving the mangrove forest.

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